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A

Acceleration, Test on N. Y. Central Locomotive [Potter] *608
——Unit of 870
Accident Claims Department: Accounting of, Accountants' Association Question Box 665
——Philadelphia 529
Accident Claims: Adjustment [Carpenter].. 776
——Alliance against Fakirs 864
——Bogus Claims [Pratt].......... 673
——Causes of [O'Connor].......... 673
——Comparison of 232
——Fakirs in Baltimore.......... 963
—— Cleveland 367
—— New York 789
—— Philadelphia 396
——Perjury, Prosecution for.......... 399
——Question Box, New York State Convention 36
Accidents: Cause of [Rockwell].......... 211
——N. Y. City Elevated Ry..........*418, 637
——Prevention of 297
——Safety Precautions, New York State Convention 41
Accountants' Association: Convention, Circular 127
—— Proceedings 668
—— Comments on 641
—— Question Box 644, 656
Accounting: Cost of carrying a Passenger [Tingley] 807
——with Four Departments [Beardsley]...... 655
——International Form of Report, Report of Committee on 650
——Method of computing Car Mileage and Car-Hours, Accountants' Association Question Box 658
——Standard Classification of Accounts, Report of Committee on.......... 646
——Standard Form of Report, Remarks of Mr. Judson, New York State Convention 113
Adams, H. H.......... 717
Advertising for Traffic: Connecticut Valley Electric Roads *210
——by Letter, New Jersey Public Service Corporation 780
——Parks and Pleasure Resorts, Boston & Northern and Old Colony Railroads... *142
——Question Box 147, 309
—— New York State.......... 35
——Rochester & Eastern Rapid Railway Company 913
——(see also Publicity.)
Aerostat (Federal) *312
Air Compressor, Electric (G. E.).......... *1148
Albany: United Traction Company, Sale of 1007
——Wage Dispute, Decision on.......... 723
Allis-Chalmers Company, Financial Report.. 396
Alternators: Allis-Chalmers *1133
——(Westinghouse) *73
America and England, Methods compared by Mr. Dalrymple.......... 222
American Railways Company, Annual Report 637
American Railway Mechanical and Electrical Association, Convention, Proceedings of 612
—— Queries 27
——Question Box *676
—— Comments on 642
American Society of Mechanical Engineers, Meeting of 932
American Street and Interurban Railway Association, Policy and Aims of [Ely, Swenson] 1091
—— Comments on 1082
——Recent Work of.......... 1004
——Revised Constitution of..........338, 610
—— Comments on 324
American Street Railway Association: Convention, Exhibits at.......... 683
——First Meeting [Rugg] 1091
—— Proceedings 621
—— Programme *452
——Enlarging Membership of..........401, 426
——Reorganization Plans [Ely].......... 390
Antioquia, Colombia, New Cars.......... *895
Armature Banding Lathe, Public Service Corporation [Schrieber] *344
Armature Drying System (Passburg).......... *464
Asbury Park, N. J., New Cars.......... 785
Asheville, N. C., New Cars.......... *1027
Atlanta, Ga., New Cars.......... *779
——Northern Single-Phase Railway.......... *413
Augusta, Ga.: Sale of Properties.......... 1152
Aurora, Consolidation 1116
Austria-Hungary, Notes from.......... 722
Automatic Circuit Breakers, Abuse of....... 1128
Automobile Ambulance, Electric Railway as 118
Automobile Bus: Gasoline, Electric, New York 814, *986
—— Comments on 967
——at Springfield, Ohio *415
——Vehicle Equipment Company.......... *813
——(see also Motor Cars for vehicles on rails.)
Automobiles: Collisions with 794
——Motor Cars on Rails (see Motor Cars.)
——in Street Railway Work.......... 190
——vs. Trolleys 95, 904
Automotoneers in Chicago (Garton-Daniels) *352
——in New York.......... 781
Axles: Dimensions in Chicago.......... *408
——Tests on [Bacon] c391
—— [Herrick] c*806

B

Baggage, Free, discussed in Indiana.......... 948
Bahia, Brazil, Open Cars for.......... *1149
Ball & Wood Company's Pipe Works....... 744
Balance Weight System proposed for Orange Mountain 736
Baltimore: Accident Fakirs sentenced in... 963
——Cast-Welding in (Falk).......... 458
——& Frederick Railway, Construction begun 720
——New Cars 44, *815
Barton, Philip P.......... 824
Bearings: Armature and Car-Journal [White] 450
——(Stiles) *818
——Lubrication for (see Lubrication).
Beaver Valley Traction Company, Sale of.... 186
Belgium, Single-Phase Traction in.......... 329
Berkeley, Cal., Secretary Taft's Party in.... 463
Berln-Zossen High-Speed Tests, of 1901..... *374
—— of 1902 ....*796, *970
—— Comments on 969
Bicknell, Warren, Change in Position of..... 865
Biloxi, Miss., Closed Cars.......... *221
Block Signal System: Alternating Current [Bennett] *117
——(Blake) *1030
——Indiana Northern Traction Company..... 256
Boiler Companies consolidate.......... 471
Boiler Tube Cleaner (Pierce).......... *419
Boilers (Parker) *459
Borinage, Belgium, Single-Phase Railway... *409
Boston: Cambridge Subway Situation....... 227
——Elevated Railway, Annual Report.......... 1154
—— Gas Power Station Equipment.......... *834
—— Comments on 826
—— Power Distribution System [Hile].....*560
—— Comments on 558
——& Fall River Trolley Line.......... 790
——& Northern and Old Colony, Advertising Parks and Pleasure Resorts..... *142
—— Increase Fares 963
—— Transfer Limits 720
—— (See also Massachusetts Electric Companies.)
——Special Hearings at.......... 88
——Suburban Electric Companies, Annual Report 1077
——Tucker-Anthony Properties, Sale of...... 787
Boston & Worcester Street Railway, Annual Report of 964
Brady, Daniel M.......... *717
Brake Hangers: Boring, New York State Question Box *77
——(Olds) *220
Brake-Shoes, Life of..........[illegible]1, 905
——New York State Question Box.......... 76
——Pressures .... [illegible]
——Proper Hanging of.......... [illegible]
——Rochester, Cost of.......... [illegible]
Brakes, Report on [Scholtes and Bjorkegren] [illegible]
Brake, Air: Automatic, for Surface Traction (Westinghouse) .... *71[illegible]
——Compressor for (G. E.).......... *1148
——Compressor Governor (G.E.).......... *783
Brakes, Emergency 905
Brakes, Mechanical: (Columbia).......... *276
——Combined Wheel and Track (U. S. M. & M. Co.) *458
——Ratchet-Clutch (Baker) *850
—— (T. E. Co.).......... *352
Braking Tests: Berlin-Zossen..........*374, *976
——Westinghouse 866
Brazil, American Operations in.......... 901
——Electric Railway for Para.......... 780
Brazing Process (Ferrofix).......... *455
British Columbia: Electric Railway, Cash Dividend for Employees.......... 865
——Lulu Island Electric Railway Contracts.. 127
British Iron and Steel Institute, Meeting of 901
Brockway, W. B.......... 717
Brooklyn: Car Despatching by Megaphone, in 386
——Convertible Cars for..........*316, *906
——Employees' Association..........791, 931, 1119
——Executive Force, Outing of.......... 450
——Improvements 127, 684
——Instruction Car *162
——Office Building 123
——Polytechnic Institute Engineering Lectures 819
——Rapid Transit Company, Annual Report of 423
——Steel Cars for.......... 790
——Transfer-Receipt Boxes in.......... *848
——Transfer Tickets *489
——Vestibuling Cars in.......... 789
——Williamsburg Power Station.......... *432
Brushes, Carbon (National).......... *815
Buffalo-Niagara Falls Private Right of Way Line 1007
Buffalo: International Traction Company, Holding Company for.......... 301
——Rail Welding in..........
——& Rochester Traction Company, Organization of .... [illegible]91
Butte, Mont., New Cars.......... *22

C

California: Central California Traction Company's Incorporation 292
——Midland Railway Company, Incorporation of 1007
——Santa Clara Interurban Railway sold.... 789
—— San Jose Railway, Sale of.......... 964
Cambridge, Mass.: Rapid Transit Question 470
——Subway Plans 824
Canada: Middlesex Railway, Status of proposed 122
——J. G. White Incorporation in.......... 156
Canals, Cincinnati & Miami Plans.......... *896
Carborundum Grinder (Royal)..........
Car Construction: Bottom Framing and Brake Apparatus *906
——Brooklyn Rapid Transit Company.......... *402
——Chicago City Railway..........
——Floor Framing, Steel (American Bridge Company) *19
——Hanging Apparatus under the Car....... 904

——Mexico City *926
——Mirrors in 159
Car Design; and Carrying Capacity [Fox].. *16
——Interurban Railways [Mitten]........... 1099
—— [Shannahan] 34
—— Discussion on 105
——Location of Toilet Room and Heaters on 795
——Location of Toilet and Smoking Compartments on [Gonzenbach].......c*914, c1090
—— [Bacon] c1024
—— [Giffin] c995
——Smoking Compartment, separate, in Youngstown *1111
——Width of Cars........................405, *893
Car Heating, Interurban Railways............ 1011
Car Hoist, Lincoln, Neb., Question Box.... *245
——Newark *140
——Roller Bearing (Duff) *72
Car Houses: Approaches........................ 263
——Construction, Steel in........................ 760
——Despatcher's Office, Scranton............ *268
——Fire Protection of........................ 325
—— Automatic Alarms for................. 936
—— Sprinklers (International) *72
—— Comments on 325
——Harrisburg [Pratt] *330
——Leith, Scotland *1017
——Lighting of 826
——Metal Furnishings for (Darby)........... *1148
——Philadelphia *525
——Public Service Corporation [Schreiber].. *132
——Rochester, Federal Street [Matthews].... *991
——Sunderland District Tramways........... *96
——Topeka, Kan. *882
Car Lighting 1011, 1046
——Clusters for (Benjamin)................... *150
——Fluctuations in 794
——Switch and Cut-Out (G.E.)............... *782
——Wiring Diagrams for [Gough]........... *847
Car Maintenance and Equipment, Physical Report on *444
Car Mileage, Method of Computing, Accountants' Association Question Box.. 658
Car Platforms, Disappearing Step on Chicago New Standard Car................ *404
Car Replacer (Buda) *120
Car Seats, Novel Arrangement in Scranton, Pa. *451
Car Windows, Cylinder Glass for (Semon Bache) *928
Car Wiring: Brooklyn Rapid Transit Company *908
——Changes in Rules on........................ 1068
——Chicago City Railway Car................ *406
——in Conduits 324
——Methods, New and Old................... 827
——to Motors, Mistakes and Their Effects [Gough] *52
Car Works Consolidation proposed........226, 423
Cars, Baggage and Express, Syracuse Northern Traction Company.................. *853
Cars for City and Suburban Service [Wilson] *83
—— Comments on 47
—— Discussion on 62, 161
Cars, Closed: Atlanta........................ *779
——Biloxi, Miss. *221
——Chicago South Side Elevated............ *997
——Cleveland *1071
——Columbus, Ohio *457
——Des Moines *173
——Jacksonville, Ill. *743
——Peoria, Ill. *1068
——Pittsburg *1028
——Puebla, Mex., Horse Car................. *277
——Seattle and Tacoma........................ *895
——Syracuse Northern Traction Company... *852
——Youngstown, Pa. *1111
Cars, Combination: Antioquia, Colombia.... *895
——Butte, Mont. *22
——Muskogee, I. T. *817
——New York City........................ *896
——Vallejo, Cal. *218
Cars, Construction and Repair, Question Box 274
Cars, Convertible: Brooklyn...............*316, *906
——Chicago *402
—— Comments on 400
——Cleveland *25
——Girardville, Pa. *1000
——Jamaica, L. I........................ *74
——Lake Charles, La........................ *849
——Lockhaven, Pa. *393
——Mannington, W. V........................ *928
——Montgomery, Ala. *275
——Philippines *255
——Shreveport *633
——Standard Types (Brill).................. *1112
——Wellsburg, W. Va........................ *151
Cars, Cost of [Armstrong]................... 1068
Cars, Non-Combustible: Comments on...... 295
——London Underground *1003
——Long Island Railroad.................... *833
——New York Central........................ *837
——New York City Railway Company....*166, *851
——New York State Question Box........... 105
——Philadelphia Subway *1140
Cars, Observation: Comments on............ 189
——Montreal *203
Cars, Open: Asbury Park, N. J.............. *785
——Bahia *1149
——Knoxville *151
——Madison, Wis. *119
——Memphis, Tenn. *742
——Norwood, Ohio *419
——Oaxaca, Mex. *256
Cars, Semi-Convertible *1001
——Asheville, N. C........................ *1027
——Baltimore *815
——Chambersburg, Pa. *634
——Dimensions (Brill) *926
——Frederick & Middletown Railway........ *119
——Grand Rapids *174
——Grooveless Post for (Brill)................ *219
——Illinois Traction System.................. *958
——Menominee & Marinette Traction Company *75
——Nashville *352
——Spokane, Wash. *24
——Wheeling, W. Va........................ *1150
——Williamsport, Pa. *785
——Wilmington, N. C........................ *1113
Chambersburg, Pa., New Cars............... *634
Charlton, Mass., Excise Tax in............. 1114
Chicago: City Railway, Report on Franchise [Arnold] 952
—— Standard Cars *402
—— Comments on 400
——Franchises........44, 123, 129, 187, 261, 320, 395, 467, 632, 723, 788, 793, 900, 1040, 1118
—— Extension Ordinance 755
—— Letter from Mr. Dalrymple..........158, 222
—— Probable Gross Earnings and Division of Profits, Reports on [Arnold].. 952
—— Comments on 935
——Metropolitan Elevated Repair Shops...... *4
——& Milwaukee Electric Railway, Zion City-Kenosha Line opened............. 1042
——Municipal Railway, A. B. Du Pont's Report on 348
—— Comments on 323
——Northwestern Elevated, Annual Report. 469
—— New Couplers on........................ *392
——South Side Elevated, New Cars.......... *997
Chimney, Concrete Steel (Weber)............ 782
Christchurch, New Zealand, Electric Tramway System [Drummond]............... *204
Cincinnati & Columbus Traction Company, Portable Sub-Station [Hewitt].......... *50
Civic Federation, Study of Municipal Ownership 259, 746, 985
Claim Agents' Association, Meeting of....... 611
Cleaning Cars (see Washing Cars.)
Cleveland: Accident Fakirs in............... 367
——Chicago, Connection Plans of............ 1119
——Electric Railway, Insurance............... 639
——Fire Protection in........................ 318
——Franchises 91, 185, 963, 1117
——Interurban Railway Financing Center... 156
——New Cars *25, *1071
——New Operating Features in............... *730
——Subway, Report against................... 724
——Traffic Problem in........................900, 1066
Cleveland-Lake Shore Electric Railway, New Cars 1072
——Obligations liquidated 725
Coal and Ash-Handling Apparatus: New York Central Power Station............ *876
——Williamsburg Power Station.............. *435
Colombia, Steam Cars for.................... *419
Colorado Electric Light, Power & Railway Association, Annual Meeting of........ 724
Columbus, Ohio: Appleyard Affairs......... 965
——Consolidation 636
——New Cars *457
——Scioto Valley Railway Notes............ *893
Concrete, Car House, Harrisburg, Pa. [Pratt] *330
——Track Construction, Philadelphia......... *494
Conduits, Feeder: Philadelphia.............. *504
——[Heywood] *269
Conestoga, Pa., New Cars.................... *1001
Connecticut, Railways, Annual Reports of.... 899
——Valley Electric Transit Route, Advertising *210
Connette, Edw. G *45, 158, 758
Consolidated Car Fender Company, Changes in 814
Controller Handle (Durkin)................*314, 393
——(See also Automotoneer.)
Controllers: 643, 827
——(Allis-Chalmers) 1137
——(Dick-Kerr) *20
——[Doyle] *616
——on Gaso-Electric Omnibus, New York... *986
——(Mudge) *1029
——Multiple-Unit Systems of [Hazelton]..... *565
——Proportioning of Car-Resistance Steps.. 1082
——Series-Parallel [Pearson] *569
——Use of Circuit Breakers with, on Large Cars 1128
Couplers, on Northwestern Elevated, Chicago *392
Coupons, Method for filing, Accountants' Association, Question Box............. 657
Crossing Gate used in Rockland, Me........ *951
Crossings, Near-Crossing Ordinance in Milwaukee 372
Cumberland Valley Electric Railway, Plans of 1118
Curtain-Roller Spring Adjuster (Brill)....... *254

D

Dalrymple, James, Interview with............ 222
Dayton, Newspaper Auto-Car................ *1026
Dayton & Muncie Electric Railway.......... *978
Dayton, Springfield & Urbana Railway, carrying Live Stock on.................... 724
——& Western Traction Company, Improvements 812
——Winter-Clegg Syndicate dissolved......... 900
Delaware & Hudson Railroad, Purchases of 1039
Depreciation and Reserve Funds in Milwaukee 441
Derrick Car, Cleveland *731
Des Moines, Ia.: Franchise Litigation in..639, 1120
——New Cars *173
——Winterset & Creston Interurban Railway, Incorporation of 1008
Despatcher's Office, Scranton................ *268
Despatchers' Signaling System (Blake)...... *1030
Despatching Cars: Indiana Union Traction Company *940
——Jackson & Battle Creek Traction Company *143
——Question Box 244
—— New York State........................ 39
——Telegraphic System vs. Telephone........ 95
——by Telephone, Reliability of.............. 937
——West Penn Railways [Brown]............ *307
Destination Signs, Scranton.................. *203
——(See also Station Indicator.)
Detroit-Bay City Line, Contract let for...... 788
Detroit: New Interurban Railway Plans.... 634
——Improvements 272
—— Prizes offered by..................85, 323, 349
Door Fixtures, Duplex (Wallace)............ *462
Doylestown, Pa., Mail Service in...........441, 959
Drake, Frank S........................ 966
Draw-Bars, Experiences [Van Dorn]......... *252
——(Van Dorn) *119
Drilling Machine (Niles)..................... *173

E

East Liverpool, Ohio, Merger in............ 790
East St. Louis, changing Gage of Tracks in, 75, 168, 450
——[Bennett] *387
Edwards, D. G........................ 966
Electric Bond & Share Company, Purpose of 226
Electrolysis of Gas-Well Pipe 1126
Elevated Railway Construction: Hamburg.. 1138
——Noise Decision 161
——Philadelphia *541
Ely, W. Caryl........................ 717
Emergency Wagon, Service in Philadelphia.. *505
Employees: Application Blanks............. 849
——Association, Brooklyn, Work of.......... 791
—— Topeka, Kan. 885
——and the Claim Department............... 889
——Competition between 825
——Courtesy of 1011
——Engagement of, Question Box 147

—— Philadelphia, Pa. 490
——Inspectors in Toronto 129, 1141
——Instruction Car, Brooklyn Rapid Transit Company *162
——Payment of 889
—— Accountants' Question Box.......... 663
——Physical Examination of [Peck].......... 33
—— Discussion on 101
——Promotion of, from Ranks................ 825
——Records, Philadelphia 490
——Report Blanks, Jackson & Battle Creek Traction Company *144
—— West Penn Railways [Brown]........ *308
——Telephones in Homes of.................... 903
——Transportation of, Accountants' Question Box 659
——Wages, Albany, Decision on.............. 723
Engines, Gas: [Bibbins]........................ *594
—— Comments on 559
——Boston Elevated, Equipment.............. *834
—— Comments on 826
——Cost of Operation [Giffin] *1143
——De La Vergne *465
——Design of Large, for Railway Work [West] *592
—— Comments on 559
Engines, Steam: Cylinder Lubrication, Discussion on 620
——High Efficiency Records.................... 296
——Operation, Cost of [Giffin]................ *1143
——(See also Power Stations.)
Erie Railroad Electric Lines, Plans for.... 1118
Excursion Tickets, Handling of, Accountants' Question Box........................ 662
Excursions, Cars for.............................. 264
——(See also Cars, Observation.)

F

Fans (American) *998
Fare Register (Recording) *151
Fares: Collection of, Interurban, Accountants' Question Box........................ 662
—— [Fullerton] 652
—— in Mexico City............................ 9
——Increase on Boston & Northern, Litigation 963
——Schedule of, New York State, Question Box 38
Feed-Water, Analysis, New York State Question Box 78
——Heater, Problem of [Harrington]........ 145
——Purification of 231
Feeders: Boston Experience with [Hile].... *562
——Cable Clamp for (Matthews).............. *742
——Method of determining Losses in [Herrick] *442
——Underground, in Philadelphia [Heywood] *269
Fenders, Pilots on Interurban Cars.......... 1047
Field-Winding Machine, Newark.............. *347
Finance: American Railways Company, Annual Report 637
——Appleyard Property, Earnings of........ 1074
——Boston Elevated Railway, Annual Report 1154
——Boston & Worcester Street Railway, Annual Report of.................................. 964
——Brooklyn Rapid Transit Company, Annual Report 423
——Chicago, Northwestern Elevated, Annual Report 469
—— Report on Probable Gross Earnings and Division of Profits [Arnold].... 952
——Connecticut Railways' Annual Report.... 899
——Cost of Heavy Equipments [Armstrong] 1068
——Cost of Rapid Transit in Cities [Parsons] 209
——Cost of Single-Phase and Direct-Current Equipments [Westinghouse] 1123
——Indiana Interurban Lines, Annual Report 1077
——Kansas City Railway & Light Company, Annual Report 258
——Massachusetts Electric Companies, Annual Report 1075
——Mexico Electric Tramways, Ltd., Annual Report 821
——Mileage, Cars and Capitalization in United States 208
——Milwaukee Electric Railway & Light Company, Ten Months' Report.......... 933
——Montreal Street Railway Company, Annual Report 898
——New York, City Railway Company, Annual Report 756, 761
—— Interborough Rapid Transit Company, Annual Report 319
——Philadelphia: Operating Expenses, Analysis of *485
—— Rapid Transit Company, Annual Report 468
——Power-Station Operation, Cost of [Giffin] *1142
——Railways Company General, Annual Report 469
——Recent Investments in Trolleys.......... 422
Fire Extinguishers on Cars...................... 936
Fireproofing Cars, Question Box.............. *148
—— New York State Convention.......... 41
Fire Protection: Automatic, for Cars in Car Houses 936
——in Grand Rapids 114
——(See also Car Houses, Fire Protection of.)
Florida Jim Crow Law, Unconstitutional.... 259
Folds, George R.................................... *294
Fort Wayne & Wabash Valley Traction Company, Rapid Track Laying on...... *957
——Steam Turbine Equipment (Westinghouse) 44
Fort Worth, Texas, Improvements............ 1018
France, Recent Progress in Alternating-Current Traction 221
France (see also Paris.)
Frankfort, Germany, Novel Method of repairing Cars and Trucks................ *994
Frederick & Middletown Railway, New Cars for *119
Freight and Express Handling: Discussion by Ohio Association...................... 116
——on Interurban Railways.................... 265
—— [Connette] 1042
—— [Graston] 946
——in Massachusetts 321
——Toledo & Indiana Railway................ *771
——Toledo & Western Railway................ *326
——Topeka, Kan. 887
Freight House, Grand Rapids.................. *960
——Indianapolis *734
Freight Locomotives (see Locomotives Electric, Freight.)

G

Gages, Track: in American Cities............ 160
——East St. Louis, changing *387, 450
——Philadelphia *497
Gas Producers and Engines, Sunderland District Tramways *97
——(See also Engines, Gas.)
Gear Wheel, Detachable (Fogarty)............ *720
Generators at Portland Fair (Westinghouse) *353
Georgia, New Interurban Railway.............. 319
Germany: Recent Progress in Alternating-Current Traction 221
——Statistics of Electric Railways in........ 253
Girardville, Pa., New Cars...................... *1000
Glen Cove, L. I., Single-Phase Railway...... *1055
——Comments on 1046
Grades, Steep, Discussion on.................. 620
Grand Rapids: Employees' Clubhouse at... 945
——Fire Protection in.............................. 114
——Freight House *960
——New Cars *174
Great Britain: Consolidated Supply Company, Ltd., Organization of.............. 932
——Electric-Steam Competition in............ 822
——Hastings & District Tramways Company, System of *840
Guy Anchors (Matthews).......................... *152

H

Hamburg: Proposed Elevated Railway in.. 1138
Hand Book, Question Box 170, 273
Harrigan, J. R.. *725
Harrington, Walter E............................188, 294
Harrisburg: Central Pennsylvania Traction Company, Annual Report.................. 259
——Electric Development in Vicinity of..... 810
——New Power House for........................ 725
——Reinforced Concrete Shops and Car Houses [Pratt] *330
Hartford: Atmospheric Valve used in [Tregoning] *20
——Worcester Plans, Completion of.......... 228
Havana Central Railway, Electrical Equipment for 90
Hayward, R. F.. 792
Headlight, Movable (Mitchell).................. *26
——Objections raised to, in Massachusetts.. 1155
——Switch in Lynchburg 745
Headway on Single-Track Roads.............. 231
Heaters, Electric, Truss-Plank (Consolidated) *462
——Hot-Water (Smith) *454
High-Speed: Automobile Contests............ 759
——Safety of 49
——Tests, Berlin-Zossen, in 1901.............. *374
—— in 1902 ....*796, *970
—— Comments on 969
High Voltage Direct-Current Motors, Advantages of [Sprague]...................... c1089
—— Comments on 1083, 1127
——European Practice [Mudge]................ c1089
——in Switzerland 54, *1067
——on Vienna Stadtbahn.......................... 911
Historical, Philadelphia 479
Hoists, Traveling (Niles).......................... *23
——(See also Car Hoists.)
Holland, Electric Railway Project in........ 7
Holyoke, Mass., Mountain Park, near...... *988
——Thermit Welded Rail Joints in............ *942
Hudson Companies, Plans of..........*740, 788, 950

I

Illinois Traction System, Cars for............ *958
Indiana: Consolidation in........................ 122
——Electric Railway Association Meeting, 776, *946, 1099
—— Comments on 935
——Interurban Lines, Annual Report of.... 1077
——Northern Traction Company, Block Signal System 256
——Ohio Mileage Book adopted in............ 241
——Property Valuation in........................ 260
——Rate Discrimination in...................... 226
——Sanitary Rules for.............................. 43
——Union Traction Company, Despatching on 940
——Widener-Elkins Syndicate buys Lines..122, 318
Indianapolis: Consolidation 636
——New Freight Terminal at.................... *734
Indianapolis & Cincinnati Traction Company, Extension of Single-Phase on.... 724
——Inspection of 1076
——(See also Single-Phase Railways.)
Inspection Car, Gasoline (Fairbanks-Morse) *23
Instruction Car, Brooklyn........................ *162
Inspectors (see Roadmasters).
Insulators, High-Voltage (Locke)............ *463
International Tramways & Light Railways Association, Convention, Programme, 837, 1121
——Executive Committee Meeting............ 776
Interstate Commerce Commission, Statistics for 1153
Interurban Railways: Freight and Express Traffic [Graston] 946
——Heating and Lighting Cars................ 1011
——Organization of Traffic Men.............. 368
Iowa: Interurban Assessments in............ 228
——Interurban Earnings, 1904................ 155
——Interurban Railways, Progress in........ 932
——Steam Road to control Electrics in...... 229

J

Jack, Car (see Car Hoist).
Jackson & Battle Creek Traction Company, Despatching Cars on.......................... *143
Jacksonville, Ill., New Cars.................... *743
Jamaica, L. I., New Cars........................ *74
Japan: Interurban Railway, Opening of.... 780
——Steam Turbines in.............................. 261
Jersey City: Constitutionality of Legislative Act 930
——Hudson Street Railway Company Plans, 899, *950
Journal Bearings (see Bearings).
——Lubrication for (see Lubrication.)

K

Kalamazoo, Mich., Traction Company, sale of 1152
——New Terminal Station in.................... *912
Kansas City-Leavenworth Railroad Company, Change of Control of.................. 125
Kansas City Railway & Light Company, Annual Report 258

Kansas City: Oil in Grease Boxes.......... *1113
——T-Rail for Paved Streets in.............. 1018
——Type M Control, Hand Reverse for..... 1023
Kansas, Gas, Water, Electric Light & Street Railway Association, Meeting of....... 823
Knoxville, Tenn., New Cars.................. *151
——Sale of Street Railway Properties........ 675

L

Laboratory for testing Supplies............. 190
Lake Charles, La., New Cars................ *849
Lamp-Socket Plug (Weather-Proof).......... *744
——(See also Car Lighting.)
Lancashire & Yorkshire Railway, Accident on 221, 297
Laundry for Waste, Philadelphia............ 536
Legal: Accidents at Windows................ 355
——Assaults by Employees, Liability for..... 278
——Duty to Persons on Streets............... 175
——Incompetent Medical Attendance in Accident Cases 747
——Interchange of Cars....................... 861
——Liability for Acts of Special Policeman or Officer 855
——Liability for Negligence.................. 857
——Notes............175, 278, 355, 747, 855, 1031, 1041
——Right of City Council to compel Adoption of Certain Fender.................. 788
Leith Corporation Tramways................ *1014
Lexington, Ky., Change in Ownership of.... 471
Lighting: Business for Interurban Railway Companies 1
——from Railway Circuits.................... 130
——System in Philadelphia Subway.......... *1138
Lightning Arresters (Shaw).................. 75
Load Curves, Topeka, Kan.................. *885
Lockers, Metal (Darby) *1148
Lockhaven, Pa., New Cars.................. *393
Locomotives, Electric: Costs [Armstrong].. 1068
——Freight, Topeka, Kan..................... *883
——Metropolitan Railway, England (Westinghouse) *313
——Single-Phase, on N. Y., N. H. & H. R.R. 638
—— [Lamme] 1124
—— (See also New York Central-New Haven Situation.)
——Tests in Switzerland...................... 888
——Valtellina Railway [Valatin].............. *192
—— Comments on 191
——Weights of 1150
London: Brighton & South Coast, Single-Phase Equipment 1145
——Great Northern, Piccadilly & Brompton Railway, Steel Cars for *1003
——Letter.................42, 224, 365, 721, 862, 1005
——Rapid Transit Problem................... 233
——Royal Traffic Commission, Report of..152, 246
——Tramway Exhibition *214
Long Island Railroad, Electrification, 123, 154, 228, 397, *828
Los Angeles, Freight Rights in.............. 91
——Mt. Lowe Fire............................ 1118
——Municipal Ownership Plans, Failure of, 866, 931
——Pacific Railway, Electric Locomotives for Freight 329
—— Signal System 15
Lottery for redeeming Tickets in Mexico.... 9, 291
Lowell-Boston, New Line proposed.......... 1119
Lubrication: Car and Motor Bearings, Discussion on 621
—— [Wright] c915
——Cost of 761
——Fireproof Oil for.......................... 957
——Grease vs. Oil............................. 95
—— Kansas City *1113
—— [Sullivan] c891
——Oil for Bearings (Campion)............. 957
——of Motors, New York State, Question Box 41, *76, 107
Lubricator (see Oil Cup).
Lunch Rooms on Interurban Railways....... 727
Lynchburg, Va., Traction & Light Company, Employees' Benefit Association....... 1155
——Property sold to R. D. Apperson....... 962

M

Madison, Wis., New Cars..................... *1[illegible]
Mail Handling on Open Cars................. 295
Management, Courtesy of Employees, Instructions 1011
——Meetings of Heads of Departments...... c741
Manager: Note-Book for, Question Box..170, 273
——Reports to, Rochester..................... 977
Manchester, England, Tramways, Annual Report of 185
Manila Electric Railroad & Light Corporation, Earnings of 928
——New Cars *255
Mannington, W. Va., New Cars............ *928
Map: Dayton & Muncie Electric Railway.. *978
——Long Island Railroad, Electrified Portion 833
——New York & New Jersey Railroad Tunnels and their Connections............. 740
——New York, showing Hudson Companies' Tunnels 950
——Petaluma & Santa Rosa Railway......... 10
——Philadelphia 477
—— showing A. C. Distribution Lines..508-509
—— showing D. C. Tie Lines............508-509
—— showing Generating and Sub-Stations and Approximate Distribution Areas..508-509
——Philadelphia & Western Railroad........ 1088
——Rochester, Syracuse & Eastern Railway. 1048
——San Francisco: Ocean Shore Railway... 1146
——Sunderland District Electric Tramways. 96
——Toledo, Bowling Green & Southern Railway and Connecting Lines............ 234
—— Fort Wayne & Western Railroad, Bryan to Fort Wayne 762
—— Port Clinton & Lake Side Railway... 1130
——Toledo & Western Railway.............. 327
——Topeka Railway 887
——West Shore Railroad, Electrified Section of 1062
Massachusetts, Companies to apply to Courts before abandoning Routes............ 822
——Extension of Right to limit Transfers..... 822
——Freight Rights in.......................... 321
——Freight Traffic in 900
Massachusetts Electric Companies Annual Report 1075
Massachusetts Street Railway Association, Meeting of 1067, 1091
McGowan, Hugh J............................ 1117
Megaphone, Car Despatching by, in Brooklyn 386
Memphis, Tenn., New Cars.................. *742
Menominee & Marinette Traction Company, New Cars *75
Mexico City, Collection of Fares in......... 9
——Construction Cars for.................... *926
——Electric Tramways, Limited, Annual Report 821
——Lottery System in........................ 9, 291
——Recent Developments 996, 1004
Michigan, Trolley Interests in............... 368
Michigan Traction Company, Track Construction with T and Girder Rails..... *809
Milan, Exposition, Plans of.................. 823
——International Exposition, Electric Railway Exhibits at 125
Mile Posts on Interurban Railways........... 372
Milwaukee: Depreciation and Reserve Funds in 441
——Electric Railway & Light Company, Ten Months' Report 933
——Near-Crossing Ordinance in............. 372
Missouri Valley Electric Railway Company, Projects 790, 817
Molder (Fay & Egan)........................ *1001
Montgomery, Ala., New Cars............... *275
Montreal: Benefit Association Picnic....... 337
——Method of preventing Vestibule Windows freezing over............................ 956
——Observation Cars in...................... *203
——Street Railway, Annual Report.......... 893
—— Benefit Association 451
Mortising and Boring Machine (Fay & Egan) *74
Motor Cars, Gasoline-Electric (G. E.)....... *19
——Gasoline for Newspaper Service......1008, *1026
——Steam, Columbia *419
——Lubrication with Grease [Sullivan]..... c891
——Recent Improvements [Potter].......... *607
—— Discussion on 671
Motors, Electric: Allis-Chalmers............ *1137
——Fields vs. Armatures nearest Trolley [Andrews] *14
——High-Voltage, Direct-Current (Oerlikon) *1067
—— (See also High-Voltage, Direct-Current.)
——Testing [Herrick] *445
——Three-Phase, Ganz (Bruce-Peebles)...... *1026
——Westinghouse 75-hp *460
Motors, Electric, Single-Phase (see Single-Phase Motors).
Motors, Electric, Stationary: Direct Connected, in Repair Shops.................. 232
——Induction (National) *783
Motor Junction Box.......................... *909
Multiple-Unit Systems: in Interurban Service 936
——[Hazelton] *565
——(Mudge) *1029
Municipal Ownership: Discussion at Mayors' Convention 373
——Investigation by National Civic Federation 259, 746, 985
——Issue of, in Chicago.....................158, 931
——Labor Vote 2
——Mr. Dalrymple on 222
——Politics in 48, 1013
——and Management vs. Company......... 56
—— [Blake] *28
—— Discussion on 56
Muskogee, I. T., Combination Car.......... *817

N

Nashville, Tenn., New Cars for............. *352
National Association of Railway Commissioners, Report of Committee attending 651
National Battery Company, Annual Meeting of 260
National Car-Wheel Company, changes Hands 467
Newark: Car Shops and Houses [Schreiber] *132
—— Equipment of [Schreiber].............. *340
——Proposed Tunnel to New York.......... 638
——Traffic Soliciting by Letter.............. 780
New Bedford, Mass., Wheel Practice in...... 1111
New Britain, Conn., Third-Rail Line, Stay for 157
New England, Employees, Scarcity of...... 899
——Street Railway Club, Meeting of.......865, 1022
—— Outing of 122, 187
New Hampshire Traction Company, Portable Sub-Station of *302
New Haven, Consolidated Railway Company: Annual Report 637
——Trolley Extensions 425, 1042, 1122
——Wages paid 426
——(See also New York, New Haven & Hartford Railroad.)
New Orleans, Improvements in............... 228
——Railways Company, Sale of 122
New Publications.........43, 85, 293, 866, 1009, 1156
——Chicago, Transportation Report in 1902. 426
——Massachusetts Railway Laws 720
——"Ohio: A Tale of Two Cities"......... 308
Newspapers: Account of Power Station.... 242
——(See also Advertising and Publicity.)
New York Central: Locomotive, Electric, Test of 823
—— Test on [Potter] *609
——Power Stations *872
——Purchase of, Trolley Lines............1078, 1116
——Steel Motor Cars for *837
——Sub-Stations and Distribution System... *920
——Terminal, Forty-Second Street *916
——Under Contact Third Rail for........... *336
——(See also New York, New Haven & Hartford and West Shore Railroad.)
New York City: Accident Fakirs caught in. 789
——Bridges, Earnings 426
——Connecting Railway, Application for Franchise renewed 965
——Edison Company, Steam Turbines for.. 157
——Electrical Show 1078, *1098
——Elevated Railway, Accident on.........*418, 637
——Engineering Building, Laying Foundation Stone of 1155
——Extension of Police Traffic Squad...... 822
——Franchises 156
——Hudson Companies' System......*740, 788, *950
——Interborough Rapid Transit Company, Quarterly Report 319, 964
——Manhattan Bridge Contract.............. 295
——Merger of Metropolitan and Interborough Companies 1153
——Motor 'Busses for 454
——Railway Company's Annual Report....756, 761
—— Automotoneers in....................... 781
—— Combination Cars *896
—— June Report 154
—— New Wheel Shop of.................... *938

—— Officers' Annual Entertainments..... 290
—— Quarterly Report 962
—— Steel Cars *166, *851
——Railways Company General, Annual Report 469
——Rapid Transit Plans considered by Board of Estimate and Apportionment........ 125
——Subway, Contracts 468
—— Cooled Air proposed for............ 43
—— Costs and Operating Conditions [Parsons] 209
—— Investigation, Report on............ 931
—— Plans for Tunnel from New York to Long Island City 157
—— Statistics for One Year.............. 864
—— Temperature Figures 154
—— Tesla answered [Stillwell] 126
—— Comments on 94
—— Ventilation of 155
——Tunnel proposed by Public Service Corporation 638
——Williamsburg Bridge, Accident on...... 865
—— Terminal Plans 1119
New York, New Haven & Hartford Railroad: Electrification 638
—— [Scott] 606
——New York Central Situation:
—— [Bell] c805
—— [Boynton] c806
—— [Lamme] 1124
—— [McHenry] 896
—— [Mudge] c1089
—— [Murray] 915
—— [Sprague] 772, c891, c1089
—— Comments on 759, 1127
—— [Westinghouse] 1123, 1125
New York & Port Chester Railroad Franchise 470, 724
New York State Street Railway Association:
Convention Exhibits 86
—— Proceedings 55, 101
—— Comments on 47
——Quarterly Meetings proposed....1045, 1065, 1098
——Question Box *35, *76
—— Value of 3, 35
New York, Westchester & Boston Railway, Plans 187
Niagara Power Contract Report............ 155
Norris, Henry H. *322
Norwood, Canton & Sharon Railway, New Cars *419
Nuremberg, Three-Wire System............ *15

O

Oaxaca, Mex., New Cars for................ *256
Ohio: Appleyard Properties, Earnings of... 1074
——Automobile 'Bus Line in 320
——Campaigning via Electric Railways...... 852
——Interurban Railway Association: Coupon Book 295
—— Meeting of 116, 892, 1019
——Traffic Handling during Fair............ 811
——Widener-Elkins Rumors discussed...... 754
—— Operations 122, 318, 965
Oil Cup for Motors (Jolt).................. *464
——Schenectady *76
——Providence *149
——Question Box *679
Oiling Cars (see Lubrication).
Oil Filter (Burt) *816
——(Turner) *850
Omnibus (see Automobile 'Bus).
Orange Mountains, N. J., Electric Railway for 736
Organization Chart: New York Central Engineering Organization 878
——Philadelphia *489
Overhead Construction: Cradle under High-Tension Wires, Rochester *80
——Catenary Suspension 325
—— Glen Cove, L. I......................... *1056
—— West Shore Railroad *1062
——Harger, Flexible (British Thomson-Houston) *996
——Leith Corporation Tramways *1015
——New York State, Question Box.......... 81
——Notes on [Schreiber] *841
——Philadelphia *504
—— Subway *1087, *1138
——Reverser for Trolley Pole................ *217
——Rochester, Syracuse & Eastern.......... *1052
——Topeka, Kan. *880

P

Paducah City Railway Company, Sale of..... 187
Painting Cars, Scaffold for................ *681
Panama, Proposed Electric Railway at...... 71
Paterson, N. J., Public Service Corporation, Festival of Employees................ 1154
Paris Letter..................226, 366, 722, 863, 1006
Parks & Pleasure Resorts: Advertising, Boston & Northern and Old Colony.. *142
——Amusements for, Bowling Alley (Mathews-Fahl) 450
—— Toboggan Slides (Paris Mfg. Co.)... 1061
——Design of Terminals 1
——Highland Park, near Brockton, Mass..... *943
——Mountain Park, near Holyoke, Mass..... *988
——Vinewood Park, Topeka, Kan............ *887
——Willow Grove, Philadelphia.............. *538
——Worcester, Mass., Quinsigamond Park... *943
Parsons, Hinsdill 229
Pennsylvania Railroad, Electrification of, between Camden and Atlantic City....1076, 1109
Peoria, Ill., Single-Truck Cars............ *1068
Peru, Trolley Contract in 15
Petaluma & Santa Rosa Railway, System.... *10
Philadelphia: Accident Frauds in........... 396
——as a Convention City 473
——Exhaust-Steam Turbine 1102
——Rapid Transit Company, Annual Report. 468
——Snow Sweeper *1114
——Specifications for Coke and Cross-Ties in. 812
——Subway Lines..................*541, 1081, *1084
—— Inspection of 1025
—— Lighting and Overhead Construction. *1138
——Track Construction *494
—— [Nichols-Voynow] *574
——Traffic Conditions of *474
——& West Chester Traction Company, New Station opened at Ardmore, Pa........ 412
——& Western Railroad, Electrification of.90, *1088
Pipe Flanges, Welded (Ball & Wood)....... 854
Pit Hoist, in Plank Road Shops, Public Service Corporation [Schreiber]......... *342
——(See also Car Hoist.)
Pit Lighting 793
——Methods of *682
Pit Tracks, Method of supporting Harrisburg, Pa., Shops *332
Pit Work, Kind of Motor adapted to........ 728
Pittsburg: Employees Benefit Association, Banquet of 471
——New Park for 1078
——New Vestibuled Cars *1028
——Subways for 291
——Transfer Swindle in 425
Poles: for High-Tension Transmission Lines, New York Central *922
——Notes on [Schreiber]...................... *845
——Reinforcement, Philadelphia *506
——Removal by Derrick in St. Louis......... *18
Political Campaign, Herrick's Use of Car.. 425
Polyphase Railways: St. Thomas *1026
——Valtellina Railway, Operating Results [Cserhati] *303
—— [Valatin] *192
—— Comments on 191
Porter, H. F. J.................................. 369
Portland: General Electric Company, Concrete Steel Chimney (Weber)........... *782
Portland, Ohio: Lewis & Clark Exposition. *248
—— Transportation Facilities at............ *266
Porto Rico, Block-Signal System at [Bennett] *117
Power Consumption: Load Curve, St. Gall-Speicher-Trogen Railway [Somach]..... *300
Power Distribution: Boston Elevated [Hile] *560
—— Comments on 558
——Feeder Problem 729
——High Voltage, D. C. Operation (see High-Voltage Direct Current).
——Location of Sub-Stations [Ricker]....1106, *1144
——Philadelphia *506
——Physical Report on [Herrick] *442
Power Stations: Accounting, Accountants' Question Box 667
——Boston [Hile] *560
——Cost of [Giffin] *1142
—— Toledo, Bowling Green & Southern Railway .... 94[illegible]
——Design of [Bushnell] .... [illegible]
Employees, Wiring Diagrams for....... 96[illegible]
——Gas [Bibbins] *594
—— Comments on 559
——Load Curves, Typical [Bibbins]........ *594
——Load Factor as a Factor in the Cost [Crecelius] .... [illegible]
—— Comments .... [illegible]
——New York Central Railroad *872
——Philadelphia 506
——Size of, compared with Load.......... 131
——Williamsburg 132
——Winchester, Ind. .... [illegible]
Power Transmission: 60,000-Volt Line, Utica, N. Y............................ 1147
Printing Department, Philadelphia 531
Probasco, W. M. 229
Publicity [White] 31
—— Discussion on 57
——(See also Advertising.)
Puebla, Mex., Horse Cars.................... [illegible]
Puget Sound Electric Railway, Traffic Circulars .... [illegible]
Pumps, Rotary (Buffalo)...................... 999
Purchasing Agent, Testing Supplies........ 190

Q

Question Box 147, 244, 273, 309
——Queries 1024

R

Radiator Valve (Crane) *816
Rail Bonds: Permanent Plastic (Brown).... *743
——Testing, New York State, Question Box. 82
Rail Grinder and Drill, Gasoline [Hadfield's] *925
Rail-Joint Company, Incorporation of...... 866
Rail Joints: Cast-Welded [Simmons]........ *581
—— Comments on 581
——Electric Welded [Wilson] *578
——Philadelphia *495
—— [Nichols-Voynow] *574
——Thermit, in Holyoke...................... *942
—— [Pellissier] *572
—— Recent Orders 461
——Various Types [Simmons].................. *571
—— Comments on 558
Rail-Piling Diagram, Philadelphia.......... *498
Rail Tongs, Philadelphia *497
Reid, M. M. 188
Reno, Nevada, Consolidation in.............. 363
Repair-Shop Management, Hints on.......... 448
Repair-Shop Practice: Blanks for Car Defects used in Schenectady 54
——Direct-Connected Motors in.............. 232
——Gage to locate Low Armature Bearings. *677
——Jury Axle for removing Motors, Frankfort, Germany *994
——Night Work 1013
——Overhauling, according to Mileage [O'Brien] c890
—— Comments on 871
——Saving Repair Parts 869
——Scrap, Accounting for 660
——Tool Rooms in Small Shops................ 870
——Track, Philadelphia *499
Repair Shops: Chicago Metropolitan Elevated, Improvements in *4
——Harrisburg [Pratt] *330
——Lighting of 26
——Location 871
——Philadelphia ....*[illegible], *551
——Public Service Corporation [Schreiber].. *132
—— Equipment of [Schreiber]............ *340
Reynolds, H. E. *128
Rhoads, S. L.................................... 717
Roadmasters in Toronto....................1129, 1141
Rochester, Brake Shoes, Co[illegible] of.............. 912
——Federal Street Car H[illegible] [Matthews]... *991
——Daily Reports to [illegible]ral Manager........ 977
——& Eastern Rail[illegible] Advertising..........165, 912
——Employees' [illegible] 1008
——Sale, Term[illegible] 1154
——Terminal-Sta[illegible]n Plans .... [illegible]
Rochester, [illegible]cuse & Eastern Railway Constr[illegible]ion Work 1048
——Comm[illegible]s on 1045
Rock [illegible]nd Railroad Cheap-Rate Cont[illegible] [illegible] .... [illegible]
Ro[illegible] Island Interu[illegible]an Servi[illegible] in Iowa discontinued 791
Rockland, Maine, Stop Gate used in........ *951
Rome, Italy, El[illegible]ic Railway in............ *100
Rotary Converters, Hunting, Means to prevent 1109
Rotterdam, Electric Tramway in............ 1008
Ryder Wire & Fibre Manufacturing Company, Incorporation of.................. 790

S

Sand-Box, Scranton Railway *277
San Francisco: Change of Control in..... 1039
——Gas & Electric Company's Plans......... 866
——Geary Street Railway, Reconstruction Plans 319
——Municipal Line 157, 396
——Ocean Shore Company, Contract Awards. 899
—— System of *1146
——Track Brake, Emergency [Bodler]....... *590
San Juan, Porto Rico, Electric Railway System *446
Schedules, Methods of preparing, in Philadelphia 188
Schenectady, Car Reports, Defects 54
Shock from Electricity, Treatment for...... *737
Scranton: Car House Despatcher's Office.. *268
——Lackawanna & Wyoming Valley Railway, Time Table *172
——New Form of Destination Signs......... *203
——Tower Car used in *242
——Novel Arrangement of Car Seats in..... *451
——Sand-Box used in *277
Scrap, Credit for, Accountants' Question Box 660
——Saving Repair Parts 869
Seattle, Car House Robbery in.............. 911
——New Cars *895
Shreveport, New Cars *633
Sign, Illuminated, Brooklyn *911
Single-Phase System: Advantages of [Westinghouse] 1123, 1125
—— Comments on 1127
——Atlanta Northern Railway........ ..... *413
—Belgium 329
——Borinage, Belgium *409
——Generators for 689
——Glen Cove, L. I........................*1055
—— Comments on 1046
——Hamburg Elevated Railway.............. 1138
——High Frequency for, in Germany........ c915
——Italy (Westinghouse) 26
——London, Brighton & South Coast, Orders 1145
——in Maine, Plans 822
New York, New Haven & Hartford, Locomotive 638
—— (See also New York, New Haven & Hartford Railroad.)
——Recent Improvements 431
—— [Scott] 604
—— Discussion on 689
——Recent Progress in France and Germany. 221
——Vienna-Baden 54
——Warren, Pa. 865
Sinking Fund. Method of establishing. Accountants' Question Box. 656
Snow Plow: and Sweeper used in Switzerland *838
——(Wilder) *351
Snow, Removal of, and Melting, Philadelphia 536
—and Sprinkler Combined, used in Perth. *1018
Snow Sweepers (Brill) *1114
Southwest Missouri Electric Railway Company, Improvements 227
Special Work: Philadelphia *498
—Topeka, Kan. *879
Speed-Time Curves: Berlin-Zossen, Tests in 1901 .... *385
—— in 1902 ....*798, *975
——New York Central Locomotive [Potter]. *609
Spike, Philadelphia *496
Spokane & Inland Railway Company, Equipment for 756
Spokane, New Cars *24
Springfield (Mass.) & Eastern Street Railway leased to Consolidated............. 823
Springfield, Ohio, Automobile 'Buses at.... *415
——Transportation of Horses by Electric Cars 420
Sprinkling Car (Brill) *354
——in Chicago, Question Box 273
Sprinkling: Cost and Value of............ 371
St. Gall-Speicher-Trogen Electric Railway [Somach] *298
St. Louis: Derrick Wagon for pulling up Iron Poles *8
—New Car Shops in 1007
——St. Charles & Western Railway Sale of, 227, 259
——Street Railway Men's Outing 420
——United Railway Company, June Report, Comparison of 123
Standardization of Parts.................... 1012
Station Indicator (Allison) *315
——(See also Destination Signs.)
Statistics: Mileage, Cars and Capitalization in the United States 208
——Operating, Philadelphia and Other Cities, 478, 484
——Table of Income and Operating Expenses per Car-Mile, of New York State Roads 115
——Vienna Tramways *846
Storage Batteries: Charging Receptacle (Westinghouse) *1149
——Regulators for Use in Connection with [Ashe] *1105
Street Railway Journal, Convention Issues. 431
——Discussion of Articles [Brown].......... c741
Sturtevant, B. F., Company's Works........ 633
Sub-Stations, Dayton & Muncie Electric Railway *982
——Design of, in relation to Operation [Ashe] *1103
——Location of [Ricker] 1106, *1144
——New York Central Suburban District... 920
——Plans, Toledo, Bowling Green & Southern Railway *241
——Portable, Cincinnati & Columbus Traction Company [Hewett] *50
—— New Hampshire Traction Company.. *302
—— Toledo & Indiana Railway *769
Subway: proposed in Hamburg............ 1138
——(See also Chicago, Cleveland, New York, Philadelphia, etc.)
Sunderland, England, District Tramways... *96
Swenson, Professor B. V.................... *427
Switch Lock (Blanchard) *854
Switzerland, Electric Locomotive Tests in.. 888
——15,000-Volt D. C. Road in................ 854
——Snow Plow and Sweeper used on St. Gall-Speicher-Trogen Railway.......... *838
Syracuse, Lakeside & Baldwinsville Railroad, Sale of 290
——Northern Traction Company, New Cars.. *852
——& Suburban Railway, Storage Battery Installation 745

T

Tacoma, New Cars.......................... *895
Taylor Iron & Steel Company, Change of Officers in 933
Technical Education in Railway Work....... 93, 94
Technical Press, Value of.................. 144
Telephones: in Houses of Employees....... 903
——Philadelphia 507
——Switchboards (Fisk-Newhall) *1072
Tennessee, Jim Crow Boycott in............ 229
Terminal Station: Kalamazoo, Mich......... *912
——New York Central Grand Central Station *916
——Philadelphia, Sixty-Eighth Street......... *549
——Toledo 864
Terminals: at Lewis & Clark Exposition... *266
——at Parks 1
—— Willow Grove, Philadelphia.......... *538
Test Car used in Cleveland................. *730
Testing: Laboratory, Philadelphia.......... *535
Supplies (see Laboratories.)
——Motors and Armatures in Chicago....... 6
——New Equipments 1127
——Physical Analysis of an Electric Railway Property [Herrick] *442
——Rail Bonds, New York State Question Box 82
Theater Coupons issued by Rochester & Eastern Railway *913
Third-Rail Shoe for removing Rust.......... *274
Third-Rail System: Long Island Railroad.. *832
——Pennsylvania Railroad to Atlantic City 1076, 1109
——Under-Contact, for New York Central Road *336
—— Comments on 325
Three-Wire System, Nuremberg............ *15
——in Vienna 911
Tickets: Destruction of, Accountants' Question Box 661
——Interline, discussed at Ohio Interurban Railway Association 1019
——Interurban Accounting [Pardee]......... *653
Ties, Steel (Carnegie)...................... 88
Time Table: Lackawanna & Wyoming Valley Railway *172
——Wall, New Hampshire Traction Company 425
Titusville Traction Company, Extension..... 386
Todd, R. L., Appointment to Indianapolis... 1117
Toledo: Passenger Station Plans............ 957
——Terminal Station 864
Toledo, Bowling Green & Southern Railway, Improvements of *234
——Power Station Figures................... 949
Toledo, Fostoria & Findlay Railway, Opening of 367
Toledo, Port Clinton & Lake Side Railway.. *1120
Toledo & Indiana Railway Improvements... *762
Toledo & Western Railway, Freight Development on *326
Tool Steel [Nelson]....................... c209
Tools, Device for heating [Osmer].......... c*71
Topeka Railway, Reconstruction of......... *879
——Comments on 869
Toronto: Electric Mileage Data............. 897
Employees, Special Christmas Bulletin to 1025
——Roadmaster System in.................. 1141
Tower Car (Brill)......................... *218
Scranton, Pa. *242
Track Brake: Emergency [Bodler].......... *590
——(See also Brakes, Mechanical.)
Track Construction: Cleveland, Method of bonding Crossing *731
— with Steel Ties......................... *732
Fort Wayne & Wabash Valley Railway.. *957
Michigan Traction Company, with T and Girder Rail *809
Philadelphia *494
— [Nichols-Voynow] *574
—— Subway *1085
Topeka, Kan. *879
Train used on Rochester, Syracuse & Eastern *1049
——Width between Cars in Different Cities.. *405
Track Drill, Automatic Feed (Ridlon)....... *1149
Track Gages (see Gages, Track.)
Track Scrapers (Kalamazoo)................ *455
Track Switches: Anti-Straddling (N. Y. S. & C. Co.).............................. 254
——at Philadelphia *500
——at Sidings 160
——used in Vancouver..................... *781
Trade-Mark, West Pennsylvania............. 174
Traffic: Handling Unusual Crowds.......... 1012
——Philadelphia Conditions *474
——Winter Pleasure, Inducing............. 936
Trailers, Use of, New York State Question Box 37, 48
Train Resistance, Berlin-Zossen Tests (see Berlin-Zossen Tests.)
Transfer-Issuing Machine (Ohmer).......... *350
Transfer Receipt Box, Brooklyn Rapid Transit Company *848
Transfer Table, Plank Road Shops [Schreiber] *347
Transfers, Check for preventing Fraudulent Issuance *741
Transfer Tickets: Formerly used in Philadelphia *480
——New Type (Folds)...................... *389
Transformers (Westinghouse) *275
Transmission of Power: Berlin-Zossen Tests *972
——New York Central Suburban District... 920
Trenton: New Line out of.................. 320
——Terminal Question 186
——Yardville Crossing Litigation............ 45
Trolley Ear and Hanger in Milwaukee...... *677
Trolley Reverses (Bristol).................. *217
Trolley, Rolling, on Valtellina Railway [Valatin] *197
Trolley Wheels [Cooper].................... c995
Trucks: Dorner No. 20, M. C. B............ *120
——Trailer for Heavy Service (Brill)......... *1112
Tunnels: New York & New Jersey Railroad Company, Completion of............... *740
——Simplon, Simplon, Electrical Equipment for 1024
——(See also Subways.)
Turbines, Steam: (Allis-Chalmers) *438, *894, *1040, 1079
——Boston Elevated Power Station.......... *234
—— Comments on 826
——Curtis 2000-kw, Test of................ *150
—— Exhaust Steam, Direct-Current, in Philadelphia 1102
——Long Island City Power Station......... *829
——New York Central Railroad.............. *876
——New York Edison Company.............. 157
——Operation of 296
—— Comments on [Emmet]................. c391
——Philadelphia *515
——Quincy [Bushnell] *557

——Recent Improvements [Potter]........... *607
——Starting of [Emmett]........................ c391
——Vacuum System for (Wheeler)........... *744
——Willans-Parsons *216

U

Unloading Cars, Convenient Method, Question Box *171
Upton, Brafton 428
Utica & Mohawk Valley Railroad, West Shore Cut-Off *1062
——Water-Power Plans of.................... 1147

V

Vallejo, Benicia & Napa Valley Railway, New Cars *218
Valtellina Railway: Electric Locomotives on [Valatin] *192
—— Comments on 191
——Operating Results [Cserhati]............. *303
Valves, Atmospheric [Tregoning]............ *20
Vancouver, Mechanical Track Switch used in *781
Ventilation: Dr. Lydston on................. 276
——Philadelphia Subway *545, 1087
Vestibule Doors, Lock for (Ridlon)......... *1110
Vestibules: Portable, for Railway Cars (Sjoberg) *24
Vestibule Windows, Method of Preventing Freezing 956
Vigo, Spain, Electric Railway for............ 1078
Vienna-Baden, Single-Phase Railway.......... 54
——Stadtbahn Three-Wire System Test....... 911
——Tramway Statistics 846
Voltage, High, Direct-Current (see High Voltage, Direct-Current.)
Voucher Checks, Best Form of, Accountants' Association Question Box.............. 666

W

Wailes, S. I.................................... 158
Waiting Stations, Improving.................. 968
Warren & Jamestown Street Railway, Opening of 865
Washing Cars, Compound for (Young)..... 22
——Question Box 148
——Stand for, Newark......................... *139
Washington, Great Falls & Old Dominion Line, Progress on....................... 789
Water-Power Plants: Hudson River Electric Power Company, Plans of.......... 1147
Weed Killing with Alternating Current....... 324
Wells, Allen B................................. 262
Wellsburg, W. Va., New Cars............... *151
Western Massachusetts Street Railway, Opening of *1058
West Penn Railways, Despatching Methods and Reporting Troubles on [Brown]... *307
West Shore Railroad, Electrical Operation on 337, *1062, 1117
Westinghouse Electric & Manufacturing Company, District Managers' Convention 1008
Wheatly, W. W...........................294, *1004
Wheel Grinder, Newark....................... *343
Wheel Shop, New York City Railway Company *938
Wheels: Cast-Iron, Specifications for....... 124
——Life of [Bacon]..........................*69, 120
—— New York State Question Box......76, 109
——Paper (Haight) *819
——Practice in New Bedford, Mass........... 1111
——Steel-Tired, discussed at Ohio Interurban Railway Association 1020
—— New York State Question Box....... 109
Wheeling, W. Va., Right to lay Guard Rails in 823
——Semi-Convertible Cars for................ *1150
White, Elmer M............................... 262
White & Company, J. G., Canadian Branch.88, 227
Whiteside, Walter H.......................... *472
Widener-Elkins Syndicate (see Ohio).
Wilkesbarre, Novel Method of transporting 3000 People *733
Williamsburg Bridge (see New York City.)
Williamsport, Pa., New Cars................. *785
Willimantic Traction Company's Properties sold 754
Wilmington, N. C., New Cars............... *1113
Woodworth, Col. A. C........................ 369
Worcester, Polytechnic Institute, Electric Railway Course at....................... 306
——Quinsigamond Park, Roller-Skating Rink and Bowling Alley at.................. *944

Y

York County Traction Company, New Clock of 272
Youngstown, Ohio, Companies Consolidated, 368, 424
Youngstown, Pa., New Cars.................. *1111

Z

Zanzibar Railroad, Enterprise in............. 745

AUTHORS' INDEX

Andrews, Joseph—Fields versus Armatures nearest Trolleys *14
Arnold, Bion J.—Report on Probable Gross Earnings and Division of Profits between Chicago Street Railway Companies and City of Chicago................ 952
Ashe, Sydney—Relation of Railway Sub-Station Design to its Operation........... *1103
Bacon, C. G.—The Wheel Question.......... *69
Bacon, F. W.—Location of Toilet and Smoking Compartments on Interurban Cars c1024
Beardsley, H. M.—Accounting with Four Departments 655
Bell, Louis—The New York Central-New Haven Situation c805
Bennett, Chas. E.—A Novel A. C. Block Signal System *117
Bennett, W. A.—Changing Gage of Tracks in East St. Louis........................*387, 450
Bibbins, J. R.—The Application of Gas Power to Electric Railway Service..... *594
Bjorkegren, M.—Reports on Brakes.......... 923
Blake, H. W.—Contrasts between Company and Municipal Ownership and Management of Public Utilities................. *28
Bodler, F. F.—An Emergency Track Brake. *590
Boynton, Edw. C.—The New York Central-New Haven Situation.................. c805
Brown, J. W.—Despatching Methods and Reporting Troubles on West Penn Railways *307
——Discussion of Articles in the Street Railway Journal c741
Bushnell, Fred N.—The Power Station...... *583
Carpenter, E. C.—Claims and Their Adjustment 776
Cooper, H. S.—Trolley Wheels............... c995
Crecelius, Lawrence P.—The Power Station Load Factor as a Factor in the Cost of Operation *563
Cserhati, Eugen.—Operating Results of the Valtellina Railway *303
Drummond, James—The Installation of Electric Tramways in Christchurch, N. Z.. *204
Ely, W. Caryl—Policy and Aims of the American Street and Interurban Railway Association 1091
Emmett, W. L. R.—Starting of Turbines.... c391
Fox, John P.—Car Designs and Carrying Capacity *16
Fullerton, Irwin—Interurban Fare Collections 652
Giffin, F. A.—Cost of Generating Electric Power *1142
——Location of Toilet and Smoking Compartments on Interurban Cars.......... c995
Gonzenbach, Ernest—Location of Toilet and Smoking Compartments on Interurban Cars *c914, c1090
Gough, Cale—Mistakes in Motor Connections and Their Effects.................. *52
——Some Wiring Diagrams for Car Lighting *847
Graston, N. E.—Interurban Freight and Express Traffic 946
Harrington, Walter E.—Some Phases of the Feed-Water Heater Problem............ 145
Hazelton, Hugh—Multiple-Unit Systems of Train Control *565
Herrick, Albert B.—The Physical Analysis of an Electric Railway Property........ *442
——Tests of Axles.............................. *806
Hewett, John R.—Portable Sub-Station for Cincinnati & Columbus Traction Company *50
Heywood, James—Underground Distribution of Power for Urban Electric Traction *269
Hile, C. H.—Power Distribution System of Boston Elevated Railway............... *560
Lamme, B. G.—Single-Phase vs. Direct-Current Locomotives 1124
McHenry, E. H.—New York Central-New Haven Situation 896
Murray, Wm. S.—New York Central-New Haven Situation 915
Matthews, I. E.—The Federal Street Car House of the Rochester Railway Company *991
Nelson, George L.—Tool Steel............... c209
Nichols, H. B., and A. C. Voynow.—Joints and Track Construction in Philadelphia *574
O'Connor, E. W.—Operating Department vs. Claim Department 673
O'Brien, M.—Overhauling by Mileage....... c890
Osmer, J. E.—Heating Tools.................. c*71
Pardee, J. H.—Interurban Ticket Accounting *653
Parsons, W. Barclay—Rapid Transit in Cities 209
Peck, Dr. F. H.—Uniform Standards of Examination of Railway Employees....... 33
Pearson, W. A.—The Series-Parallel Railway Controller *569
Pellissier, G. E.—Thermit Rail Welding..... *572
Potter, W. B.—Electric Railway Equipment. *607
Pratt, James R.—Bogus Claims against Street Railway Companies.............. 673
Pratt, Mason D.—New Reinforced Concrete Shops and Car Houses of the Central Pennsylvania Traction Company, at Harrisburg, Pa. *330
Ricker, C. W.—Some Considerations determining the Location of Electric Railway Sub-stations 1106, *1144
Rockwell, Dr. H. B.—Why Accidents Happen 211
Rugg, J. E.—The First Meeting of the American Street Railway Association.. 1091
Scholtes, Philip—Reports on Brakes......... 923
Schreiber, H. V.—Notes on Overhead Lines *844
Schreiber, Martin—New Car Shops and Houses for the Public Service Corporation of New Jersey..................*132, *340
Somach, Henri—The St. Gall-Speicher-Trogen Electric Railway.................... *298
Scott, Charles F.—The Single-Phase Railway System 604
Simmons, Fred G.—The Cast-Welding of Rail Joints *581
——The Treatment of Rail Joints............. *571
Sprague, Frank J.—A New and Higher Standard of D. C. Operation........... c1089
——An Unprecedented Railway Situation..772, c896
Stilwell, L. B.—Tesla's Criticism............. 126
Swenson, B. V.—Policy and Aims of the American Street and Interurban Railway Association 1091
Sullivan, J. L.—A Word for Grease.......... c891
Tingley, C. L. S.—Cost of Carrying a Passenger 807
Townley, Calvert—The New York Central-New Haven Situation.................... c805
Tregoning, John—Atmospheric Valve........ *20
Valatin, Bela—New Electric Locomotives for the Valtellina Railway.................. *192
Van Dorn, W. T.—Some Experiences with Draw-Bars for Electric Cars............. *251
Voynow, C. B. and H. B. Nichols—Joints and Track Construction in Philadelphia *574
Westinghouse, George—Correspondence on Direct vs. Single-Phase Traction....1123, 1125
White, H. P.—Improved Service in Armature and Car Journal.................... 454
White, J. Harvey—Publicity.................. 31
Wilson, T. W.—Electrical Rail Welding..... *578
——Suitable Cars for City and Suburban Service *82
Wright, W. D.—Cost of Oiling Cars......... c915

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Of this issue of the Street Railway Journal 8250 copies are printed. Total circulation for 1905, to date, 213,350 copies, an average of 8206 copies per week.

Interurban Roads and the Lighting Business

The interurban electric railway that employs alternating-current transmission and is looking for all possible sources of revenue will do well to investigate the chances for furnishing electric light and power to the small towns along the lines. This is a matter which has never received the attention that it should from interurban railway companies or from the small electric lighting companies in the towns through which interurban roads run. This may be due in part to supposed engineering difficulties in the way of successful lighting and railway service from the same transmission lines. In most cases it is probably caused by the fact that no one concerned realizes the advantages to be gained. An interurban road of sufficient size to require alternating-current transmission usually has a power house of such size and equipment as to be able to generate power for very much less per kw-hour than the small country lighting station. The interurban road also very likely has sub-stations, in which lighting apparatus can be placed, in or near a number of towns along the line. Even where such sub-stations are not already in existence, it is easy to establish small sub-stations in which lighting apparatus supplied from the high-tension transmission line furnishes current to village lighting systems. There would in most cases be little doubt but that with an interurban power station of good design and the transmission line already in existence, a small town could be lighted with more profit than with a small steam plant of the size the town might require. It would probably also be possible to do electric lighting in towns too small to support an independent lighting station. Sometimes the lighting distribution system of the town could be owned by the railway company. In other cases the existing lighting companies could buy their power by the wholesale from the railway, and retail it to private consumers in the town.

The engineering features of such work are simple. The high-tension transmission line of the railway will usually be 25-cycle, three-phase. To furnish incandescent lighting current from the railway transmission line nothing beyond the usual transformer will be necessary. If 60-cycle, single-phase current is required for arc lighting, either a frequency changer or motor-generator set must be installed.

The business of furnishing light and power to small communities, like many another, requires good management to make it pay, but many well managed small companies are doing well in spite of the handicap of an uneconomical power station. Railway companies with their economical plants and with the talent at their command should be able to do as well or better.

Handling Crowds at Parks

An important feature of electric railway service at parks is the proper handling of large crowds. There are a few points in this connection which must not be overlooked, if congestion of traffic is to be avoided. While a great deal depends upon the number of persons to be handled in a given time, two features of the problem are of special weight: the cars must be kept close to their schedules and the movement of foot passengers must not be impeded.

In nearly all park work the problem is in handling the

crowds on their return, as people come to the park all through the evening, but all want to return about the same time. All arrangements should, therefore, be made for the rapid despatching of cars on the return trip, and this can usually be done better by a system of loops than by stub tracks, unless the latter are very extensive. The double stop entailed on a loop by separating the inbound from the outgoing travel is a small matter in comparison with the delays which generally occur when large numbers of people attempt to enter and leave the cars simultaneously; and, in addition, the trouble of switching is practically eliminated in a well-designed loop scheme. In cases where space permits, stub tracks can often be employed with profit for the storage of extra cars before the homeward rush hour, but as a general rule it is better to load and unload upon loop tracks than upon spurs. The crux of the whole matter is to keep things moving in the right direction, and this can only be accomplished by diverting the traffic into the channels of least resistance, always taking care to separate incoming from outgoing travel.

While many street railway summer resorts are open grounds, without fencing or special trackage, it would seem wise to study the problem very carefully before deciding that nothing need be done to avoid congestion. In very small centers of population there is, of course, little occasion to worry about overcrowding and possible accidents, but as the population begins to run upward into the ten thousands it does not require especially abnormal conditions to create almost intolerable overcrowding, if precautions are neglected. Then, too, the manner in which the people are handled has a very real influence upon their patronage of a given resort; if one can leave his car comfortably at the park entrance, pass into the grounds without encountering a stream of outgoing traffic through which the way must be contested, and finally leave the premises in decent order, reasonably certain of a seat on the homeward trip, he is much more likely to come again than as though everything at the entrances and exits were in a hurly-burly of every man for himself and the rest of the aphorism. It is better to invest in passageways than policemen for diverting traffic, and, after all, the separation need not be carried far into the grounds. All that is needed is organization, and if the crowds are handled in a systematic way the probabilities are that everything will move like clockwork. The sign feature must not be forgotten, but even these arrangements can be of the simplest character. As a matter of detail, the question deserves consideration from managers who are trying to bring their service up to the best modern standards.

The Labor Vote and Municipal Ownership

The effect of introducing street railway employees into politics, as would be the case if the policy advocated by Mayors Dunne and Johnson should be adopted, is occasionally mentioned in discussions on the subject of municipal ownership, but the opportunities which such a large and trained body of men would offer to the professional politician are not generally realized. The labor employed in street railway service is of necessity exclusively, or almost exclusively, male, and as the work requires strength and intelligence every employee is of voting age. A tabulation of the employees on the street and elevated railways in Greater New York, according to the last report of the New York State Railroad Commissioners, shows that they amounted to 29,400 men. This number was 7 per cent of the total vote cast for the last successful candidate for Mayor, and nearly 50 per cent of his plurality. We all know what an enormous influence in politics even a small body of organized voters can and does exert, and with the support which such a body would have in a political contest from trade unions and other allied socialistic bodies their influence would be well-nigh irresistible. The average citizen would be reduced to a thraldom comparable only to that in Russia, with no voice in the administration of affairs, except at rare intervals, when a cataclysm would occur to bring about a temporary relief.

The situation is entirely different in European cities where municipal ownership is in vogue to some extent, and where a restricted suffrage is the rule. In some cities in Germany, for instance, 2 per cent of the people cast one-third of the vote, and in all German cities the extent to which the residents participate in the selection of their municipal officers varies with the extent of the contributions of the voter to the public revenue. Even in Great Britain suffrage is by no means universal among the male inhabitants, and that for municipal elections is much more restricted than that for national elections. In the former no one can vote who is not a householder as well as a taxpayer up to a certain amount. Compare this with New York city, where less than one-twentieth of the voters are owners of real estate and actual direct taxpayers to the city government!

It may be largely owing to this condition, but at all events it is undeniably true, that tenure in office is very much greater in the average municipality abroad than in this country, and cities are more careful about the men who are put in charge of these responsible positions. For example, in Germany the cities are not confined to residents within their boundaries for candidates to the office. Thus, when the city of Magdeburg recently required a new Mayor, a canvas was made among the possible candidates, and the selection fell on the Mayor of Erfurt, who had distinguished himself in handling the affairs of that city and who previously had been Mayor of a still smaller city. In fact, it is the recognized policy of the largest German cities, in selecting a Mayor, to canvass carefully the records made by the incumbents of that office who had demonstrated the greatest capacity for such duties.

Although exactly the same policy in regard to choosing Mayors is not followed in Great Britain, the conditions are such in that country as to attract the best men in the community into the administrative councils and to keep them there. Mr. C. R. Bellamy, general manager of the municipal tramways of Liverpool, describes this condition, in a paper on municipal ownership, in the following words: "In England men of the keenest business acumen and of the highest standing are associated with municipal politics through long periods of years—ten, twenty, thirty and even forty years. They are expert in all that pertains to municipal ownership. Patriotic regard for everything that operates to the well being of their town and a desire to secure equally good results with those obtained in other towns lead them to devote a large amount of time, care and energy to the discharge of their duties."

It is differences like these which vitally affect the question of municipal ownership. There are other considerations as well, but the ability and permanency of policy of the city administration is certainly a vital one. Whether municipal or private roads abroad have shown the better results is immaterial in this connection. With only the fraction of a cent in each fare difference between a profit and a deficit, street railway operation requires the ablest administration, and this is not possible when politics is the chief concern of our municipal officers.

New York State Question Box

The value of the Question Box idea as a means for collecting and presenting suggestions, opinions and results of experience on practical electric railway subjects has been demonstrated at several street railway conventions recently, and also in the columns of this paper. The chief advantage, of course, lies in the facility with which discussion can be concentrated on any one particular and definite topic. The Question Box as prepared for the Lake George convention of the Street Railway Association of the State of New York contained about fifty practical questions on practical subjects, and all of these questions brought out some interesting and valuable answers, both in the preliminary canvass and in the discussion at the meeting.

The question relating to advertising received special attention, and some dozen different methods of securing publicity for the road and its attractions were suggested. As to the relative merits of the various methods of advertising, the opinions differed widely. From the tone of the answers, it may be assumed that no one medium of advertising can be called the most effective for all localities, but some or all of the various methods suggested must be used in combination, depending upon the sort of people to be reached and what the road has to advertise. The illustrated folder or pamphlet, more or less elaborate, as the case may be, is mentioned favorably in most of the answers, and this medium perhaps stands in highest favor. It has the commendable feature that the number printed, size and make-up, and therefore the general expense of producing it, can be closely regulated to fit the needs of the particular road and locality.

Other methods of advertising which received favorable comment included newspapers, display cards inside cars, banners and display cards on outside of cars, small posters for shop windows, billboard posters, periodicals published by the company, souvenir postal cards, handbills, popular contests of various kinds, illustrated lectures, etc.

The snow-fighting and snow-removing problem also came in for considerable attention, and four valuable aids in fighting snow were mentioned, namely, scrapers, sweepers, shear and nose plows and rotaries. It was emphasized, however, that, after all, the best snow-fighting equipment must be rated as secondary to the method and organization employed for handling the equipment. The descriptions of methods of fighting snow, many of which have already been published in the columns of this paper, make interesting reading.

Under the heading Claims, a number of methods of handling the "accident account" are described. The amounts charged to this account vary from less than 1 per cent to 5 and 6 per cent, with 3 per cent a good average.

The pros and cons with respect to the advisability and economy of running trail cars are well brought out in the Question Box, but the diversified character of the roads reporting on this question makes it difficult to arrive at a consensus of opinion with respect to the advisability of running trail cars. Certain of the answers expressed the opinion that trail cars increase the number of accidents, while others state it to be the experience that trailers not only do not introduce an added hazard, but that in fact they decrease the liability to accidents. The deciding factor is probably the combination of grades and curves on the road. For comparatively straight, level lines, especially if there are loops at the terminals, it is probably safe to say that the running of ordinary trail cars presents a convenient and economical method of handling extra heavy traffic. Just where the line should be drawn with respect to topographical conditions is still a matter for discussion. Practically all the answers agree that for suburban and interurban roads two or three-car trains equipped with some form of multiple-unit control are entirely feasible and desirable if traffic requires the additional carrying capacity.

On the question of rates of fares, the consensus of opinion seems to be that fares on suburban lines should be based on mileage, but opinions differ as to the proper rate per mile, this ranging from less than 1 cent to 2½ cents per mile, with the majority in favor of 1½ cents. Competition undoubtedly enters into the question, although several electric roads report that their fare is higher between stated points than the steam road rate, and yet the trolley road is getting most of the business.

Several methods of despatching cars were presented, and interest in this matter centers chiefly in methods of ensuring that conductors and motormen understand the orders correctly and then proceed to carry them out carefully. The answers contain several good suggestions along this line.

In regard to giving special rewards or prizes to employees for meritorious services, the experience and opinion of the New York State roads seem to be against giving special recompense to employees for doing their duty.

Under the heading Safety Precautions were described several means and devices for securing greater safety in electric railway operation.

Questions in the mechanical department included topics such as fireproofing cars, oil vs. grease lubrication, cast iron vs. steel wheels, brake shoes, shop devices, etc. Interesting discussions took place on all these topics. The answers of interest to power-house men included treatment of feed water, methods for increasing power to carry the peak of the load, lighting, precaution against lightning, etc.

All of the answers pertaining to the line department topics make excellent reading to those having to deal with line problems, and a number of suggestions for cheapening and expediting the work of this department were given.

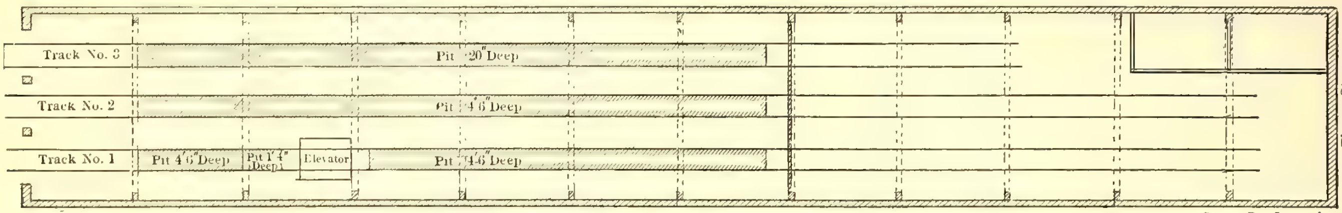
With reference to the track department, the topics discussed included the best methods of testing bonds and the experience with soldered bonds. The use of concrete foundations under rails or roadbed also received attention, and it is believed the answers dealing with this topic present a very comprehensive review of this subject. The gist of the matter with regard to concrete foundations seems to be that if the concrete beam is made deep enough and wide enough, good results will be obtained with concrete construction under track. A number of suggestions were also made for expediting and cheapening the work of the track department.

While the very noticeable diversity of opinion in the answers to most of the queries may at first thought seem to detract from the practical value of the "Question Box," yet this diversity is in many cases not without a certain advantage, though indicating that a problem may have many solutions depending upon local and other circumstances. Moreover, in most instances, solutions are asked to special cases without a statement of all the factors involved, and naturally the answers will vary in accordance with the way in which the missing factors are supplied. That the "Question Box" is held in high esteem is indicated by the extent of collaboration accorded by members in its preparation, which also reveals the spirit that gives to the New York body such a leading position among the State railway associations.

IMPROVEMENTS IN METROPOLITAN ELEVATED SHOPS, CHICAGO

As described in the STREET RAILWAY JOURNAL of April 22, 1905, the Metropolitan West Side Elevated Railway Company, of Chicago, has made important changes in its rolling stock during the past year. By way of preparation for these changes, and to provide better repair facilities for the future, the company completely overhauled its repair shops and introduced a number of improvements in them. The shops as they now stand are well up to date, and, as will be mentioned later in this article, the changes in the equipment were made with a surprisingly small number of men in addition to the regular repair force, and in a remarkably small area of shop space.

The main repair shop is located at Throop Street on the company's right of way. The shops occupy an island position, with the two elevated main line tracks on each side. The cars to be repaired are run into the second floor of the building, which is on a level with the tracks on the elevated structure. All the car body repairs are carried out on this second floor. Truck and motor repairs are made on the floor below. The trucks are lowered from under the car bodies by an elevator.



SECOND FLOOR PLAN SHOWING PITS

FIG. 1.—PLAN OF SECOND FLOOR OF THROOP STREET REPAIR SHOP

The second floor plan of the building is shown in Fig. 1, and the first floor plan in Fig. 2. Fig. 1 indicates the location and depth of the pits under the repair tracks, and also shows the position of the elevator by which trucks are removed from the car bodies and new trucks are substituted. The pits for motor and truck work are in the end of the building nearest the entrance. At the rear end of the building are the tracks where painting and carpenter work are done. There are two kinds of repair pits, one 20 ins. deep, others 4½ ft. deep. There are no third rails inside this building. When cars are to be moved inside of the building an attendant takes a flexible cable with a handle on the end and makes contact with a third-rail shoe on the car, walking alongside the car as it moves. Cars are therefore always dead when in the shop, except when this employee makes this temporary connection with his flexible cable. Before making a connection, two warnings are given, so that anyone who may be working on the equipment can get clear or make his presence known.

The appearance of a car, when over the elevator shaft, is seen in Figs. 3 and 4. When the truck is lowered from under the car, the car lays on a dog. This dog folds back into the column on each side of the elevator when not in use. It comes out just far enough to engage the I-beam side sills of the car. The cars never have to be left over the elevator long, because a truck in good order is at once placed on the elevator and put under the car. Or, if the car is not to be put back in service, a shop truck can be placed under it.

Fig. 5 is from a photograph taken on the first floor of the shop, and shows the elevator. Fig. 5 illustrates the elevator raised to its full height, and also shows an interesting feature of the shop, which is a gallery track for shop trucks, located midway between the first and second floors. On this gallery track are placed old trucks, which are used simply for moving cars around the shop. When required they can be instantly run on to the elevator, raised to the second floor and placed under cars that may need them. The elevator, as can be seen from the illustration, is of the direct-acting hydraulic-piston type, and is built for a capacity of 50 tons. It is very massive in its

FIG. 3.—CAR OVER ELEVATOR, SHOWING POST AND DOG FOR SUPPORTING CAR BODY

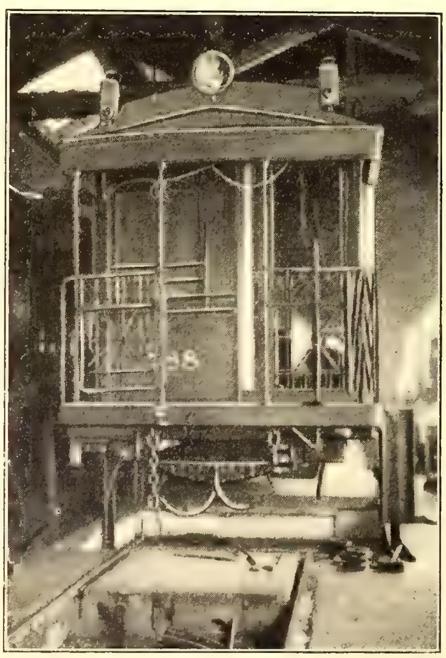


FIG. 4.—CAR OVER ELEVATOR, WITH TRUCKS REMOVED

FIG. 5.—ELEVATOR AND GALLERY STORAGE TRACK FOR SHOP TRUCKS

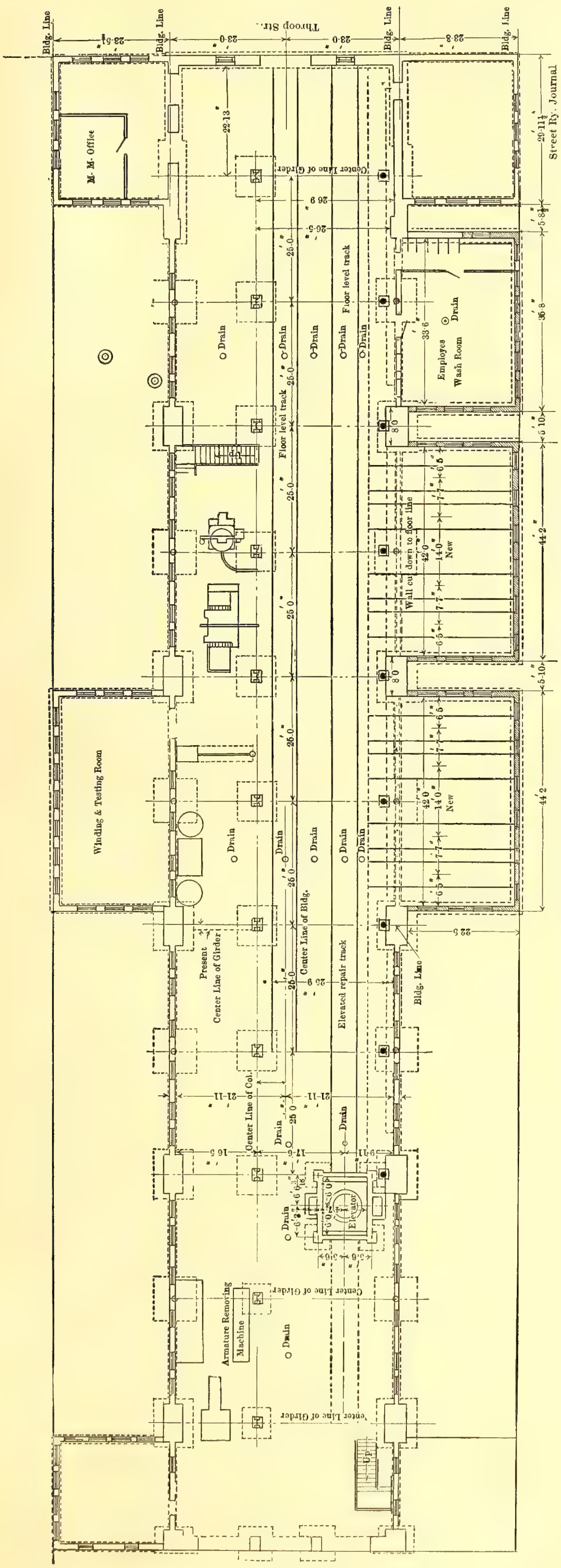


FIG. 2.—PLAN OF FIRST FLOOR OF THROOP STREET REPAIR SHOPS

construction. When at the bottom of its travel, it delivers the trucks at the level of a slightly elevated repair track, to be seen in Figs. 6 and 7. In Fig. 7 the elevator is standing at the level of this repair track. Fig. 6 was taken from the elevator looking toward the repair track.

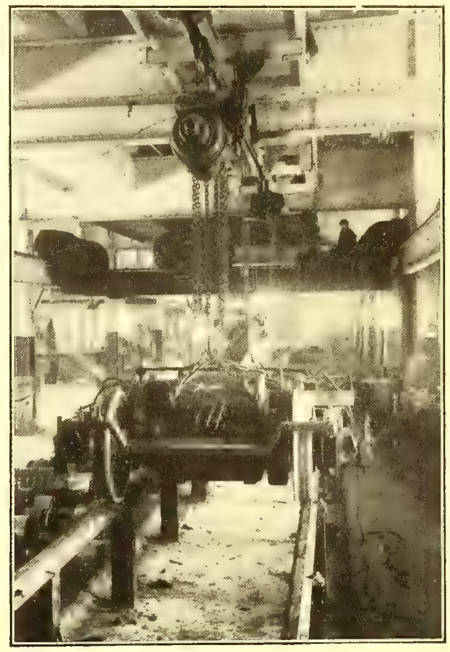


FIG. 6.—VIEW OF REPAIR TRACKS AND CRANES FROM ELEVATOR

The repair track is served by two cranes. One of these has a 5-ton air hoist, which runs on an overhead traveler directly over the repair track. It is seen in the foreground in both Figs. 6 and 7. Besides this there is a 12-ton Whiting traveling crane, which spans the main bay of the repair shop, as shown in the background of Fig. 6. This crane had to be of special design in order to clear the girders which support the tracks on the second floor. In Fig. 6 the under side of the pits extending below the second floor of the building can also be seen above the traveling crane and in the background. This shop formerly had wooden floors and pits, but these have all been changed to concrete. The traveling crane has a span of 25 ft., and serves the entire area shown in Fig. 8.

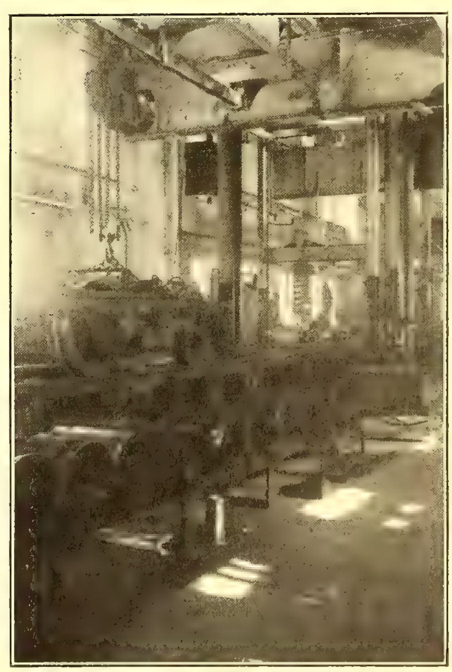


FIG. 7.—ELEVATOR AND REPAIR TRACK

Fig. 6 is the background of Fig. 8. The electric hoist seen in this illustration is used for lifting motors out of trucks in the manner indicated. If the whole truck is to be lifted off the elevated repair track and placed on the floor, the traveling crane is, of course, used. The method of hooking on to trucks which are to be so elevated is shown in Fig. 9. This engraving also shows the new motor leads covered with spiral brass wire for mechanical protection, which is a practice recently adopted by this company. It will be seen in this engraving that the motor leads are cleated to the motor nearest the middle of the car, so that all the slack in the leads necessary for swiveling of the trucks comes at a place where there are comparatively few parts which are likely to wear the leads.

Besides the 5-ton electric hoist, there is also a 5-ton air hoist

and four 1-ton barrel hoists for use in the shop. Overhead travelers are provided for carrying heavy parts whenever the traveling crane is not available. For removing the armatures from GE 55 motors, which are of the box type, the armature shaft is supported in a special machine on centers and the motor casing slid along until the armature is exposed.

FIG. 8.—GENERAL VIEW OF TRACKS UNDER TRAVELING CRANE

Several wings of one story have been added to the main shop. Two of these wings are provided with tracks. Fig. 10 is a view looking into them from the main shop. They are principally used for the storage of wheels and axles.

The practice of this company as regards wheels and gears is somewhat peculiar. Fig. 11 is a sectional drawing, showing the company's standard practice for motor-driven axles. Several years ago the company had an excessive amount of trouble with the cracking of axles between the wheel and gear. The plan of relief which was then adopted and has been followed since is to have the wheel made with an extended hub. On to this hub the gear is shrunk. Special gas torches are provided at the shop for heating gears preparatory to shrinking them on hubs. The company also makes it a practice to shrink pinions on to motor axles. Fig. 12 shows a group of these wheels and axles in the shop.

The shop is supplied with compressed air for operating the compressed air hoists mentioned, and also six air drills and two air hammers. Air is supplied from a Christensen compressor and automatic governor, and the compressed air system of the shop is interconnected with that of the power house across the street, which also has a compressor, so that one acts as a reserve for the other.

Interesting details of building construction are shown in Figs. 13, 14 and 15. Fig. 13 is the sectional elevation of the repair shop, showing the location of the girders supporting the tracks of the traveling crane and the concrete floor construction. Fig. 14 shows the details of the guard rail track construction on the first floor, while Fig. 15 illustrates the method of supporting the rails on the edges of the pits on the second floor.

Fig. 16 shows a detail of car equipment practice which may be of value to other companies. This is the method of supporting the platform carrying the compressors under the cars so that the platform will be insulated from the car framing.

TESTING ARMATURES AND FIELDS FOR FAULTS

All rewound armatures are tested for faults before they leave the racks in the winding room. This is done by passing heavy alternating current through the armature. To make such a test, brush holders are bolted to the armature rack, as shown in Fig. 17. The brushes bear on the commutator 90 degs. apart, just as when the armature is in a motor, but the armature is, of course, without fields. The armature is rotated by hand. For testing GE 55 and GE 2000 motor armatures, 300 amps. alternating current is passed through the armature. To obtain this current about 80 volts pressure is required. In testing Walker motors of 150 hp, 200 amps. at 110 volts is necessary. The alternating current has a frequency of 37½ cycles per second. This method of testing armatures is not commonly known or used, but has several advantages over others which are followed. It is not quite as simple in its application as the

FIG. 10.—LOOKING INTO ONE OF THE WINGS FROM THE MAIN SHOP

transformer method of testing armatures for short-circuits which is coming into favor for the testing of smaller motor armatures. It has the important advantage, however, that, as the armature is revolved in the rack during the test, any open circuit in the armature will make itself manifest by severe flashing at the brushes. Any slight commutator defect like a burr of copper or piece of solder causing a short-circuit between two segments will be burned out with a snap by the testing current without injury to the armature. The method therefore gives a quick and thorough test both for short-circuits and open circuits at the same time.

Besides testing for short-circuits and open circuits, all armatures are testing with 1800 volts between windings and core. Field coils are given similar tests. Current is supplied by a 30-kw generator driven by a 24-kw motor, the generator giving alternating current at 90 volts. Fig. 18 shows the corner of the armature room devoted to the switchboard and motor-generator set.

Another interesting feature in the armature department is a

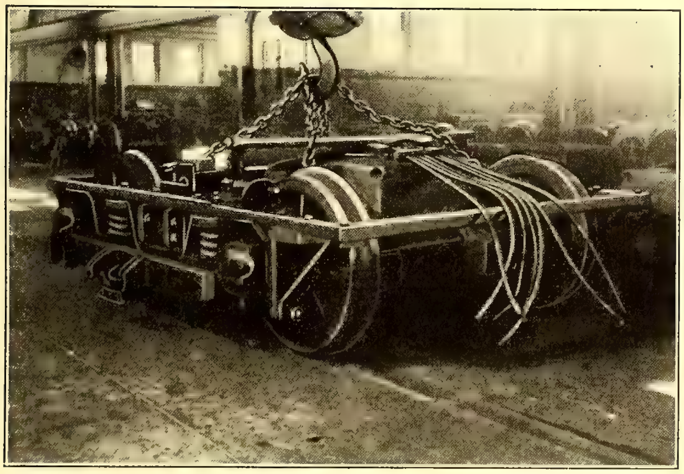


FIG. 9.—LIFTING TRUCKS BY HOOKS IN MOTOR CASINGS

home-made transformer for burning insulation loose from old armature coils which it is desired to rewind. It was found very difficult to get the insulation off these coils until the present machine was devised. It is nothing more nor less than a transformer supplying a low-voltage current which is passed through the armature coil to heat it sufficiently so that the insulation comes off easily. The transformer has as a core the core of an old compressor motor, Fig. 19. The primary coils which are on this core are connected to a source of alternating-current supply, and the secondary coils, of which there are a number in multiple, are connected to the terminal clamping plates on a bench. In Fig. 19 an armature coil is seen with its terminal clamped ready for the operation. Ordinarily, two boys work at the same time, one taking one-half of the armature coil and the other the other half. The secondary of the transformer gives about 1000 amps. at 6 volts. The current

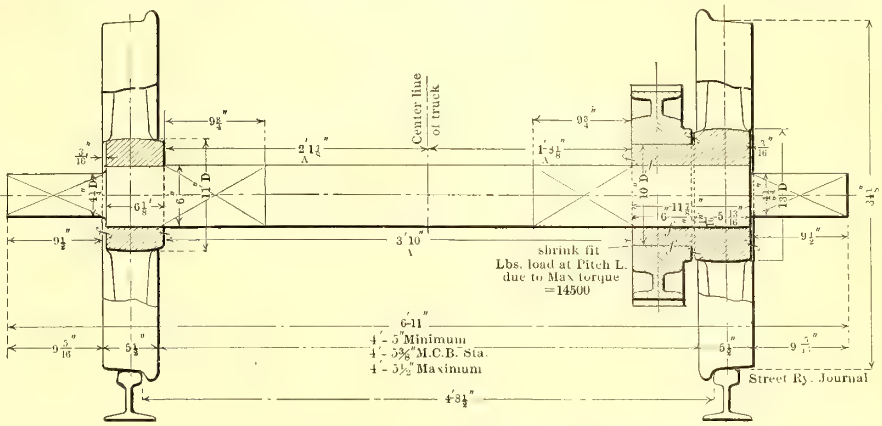


FIG. 11.—MOTOR AXLE, WHEELS AND GEAR—METROPOLITAN RAILWAY

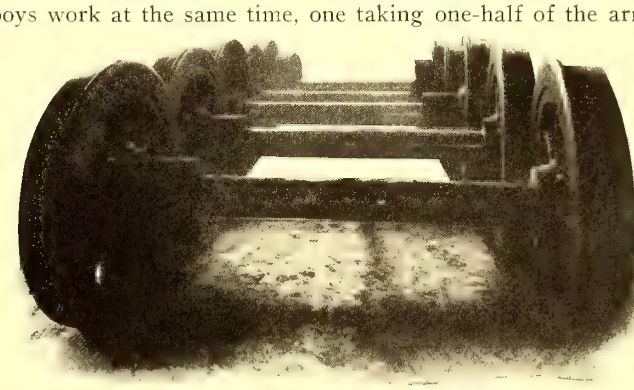


FIG. 12.—WHEELS WITH HUBS FOR RECEIVING GEARS

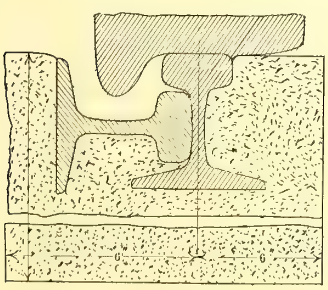


FIG. 14

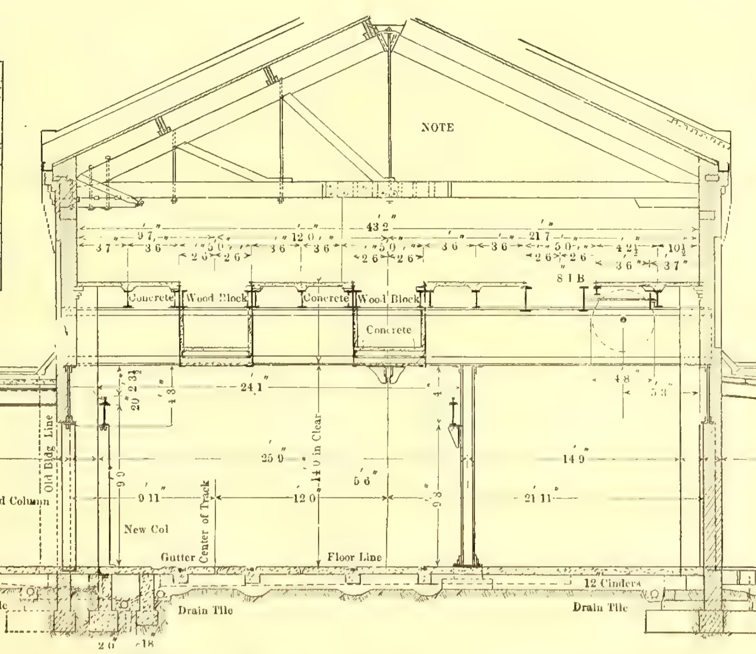


FIG. 13.—SECTION THROUGH REPAIR SHOPS

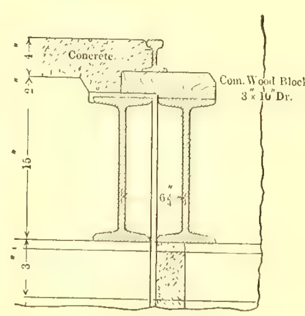


FIG. 15

has to be turned on the coil for about half a minute during the operation of scraping off the insulation. It is unnecessary to actually burn off the insulation, but only to heat the coil enough to soften and disintegrate it. This little device is a great time saver. In rewinding armature coils mica is not used, as the

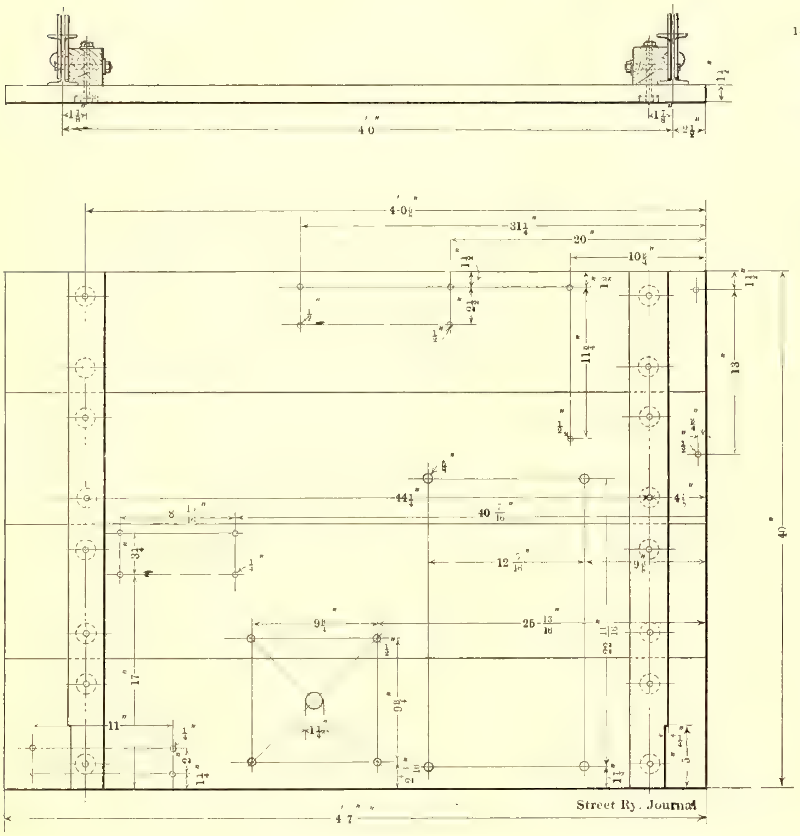


FIG. 16.—DETAILS OF SUPPORTING PLATFORM

company has not the facilities for shaping mica. Instead the coils are wound with Mica Insulator Company's oiled linen, cut bias, and covered with "dielectro," an insulating compound made by the Dielectric Manufacturing Company, of St. Louis.

WORK TURNED OUT DURING OVERHAULING

The overhauling of the equipment mentioned at the beginning of this article called for several operations on all the cars

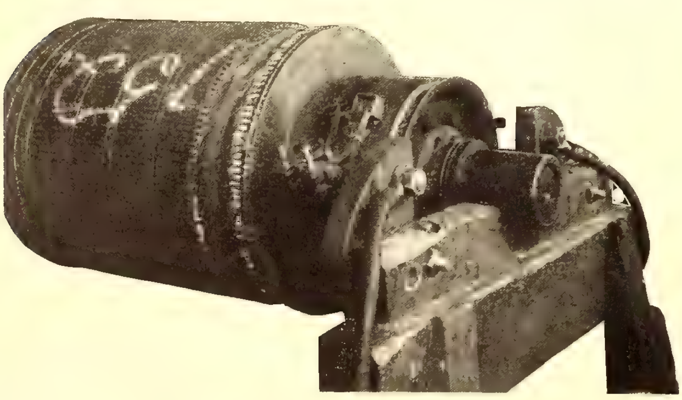
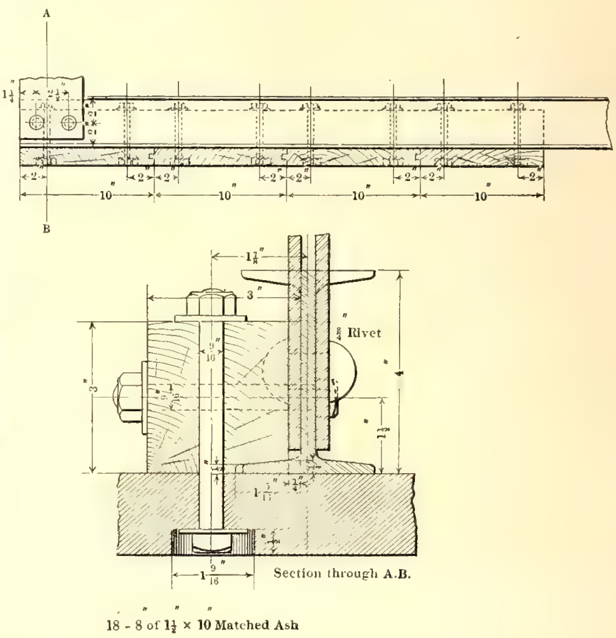


FIG. 17.—TESTING ARMATURE FOR OPEN AND SHORT CIRCUITS

of the company. The air-brake equipment, as described in the issue of April 22, was changed from straight air brake to the Westinghouse automatic brake with graduated release. The motor cars were rewired and equipped with the Westinghouse multiple-unit system of control, and the trail coaches were also rewired for train control. Along with the rewiring, the old motor cars were made proof against electrical fires as far as possible. All the cars, both motors and trailers, were raised 3 ins. Sixty-eight cars were equipped with hot-water heaters. All cars were fitted with new Van Dorn couplers similar to



those used in the New York Subway. Seventy-six trail coaches were equipped with controllers. Details of all this were given in a previous article in the Street Railway Journal of April 22, 1905, so that it comes within the province of this article only to mention how this work was taken care of by the shop. In the main shops described in this article, from eight to ten motor cars were overhauled each week and turned out ready for service with all the changes made, in addition to the regular maintenance work. In this shop there is only room for seven cars on the repair tracks on the second floor, as can be seen in Fig. 1. It will be realized therefore that to do this work

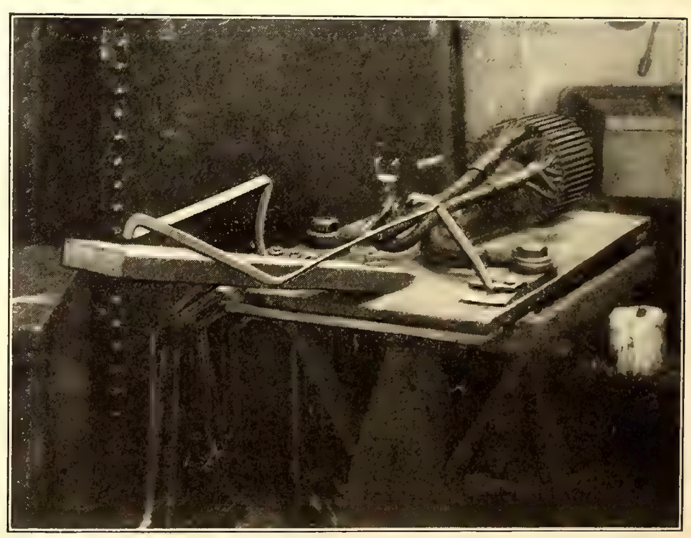


FIG. 19.—BURNING INSULATION LOOSE FROM ARMATURE COILS

with a shop of this size and without men interfering with each other, required excellent organization. The overhauling of the trail coaches was done in a smaller shop located at the terminal of the Garfield Park line at Fifty-Second Avenue. At this shop eighteen trail coaches were turned out per week. Overhaul-

ing was done at this rate during the progress of the work with the addition of about fifty men to the regular repair and inspection force.

For the information contained in this and in the previous article describing the changes in this company's equipment, and for many courtesies extended, acknowledgement is due to H. M. Brinckerhoff, general manager, and E. T. Munger, master mechanic.

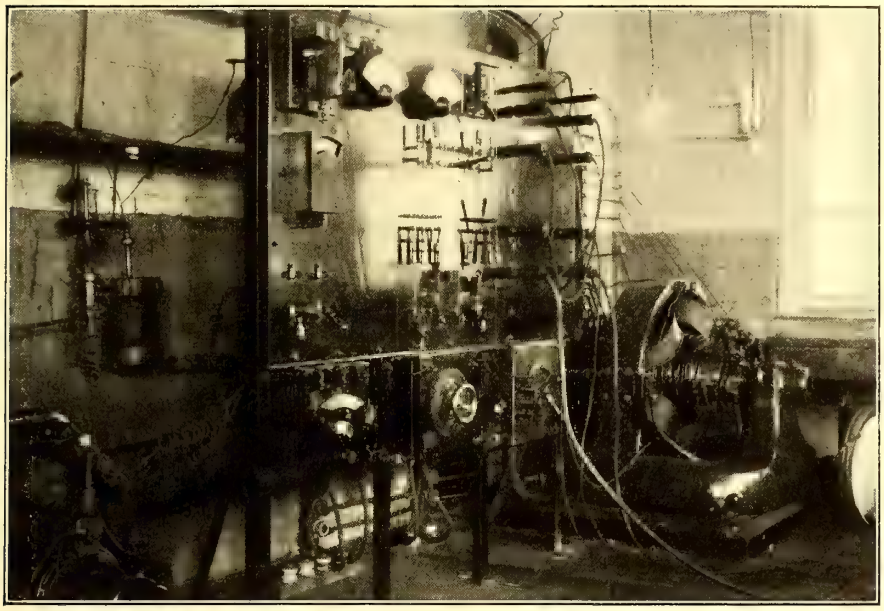


FIG. 18.—SWITCHBOARD OF COIL-TESTING APPARATUS

THE COLLECTION OF FARES IN THE CITY OF MEXICO

The system of collecting fares in the city of Mexico differs radically from that employed in this country, as a slip is handed by the conductor to each passenger as a fare receipt. This receipt shows the date, amount of fare and direction of trip, bears a serial number, and must be retained by the passenger until the end of his ride as proof that he has paid his fare.

The company has seventeen different rates of fare, varying from 3 cents to 30 cents (Mexican), and being divided between first and second class. On the city lines there are no second-class cars or fares, the city rate being 6 cents, which at the present rate of exchange amounts to a little less than 3 cents gold. The colors of the paper upon which the tickets are printed are changed each month, and this fact, together with the practice of varying the progressive enumeration of the tickets among the seventeen different rates of fare, makes counterfeiting practically impossible. No transfers are given.

The day card which is issued to each conductor when he begins work shows on its back the commencing and closing numbers of all tickets issued to him, and should he draw additional tickets during the day they are also listed on the day card. This work is done by the ticket clerks and receivers, who prepare the day cards and issue the tickets. The company's records, therefore, show the precise enumeration of tickets issued to each conductor, with the corresponding price and their total value. The conductor, at the close of his day's work, must pay for all tickets not returned to the receivers.

Each line has a starter or despatcher at its terminal who must take an account and render to the auditor a report showing the closing numbers of the tickets held by all conductors at the end of each trip; this gives the auditor the exact enumeration and value of the tickets issued to the passengers on each trip. This information must, of course, check exactly with the conductor's day card.

Each line has one or more inspectors whose principal duty it is to go through each car passing a given point and see if all passengers are provided with tickets. The inspector is familiar with the colors of the tickets representing the rate or rates of fare on his line, and does not have to inspect the tickets closely. It is also the inspector's duty to occasionally inspect the conductor's day card, and his pad or pads of tickets, to determine whether the tickets are being issued in the order of their progressive enumeration as shown on the back of the day card.

The tickets are put up in pads gummed on two sides, the purpose being to prevent conductors taking tickets from any other part of the pad than the top. Conductors are required to tear the tickets from the pads in the presence of the passenger, which prevents the use of loose tickets that may have been picked up from the floor or otherwise secured. The receivers are instructed not to accept from conductors, at the time of liquidation, any tickets that have been detached from the pads. Each pad of tickets when issued to conductors is punched by the ticket clerk or receiver to show the date of issue and the line. The conductors are only required to make one punch, which is to show the "up" or "down" trip. The work of the conductor is therefore exceedingly simple, and his day's card when completed tells the true story of every ticket issued on each half trip. The auditor is therefore able to tabulate the exact earnings of each car for each half trip, and the total tickets sold on all the runs on each line represents the total cash earnings.

As an additional precaution and incentive to each passenger to retain his fare receipt the company has just announced the establishment of a lottery, the tickets for which will be the fare receipts issued by the conductors. Lotteries, as is well known, are exceedingly popular in Mexico, as in all other Latin countries, and in this case the sanction of the Government has been secured. The official circular of the company announcing the plan has just been issued in Spanish, French and English, to meet the requirements of the cosmopolitan population resident in Mexico. The English notice, somewhat abstracted, follows:

NOTICE TO THE PUBLIC:

Commencing with July 1, 1905, a new system of tickets or checks will be inaugurated on all the lines of the Mexico Electric Tramways, Ltd. The essential feature of the new system is that each check issued to passengers by conductors will participate in a monthly drawing and may draw a valuable cash prize. The prizes will range in value from $2.50 to $1,000, and each check will participate in the drawing in accordance with its value.

There will be 209 cash prizes each month, representing a minimum total value of $2,000 and a maximum total value of $10,000, the exact amount depending upon the respective values of the checks drawing the prizes. The numbers of the winning checks will be announced in the cars and in various other ways immediately after the drawings, which will take place under Government supervision at the company's offices at Indianilla within the first five days of the month following that during which the tickets are issued.

In view of the benefits offered to its patrons under the new plan, the company requests their co-operation in carrying out its regulations.

The details of the plan are as follows:

Checks representing the values of the different rates of fare will be printed upon distinctive colors of paper, and each check will show on its face in large figures the rate of fare paid by the passengers, the colors of the respective checks being changed each month.

These checks will be consecutively numbered for each month, and will be issued to conductors in pads. In order to prevent the irregular use of the same, or the use of counterfeited checks, passengers are requested, for their own protection, as well as that of the company, to see that checks given them are torn by the conductor from his pad in their presence, as conductors are prohibited from tearing them from the pads in any other manner. Loose checks should, under no circumstances, be accepted by passengers, as they are likely to be counterfeited or otherwise irregular.

Mutilated or disfigured checks should not be accepted. Passengers are therefore requested to see that their checks, when received from conductors, are in proper order and are punched to show the date of issue and the direction (subida or bajada) in which the car is moving, as otherwise they will not be accepted by the company as participating in the drawings. The word

"subida" is intended to indicate that the car is moving outward from the center of the city, and the word "bajada" that the car is moving inward toward the center of the city. Checks for suburban lines must also be punched to show the name of the line.

Conductors' checks issued for one line will not be accepted upon another line, and checks issued on one trip will not be good for another trip.

The check issued by the conductor is not good for passage, but is intended solely as a receipt for the amount paid by the passenger, and will only be honored as such for a single trip on the car upon which it is issued. Failure on the part of the passenger to preserve the check and show it to the inspector upon demand will result in his being obliged to pay his fare a second time. For their own protection, and to insure prompt payment of prizes in the drawing, passengers should carefully examine their checks and preserve them in good order.

The basic unit of each of the prizes will be the check representing a $0.06 fare, and the corresponding prizes are shown in the following table:

Total No. Prizes		Total
1	prize of $200.00	$200.00
2	prizes of 100.00	200.00
6	" 50.00	300.00
10	" 20.00	200.00
30	" 10.00	300.00
160	" 5.00	800.00
209	prizes aggregating	$2,000.00

When the winning checks are of other values, the prizes will be correspondingly greater or less, in accordance with the value of the check, for example:

Should a Mexico to Tlalpam first-class check, the value of which is $0.30, draw one of the prizes, the holder of that check will be entitled to five times the amount of the prize, for the reason that the value of his check is five times the basic unit of $0.06.

Should a Mexico to San Angel first-class check, the value of which is $0.20, draw one of the prizes, the holder of that check will be entitled to three and one-third times the amount of the prize.

Should any check, the value of which is seven cents, draw a prize, the holder will be entitled to one and one-sixth times the amount of the prize.

Should any check, the value of which is six cents, draw a prize, the holder will be entitled to the exact amount of the prize.

Should any check, the value of which is three cents, draw a prize, the holder will be entitled to one-half the amount of the prize.

It is therefore very important to each passenger that the check handed to him by the conductor shall show the full amount of the fare paid.

As will be seen, if a thirty-cent check should draw the first prize of $200, the holder thereof would be entitled to a prize of $1,000, while if the first prize of $200 should be drawn by a $0.03 check, the holder thereof would be entitled to a prize of $100, etc.

The company guarantees the prompt payment at its offices at the Kiosko, located at the "zocalo," or Plaza de la Constitución, of all prizes upon presentation of the checks drawing the same. Furthermore, the company guarantees that it will not take advantage, for its own account, of any prizes which may be drawn by checks remaining in its possession. Should it happen that any unissued or mutilated checks in the company's possession draw a prize or prizes, the value of the same will be added to subsequent monthly drawings as special prizes in addition to the regular schedule of prizes. Checks drawing prizes which are not claimed within a period of three months after the date of the drawing will be considered as forfeited or canceled, and the prize corresponding to such checks will be added to subsequent monthly drawings as special prizes.

Free passes, monthly tickets (abonos), and special forms of tickets issued at reduced rates are not included in the new plan, and conductors' checks will not be issued for them.

Passengers using the cars regularly two or more times per day will be able to accumulate a large number of checks each month which will greatly increase their chance of drawing a valuable prize. It should be understood that the checks are given free in order to secure the cooperation of the passenger in carrying out the company's rules and regulations. The winner of a $200 prize will have received, without cost to himself, a sufficient amount to enable him to pay his car fares at the rate of 55 cents per day for one year, or at the rate of 27½ cents per day for two years. The fortunate winner of a $1,000 prize will have received, without cost to himself, the price of his car fares for a period of several years, or an amount sufficient to pay for one first-class passage to Europe and return.

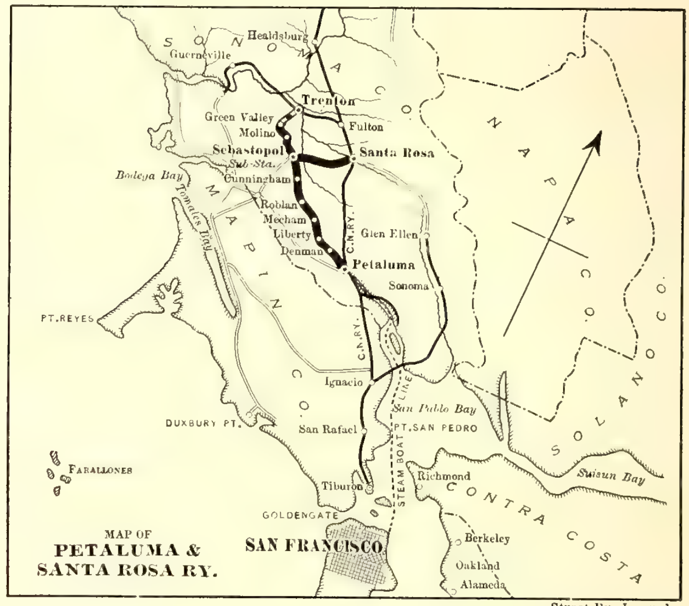
The schedule of rates of fare between different points on this company's lines is printed herewith for the information of the public.

MEXICO ELECTRIC TRAMWAYS, LTD.
(Signed) W. W. WHEATLY,
General Manager.

In addition to the plan outlined the company is making other improvements. Among them the company proposes to inaugurate an express business the latter part of this year. It is already doing quite a profitable freight business, which is rapidly increasing. Thirty-five 20-ton trailer freight cars have already been built in the company's own shops during the past year, and they are inadequate to do the business offered. The company is consequently now building twenty-five additional 20-ton trailer freight cars, and has just purchased four large heavy motor cars (with four G.E. 57 equipments) from the J .G. Brill Company. These motor cars are intended to draw six fully loaded 20-ton trailers, and the motor cars will also carry a full load. The company now has on hand four specially constructed express cars and twelve standard wagons for express service. It is now waiting the approval of its express tariffs by the Government and the completion of other necessary details before starting its express business.

THE PETALUMA & SANTA ROSA RAILWAY

The completion of the Petaluma & Santa Rosa Railway marks the beginning of a new era in interurban road building in California. The State has a number of interurban railways connecting the larger cities with their suburban communities,



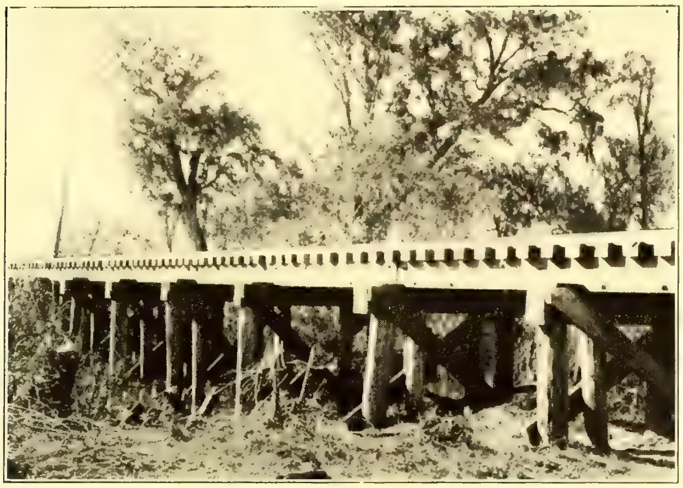
MAP SHOWING THE TERRITORY OF THE PETALUMA & SANTA ROSA RAILWAY

with outlying towns and resorts, but these cater almost exclusively to a passenger business. Some of the systems are characterized by very interesting engineering and operating features, and many of them have been described in these columns during the past year. Differing somewhat from other

PETALUMA'S ORIGINAL RAPID TRANSIT

systems, the Petaluma & Santa Rosa Railway is built primarily for the handling of all kinds of express and freight, and, with the possible exception of the Watsonville system, it is the first electric railway in California to take up the freight question so comprehensively at the start. The railway will also develop its passenger business to the fullest extent possible, and it will be interesting to observe the combined growth of its two sources of revenue.

The Petaluma & Santa Rosa Railway extends north from Petaluma 17 miles to Sebastopol, where it divides, one branch going 7 miles east to Santa Rosa, the other continuing in a generally northern direction 8 miles to the town of Forestville. Petaluma is situated on Petaluma Creek, an estuary of the north end of San Francisco Bay, with which it has tide water connection. The company has at this point a large warehouse and terminal yards on the water front, and every facility for handling large quantities of freight. It owns the steamer "Gold," and charters another steamer of equal capacity. Both make daily trips to San Francisco, a distance of 40 miles.



AN EXAMPLE OF BRIDGE CONSTRUCTION ON THE PETALUMA & SANTA ROSA RAILWAY

A FINE STRETCH OF TRACK ON THE LINE TO SANTA ROSA

Leaving Petaluma the track of the company parallels the steam railroad track of the California & Northwestern Railway for about a mile, and then turns to the left on a 3-mile tangent through a level stretch. The road passes between low foothills, and 10 miles from Petaluma reaches Stoney Point quarry. This quarry is owned by the company, and contains the only rock tributary to the line. The stone is used for ballasting the track and is also sold for building and paving purposes. From Stoney Point the road continues on to Sebastopol through chicken ranches and fruit and berry farms. Between Sebastopol and Green Valley the line passes through the Gold Ridge Belt, a very productive strip of land, 15 miles long and 5 miles to 10 miles wide, whose chief products are hops and fruit and berries of all kinds. At Green Valley a new town site has been laid out.

The branch from Sebastopol to Santa Rosa parallels a spur from the California & Northwestern Railroad's main line and passes through a rich, level country.

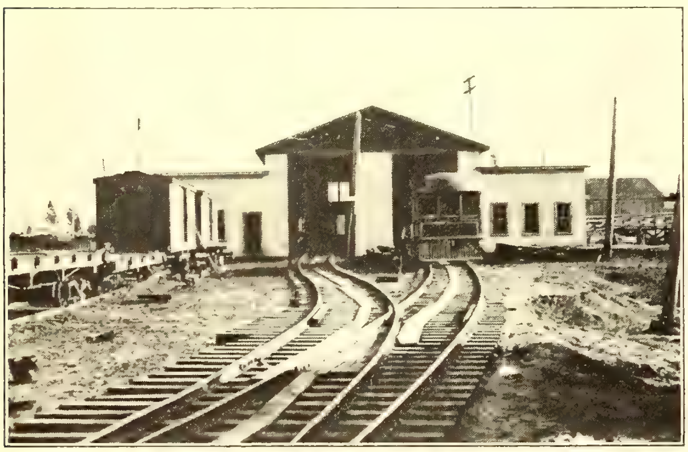
THE SEBASTOPOL STATION OF THE PETALUMA & SANTA ROSA RAILWAY, SHOWING FREIGHT STATION ON THE LEFT AND STONE SUB-STATION IN THE LEFT BACKGROUND

The district served by the Petaluma & Santa Rosa Railway is the richest, most thickly populated and the most rapidly growing portion of Sonoma County. It lies west of the steam road, and until the opening of the electric road was reached only by the former's spur mentioned above. In 1900 the population of the district was 21,996, and the increase since that date has been considerable. The country in Sonoma County and other coast counties to the north is attractive to the Eastern fruit grower and farmer, since the rainfall is ample to insure excel-

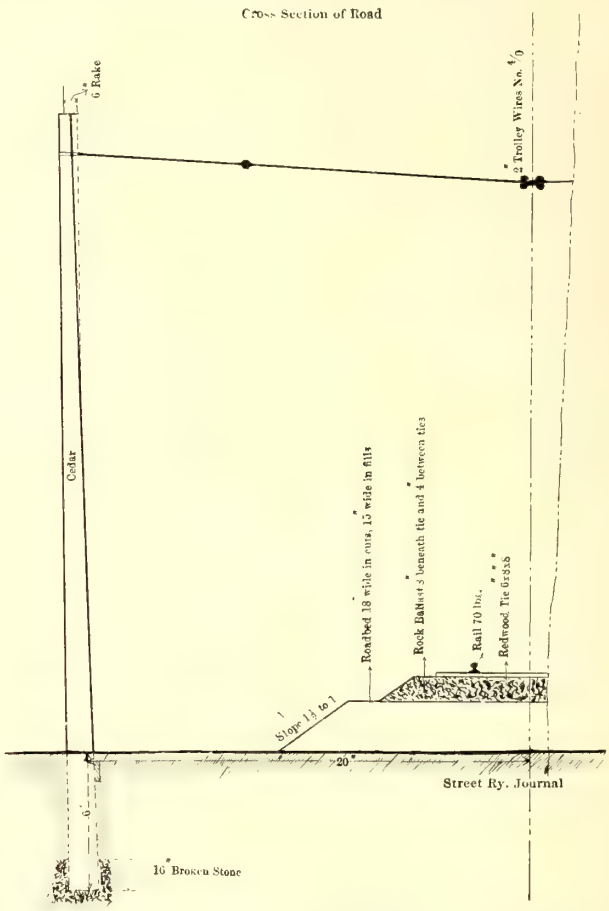
lent crops without the expense of irrigation. Proximity to the market of San Francisco also makes the district attractive.

Petaluma, the tide-water port of the county and the southern terminus of the electric railway, is a city of 5000 people, and is enjoying a good, steady growth. It is known as the largest poultry center of the United States, about $100,000 worth of poultry and eggs being shipped monthly to San Francisco and other points in California. Petaluma also has a number of mills and manufacturing establishments. Santa Rosa, the county seat and the largest city of Sonoma County, has a population of about 10,000. It contains a number of manufacturing industries and is the distributing center of the northern part of the county.

COMBINATION PASSENGER AND BAGGAGE CAR ON THE PETALUMA & SANTA ROSA RAILWAY



SHOPS AND CAR HOUSE AT THE PETALUMA TERMINAL



HALF CROSS-SECTION OF LINE, SHOWING TRACK AND OVERHEAD STANDARDS

THE STEAMER "GOLD" DOCKING AT THE PETALUMA WAREHOUSE OF THE PETALUMA & SANTA ROSA RAILWAY

Of the total 30½ miles of track at present completed by the company, 26 miles is on private right of way, which, in most instances, is 60 ft. wide. The track consists of 70-lb. standard A. S. C. E. section T-rail, laid in 30-ft. lengths to standard gage on 6-in. x 8-in. x 8-ft. redwood ties. The maximum curvature is 10 degs., and the maximum grade 2 per cent. The main line is thoroughly ballasted with broken rock obtained from the Stoney Point quarry, as mentioned above, while the ballast on the Sebastopol-Santa Rosa branch consists of river-bed gravel. Ample drains are installed in the road-bed at cuts and at other points requiring drainage, and, as an additional precaution against washouts in times of heavy rainfall, ditches have been constructed along the right of way to carry off the surface water. The record rainfall in this section, set last year, was between 8 ins. and 9 ins. in twenty-four hours, so that suitable precautions against washouts are quite necessary. All the road crossings of the railway are protected with steel cattle guards. The right of way is fenced in with American field fence, a barbed wire being fastened along the top and on the opposite sides of the posts from the fencing.

The overhead construction of the line is supported from 30-ft. Washington cedar poles set at the sides of the right of way and spaced 100 ft. apart. The poles are set 6 ft. in the ground, and before setting the butts were treated with crude oil as a preservative. The overhead conductor consists of two No. 0000 grooved trolley wires, spaced 6 ins. apart, and hung with twin hangers. Jumpers, consisting of copper strips and located every 600 ft., cross-connect the two wires.

Anderson overhead material is used, with the exception of a special trolley ear which has been developed by the officers of the railroad. The two trolley wires are supplied with current at Petaluma and Sebastopol, and at first were sufficient to operate the road without feeders. Recently a 500,000-circ. mil feeder has been installed, in order to provide for the increased capacity demanded by the growth in traffic.

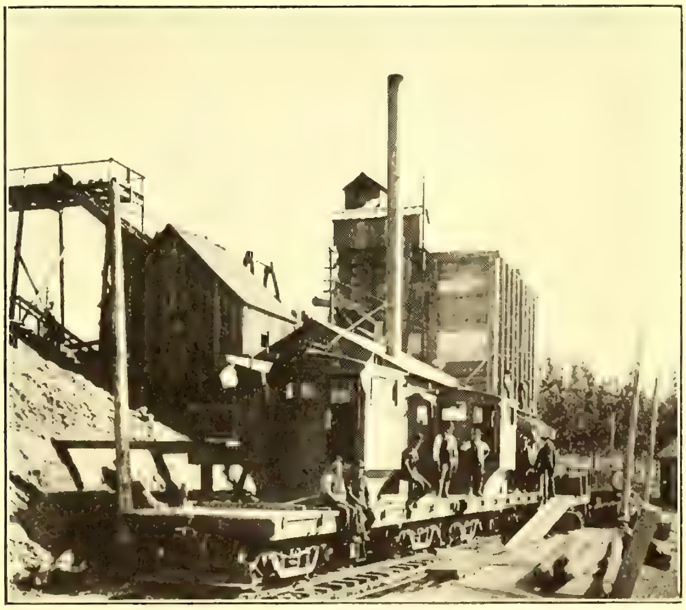
On the Sebastopol-Santa Rosa branch the track follows the county highway most of the distance, and the poles that carry a 55,000-volt transmission line of the California Gas & Electric Corporation are used to support the trolley wires on one side. As the transmission poles are spaced 200 ft. apart, ordinary 30-ft. poles are alternated with them on that side.

The railway is operated by power purchased from the California Gas & Electric Corporation under a ten-year contract. The main sub-station is located at Sebastopol, in a substantial stone building designed by the power corporation, but built by the railway company. Here the 55,000-volt current is transformed to 2300 volts by means of three 250-kw transformers, and is then used to operate a 400-kw General Electric motor generator set. The latter consists of a 2300-volt synchronous motor, driving a direct-current 575-volt generator, the speed of the unit being 450 r.p.m. Foundations have been installed for a duplicate motor generator set. A 15-kw exciter for the synchronous motor is driven by a 500-volt motor off a storage battery.

MOTOR CAR USED AS A FREIGHT LOCOMOTIVE AND FOR CONSTRUCTION PURPOSES

A TYPE OF SMALL STATION WAITING ROOM ON THE PETALUMA & SANTA ROSA RAILWAY

A VIEW OF APPLE ORCHARDS ALONG THE LINE OF THE PETALUMA & SANTA ROSA RAILWAY



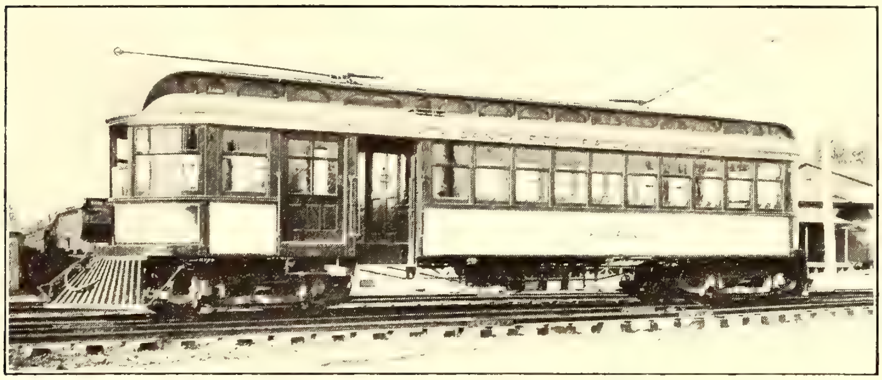
THE PETALUMA & SANTA ROSA RAILWAY COMPANY'S QUARRY, SHOWING TWO MOTOR CARS COUPLED TO CRUSHED ROCK TRAIN

The current is controlled from a switchboard of blue Vermont marble, consisting of standard a. c., d. c. output, exciter, feeder and storage battery panels. The storage battery, which floats on the feeder system, is formed of 264 type-G cells, the tanks each having a capacity for twenty-one plates, with thirteen plates installed. At a one-hour rate of discharge the battery has a capacity of 480 amps. A General Electric booster is used in connection with a carbon regulator to regulate momentary fluctuations in load on the battery. The battery room was specially built, and has a concrete floor painted with P. & B. paint. The tanks are of a new type, having flat lead tops, which permit them to be filled higher and with less danger of slopping over. The tanks are doubly insulated from the floor by porcelain and glass. The battery was installed by the Electric Storage Battery Company.

At Petaluma an additional current is supplied to the railway by the California Gas & Electric Corporation from a motor-generator set. This set consists of a 440-hp Stanley synchronous motor, driving a 350-kw Bullock generator at 360 r.p.m. The motor connections at Petaluma are 4000 volts star, while those at Sebastopol are 2300 volts delta.

The passenger service of the Petaluma & Santa Rosa Rail-

way is handled by ten 45-ft. semi-convertible cars, manufactured by the American Car Company, of St. Louis, and W. H. Holman & Company, of San Francisco. These cars are able to maintain a speed of 35 m.p.h. on the level, and contain baggage and smoking compartments. Each is equipped with four General Electric 70-motors and two 28-A controllers. Westinghouse straight air-brakes are installed with Nichols-Lintern pneumatic sanding devices. Wagenhals arc headlights

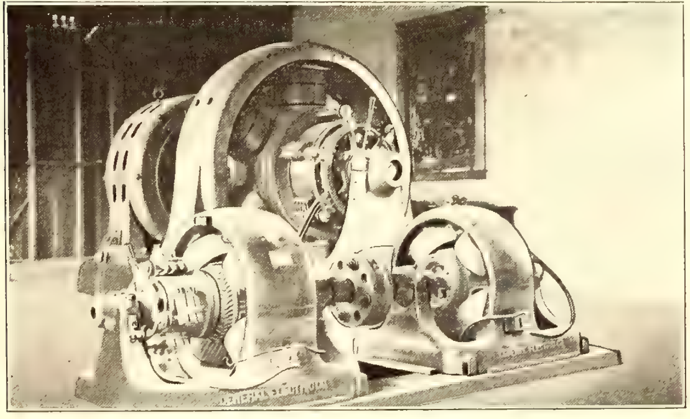


STANDARD PASSENGER CAR ON THE PETALUMA & SANTA ROSA RAILWAY

with roller-canvas screens are used, and all cars have standard pilots. A half-hour passenger service is operated at present, the cars being despatched by telephone with duplicate train orders. The passenger rate charged is 2 cents a mile, with a minimum of 5 cents.

The company's freight service is handled by an equipment consisting of fifty flat and ten box cars, three motor freight cars and one baggage express car. Each of the motor freight cars is equipped with four General Electric No. 70 motors, and consists of a flat car with cab in the center. At each end of the cab is mounted a swinging jib crane, by the aid of which the car may be quickly loaded and unloaded. This type of car is used for construction work, and in regular freight service hauls a train of box cars or flats.

At Petaluma the railway company controls a valuable water front property, as before stated. Soon after the railroad service was begun the freight traffic increased to such an extent



THE MOTOR-GENERATOR SET AND BATTERY BOOSTER IN THE SEBASTOPOL SUB-STATION

that the steamer "Gold," with a net tonnage of about 300 tons, was inadequate, and an additional boat was secured by the company. The two are now hardly able to keep up with the business. The steamers have their own wharf at the foot of Market Street in San Francisco.

Plans are now being prepared for an extension of the electric railway from Petaluma to Point Pedro, about 20 miles south, where better shipping and dock facilities may be secured. This will also reduce the boat distance to San Francisco, and will thus increase the passenger facilities of the system. Active steps are also being taken for an extension of the railroad north from Forestville through the Dry Creek Valley to Healdsburg and other prosperous towns on the Russian River. A branch westward through Sonoma County, with the possibility of eventually reaching the ocean, is also talked of.

The present officers of the Petaluma & Santa Rosa Railway Company are: President, John A. McNear, of Petaluma; vice-president, W. F. Kelly, of Oakland; secretary, Thos. Archer; treasurer, Burke Corbett; general manager, E. E. Downs. Much credit for the successful construction is due to Alfred D. Bowen, who also supervised the early operation of the road.

FIELDS VERSUS ARMATURES NEAREST TROLLEY

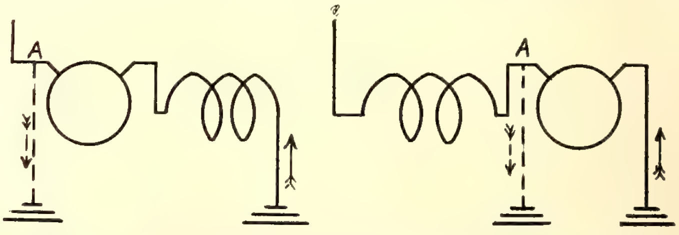
BY JOSEPH ANDREWS

It has become standard practice in railway motor work to place the armature in circuit nearer the trolley side of the line, and the fields nearest the ground side. The practice has become so universal that no question is raised concerning it, and the reason for so connecting the motors has probably not occurred to many.

It is often explained as being indirectly due to the fact that reversal of current to obtain reversal of rotation of the motor should occur in the armature rather than in the field. To retain the reversal in the armature, were it connected in the circuit last, would necessitate the return of all of No. 2 motor leads to the controller, where now one of them is carried direct to the shell of the motor. This would require more complicated controller wiring, which is always to be avoided as far as possible.

The more important reason for the present method of connection, however, becomes clear when inquiry is made into the behavior of the motor when a brushholder or the armature becomes grounded.

Fig. 1 is a diagram of the motor circuit with the armature in nearer the trolley, as in present practice. Fig. 2 shows the fields next to the trolley. The motors are assumed to be in multiple. In both diagrams a brushholder is supposed to have become grounded at "A." In Fig. 1 such a ground shunts both fields and armature, and weakens the field. The armature and fields are also in series with each other through the short circuit. Grounding usually occurs when the car is in motion. The counter-electromotive force of the motor, due to the residual magnetism of the fields, will then tend to set up a cur-



FIGS. 1 AND 2—DIAGRAMS OF MOTOR CIRCUIT WITH ARMATURE NEARER TROLLEY, AND WITH FIELD NEARER TROLLEY

rent through the fields and armature in a reverse direction to that of the original line current. This generated current, however, being in the reverse direction to the former current, at once destroys the residual magnetism and consequently the counter-electromotive force of the armature. This stops the generation of any more current, and no bad effects are noticeable.

The results when the fields are in circuit first is quite different. The increased current due to the short circuit passes through the fields, strengthening them greatly. The armature alone is short-circuited by the grounding path. The counter-

electromotive force instantly generates abnormal currents in the armature, causing it to cease rotating. Even after the circuit-breaker has acted or the fuse blown the residual magnetism of the fields is sufficiently strong to cause the same action. The car is then brought to a standstill by a series of jerks, as when an emergency stop is made by throwing the reverse handle and putting the motors in multiple.

Under such circumstances the motor may be regarded as a separately excited generator on a short circuit, the armature being driven by the momentum of the car instead of by an engine.

In case of a grounded armature coil the effects would be practically the same as with a grounded brushholder. When the grounded coil is near the negative brushholder a motor action will be obtained so long as the breaker does not fly out. With the armature in circuit first, the motor will have very little torque, due to the weakened fields. With connections as in Fig. 2 there will be a strong torque, due to the strengthened fields. As the grounded coil approaches the positive holder, the action becomes more than obtained with a ground at "A," as previously described.

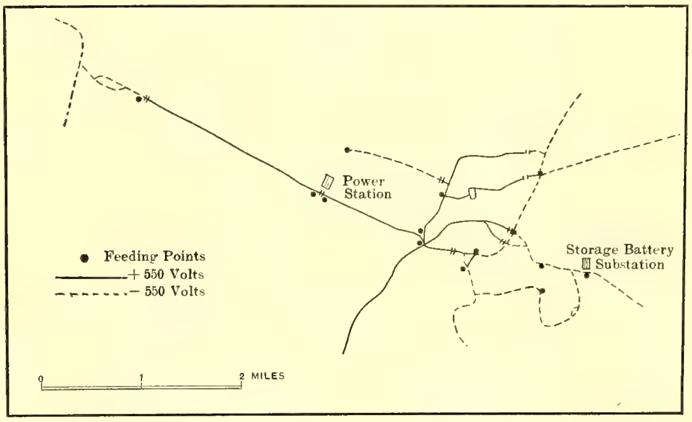
Were it not for the undesirable effects as explained above, it would probably be better to connect the motor with the fields in the circuit nearer the trolley. The advantages gained would be due to the better opportunity of insulating the fields. Were the fields in circuit first their high inductance would in most cases prevent lightning reaching the armature. Their better insulation would force through the lightning arrester many discharges which now reach ground through the armature. However, in many cases, the fields would suffer, where, with the present connections, the armature receives the discharge. So far as the question of cost of maintenance of armatures and fields is concerned, this would be preferable, as it is much cheaper to repair a grounded field than an armature.

Another protection offered the armature by putting the fields in circuit first is that due to the drop of voltage in the fields. This is a rather important consideration in air-compressor motors, and others where the resistance of the fields is considerable, and the fields of these machines are usually found between the armature and the trolley. In the railway motor, however, the drop through the fields is a comparatively small fraction of the total, but nevertheless the protection offered the armature by the lowered voltage between it and the ground would be worthy of consideration.

With the fields so connected that reversal of the current took place in them it would be a simple task to remove doubt as to a grounded field. A grounded field near one of the leads would permit the motor to operate in one direction about in the usual manner. But if the reverse lever were thrown, the ground near the lead would shunt all the fields beyond it, which would be at once noticeable in the operation of the motor.

THREE-WIRE SYSTEM IN NUREMBERG

The three-wire system of direct-current distribution has been in use on the tramway system of Nuremberg, Germany, since October, 1903, with satisfactory results. According to an article on the installation by P. H. Scholtes, manager of the company, and appearing in a recent issue of the "Electrotechnische Zeitschrift," the line is divided into two approximately equal parts, one supplied from the positive bus-bar, the other from the negative bar. The rails are neutral, and at 550 volts difference of potential from either bar. Certain short sections of overhead wire are so arranged that they can be cut into one or the other side of the circuit. The sections nearest the power station, as shown in the accompanying map, are supplied with positive current, while the more distant lines are of negative potential. One object of dividing the line in this way is the ability to get a higher voltage, and consequently higher speed, in the suburbs than in the center of the city. Two generators, each of 550 kw, are connected in series, and are driven by one engine. A storage battery of 270 cells and 360 kw-hours is installed in the main station, and one of 245 cells and 330 kw-hours at the end of one line. The station battery is charged with a booster, the battery at the end of the line without a booster. The latter battery is charged at the time of low load



DISTRIBUTION DIAGRAM OF THE NUREMBERG THREE-WIRE SYSTEM

with a slow charge, to avoid excessive current in the rails which carry the return current.

Mr. Scholtes states that no difficulty has been experienced in keeping the load balanced or in keeping up the insulation. A comparison of the first year's operation shows that although the car mileage increased from 3,269,125 to 3,706,925, or 13.4 per cent, the cost of fuel rose only 1.8 per cent. This the writer attributes to the smaller loss on the line and in the track.

IMPROVED SIGNAL SYSTEM ON HUNTINGTON LINES

With a view to reducing its fatalities to a minimum on its electric railway lines, the Pacific Electric Railway Company is ever alive to the necessity of providing safeguards to eliminate as far as possible all collisions. Recently the Los Angeles Railway Company provided signals at every crossing. These are red crosses painted on a white background and suspended from overhead wires. At night, however, they are practically useless. Now the Pacific Electric Railway has in contemplation a signal system superior to these. Instead of painted signs there will be green electric globes suspended over the crossing. These will flash automatically the signal that a car is approaching. Before the globes will be a vane painted green, which will point the direction of the approaching car and will be moved by the same power that lights the globe.

A consular report states that a contract has been entered into between the Ferrocarril Urbano de Lima (Peru) and the Provincial Council substituting overhead trolley for horse traction on all the street railways of Lima (about 16 miles in extent). The new system is required to be in operation within two years from the signing of the contract, and 5 kilometers (3.1 miles) of new road between the specified points in the city must be in operation within the following five years. A new company, representing American and local capital, succeeds the old one, and the electric and other new material required has been ordered from the United States, as happened in the case of Lima's two suburban lines now in successful operation.

CAR DESIGNS AND CARRYING CAPACITY

BY JOHN P. FOX

Since the publication of an article on the above subject in the Street Railway Journal for April 1, 1905, some interesting points have come up. The most important question raised has been the practicability of the side-door car for the most congested city service with frequent stops, and the most serious faults suggested for this type have been the difficulty of cutting off a stream of boarding passengers with so many doors, and the increased liability of real or pretended accidents from the multiplication of entrances and their distance from the guards. It has been suggested that, to start a side-door train where people were continually trying to board, it would be necessary to fence off the platform next to the train, close all gateways at the proper time, and allow no late comers near the train, as on the City & South London Railway and at some railroad terminals. The service of the Illinois Central seems hardly severe enough to throw light on this point, and it may be that actual experiment under the worst conditions alone can settle the question. But further observations of the experience of the Boston Elevated Company, with pneumatically-operated middle and end doors, afford some interesting and important light on the matter. Continuous streams of people trying to board trains can always be found at the elevated terminals and some other stations, especially at the rush hour. It will be remembered that the latest Boston cars have three wide sliding doors on each side, all of which are now operated by compressed air from the car ends; and besides this, the middle doors of the older cars are being operated more and more by air by the trainmen, without any platform men to assist most of the day. The forward guard on all these trains has to open and close four entrances at way stations, and eight at terminals. In other words, the Boston Elevated Company appears to be operating under conditions quite similar to what would be met with side-door cars, conditions in some ways more unfavorable, and yet the results have been most satisfactory.

The forward guards at terminals have to shut off from one position as many as twelve or even sixteen lines of people, a maximum then as great as with a side-door car, as the latter would have only eight doors on each side. And it must be remembered that the Boston guards have to look half a car length to the middle doors, and often through several panes of glass, or else lean way out over the folding gates between cars to see along the station platforms. These difficulties are wholly obviated in the Illinois Central type, where a guard has only one or two door valves to operate instead of a maximum of eight, in addition to four unlocking pedals. The success of this very ingenious Boston Elevated equipment would seem to predict the success of regular side-door cars under similar conditions.

As to the danger of multiplying doors, the Boston experience again seems to furnish a satisfactory answer. The perfection of door details seems an important factor, and the pneumatic tubes or "strikers" on the Boston door ends, as described in the Journal for Aug. 6, 1904, seem to have met with every requirement for safety and made impossible the holding of clothing in the doorway or injury to any part of a person struck. People seem to tend to keep away from an automatic door, the power of which they do not know, the movement of which can instantly be checked or reversed, as is often done in practice. As to cutting off people from entering, the writer has failed to notice any difficulty. Where a car has an unusual number of entrances, it allows time to close these slowly, and with slow closing there seems to be no reason why side doors cannot cut off streams of people, especially as by spreading people out to twice or four times as much as now, pressure and crowding should be much reduced. On the possible dangers from multiplying side doors, A. W. Sullivan, the originator of the Illinois Central type, sends the following to the writer:

> Accidents to passengers and claims arising therefrom, do not result from the working of the doors, but from the attempt of passengers to get on and off trains in motion. No serious accident can occur to a passenger in entering and leaving a train while it is standing still, and this statement holds good whether there are one or ten doors in use. The trouble arises from passengers trying to get on or off before a train has stopped, or after it has started. As the sliding side-door in my design of car cannot be opened until unlocked, after the train has come to a full stop, it is apparent that no accident can result from passengers getting off such trains while in motion; and, as the train cannot start until all the doors are closed and locked (and when this is done there is no possible means of a passenger getting on or attaching himself to a train), it is clear that no accident can occur from passengers attempting to get on such trains while in motion. Therefore, the two most prolific causes of personal injuries are eliminated by the use of these sliding side-door cars; and, as the multiplicity of side-doors does not in any way increase the hazard of personal injuries, while it greatly facilitates the rapidity of movement in entering and leaving cars, it must follow that the multi-side-door car is the best one for the rapid handling of a dense traffic.

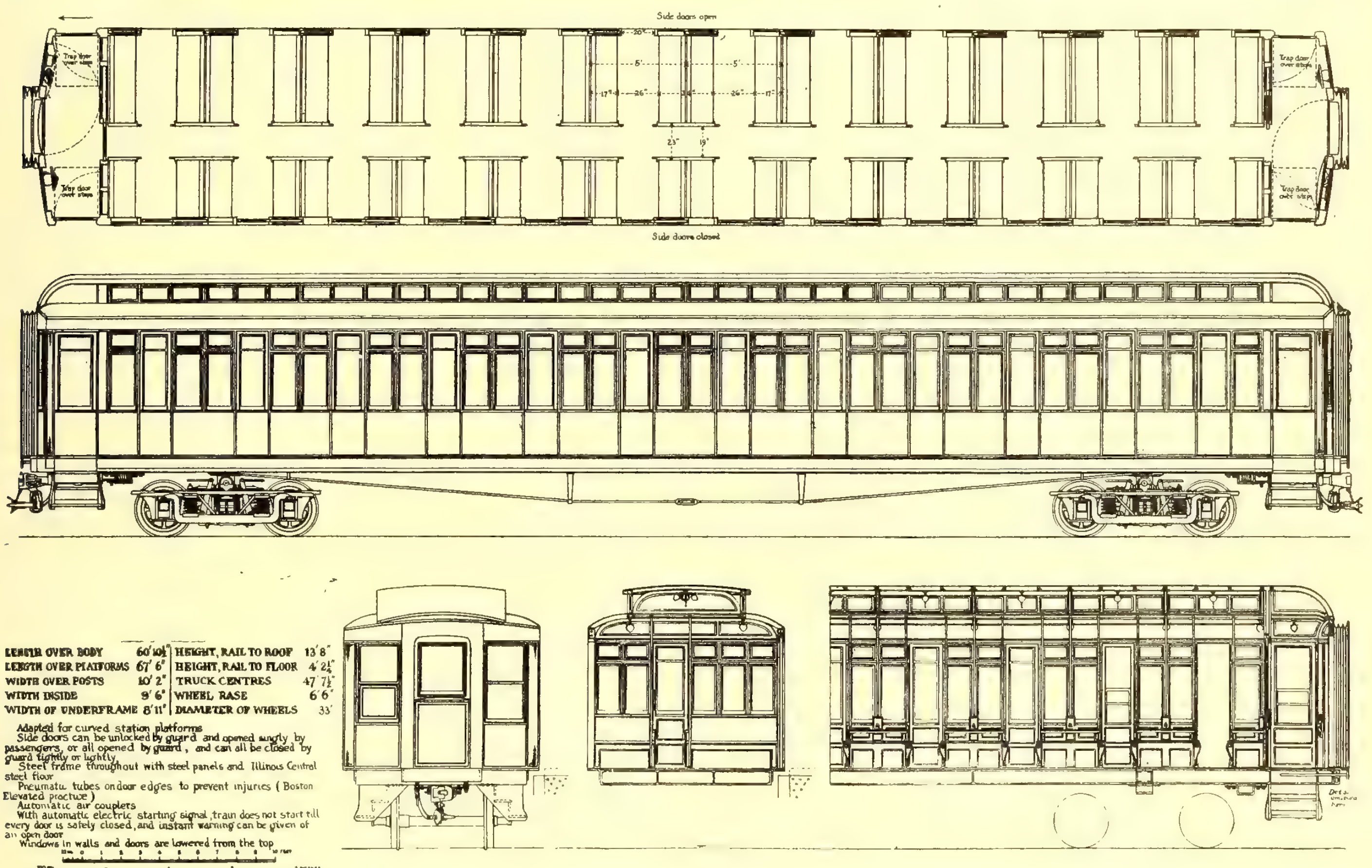
The operation of the middle Boston doors from the center of the car platforms does not appear as difficult as might be expected. This is partly because the guard, looking through the car, can see over the heads of people on the longitudinal seats, which thus keep an unobstructed space to the middle door. If necessary to look along the station platform, the guard, in leaning out, has his side-door valve placed to allow easy operation from any position. Of course, with the side-door car the guard is close to one side, has only to look in one direction, and can look along the car wall, inside and out, with greater ease; only, to see best, it might be well for guards to stand on some box, so as to look better over the heads of passengers within and without.

To the writer's own designs in the former article, he would now add these features: Besides making the doors in the end partitions sliding instead of swinging, it also seems best to regularly vestibule the cars, like the Illinois Central, so as to allow easy passing through the train, except perhaps when on the worst curves. While car construction in Europe has formerly been such as to allow only emergency passing between cars, and while recent Boston and Chicago cars embody a similar idea, vestibuling, of course, has great advantages in allowing passengers to spread out from crowded cars. It is not uncommon in Boston to see numerous seats in one or two cars of a train, and other cars too full for quick and economical operation. With the curves and grades of the Boston Subway, satisfactory vestibuling would at least be very difficult, and even then passing between cars would hardly be safe on some curves. But as trains grow longer, the need of vestibuling becomes greater, for late arriving passengers do not have time, nor others the inclination, to walk to the ends of the station platforms. To meet this difficulty the side-door car is again the best, for, with eight or nine doors to a car, passengers can quickly board, even if many are concentrated at the center of a train, and they can then walk through and find seats out of the way after the train has started. This suggests a well-known important principle which should have been considered in the previous article on car design, viz., that where people must do things in a hurry, the possibility of choosing between different ways of acting should be reduced to a minimum. The open car and the non-vestibuled European steam car illustrate this point best, as people delay, not only to look for the first available seat, but often to choose further between different locations. A vestibuled train encourages people to enter the nearest doors at once, but when passengers are inside, further care must be taken not to have a choice of direction too near the entrance, as otherwise there will be delay there and blocking others entering. Perhaps the "quarter-door" cars fail most in this respect; but a side aisle next the doors, as previously

pointed out, might, with very heavy traffic, also be a cause of delay from passengers passing back and forth directly in front of the doors to find seats, a difficulty not so likely with a center aisle further into the car. With end entrances only there need be no choice of doors, of course, if a train is vestibuled, but if no passing between cars is allowed, there is the tendency either to seriously overcrowd certain cars or else to hunt for the one with the most room. A regular direction of circulation through end-door cars is a great advantage, but some passengers, as in Boston, insist on going out the wrong way, continually upsetting the circulation, sometimes quite forcibly. While a middle door does have the disadvantage of causing delay from choosing which way to go in or out, its large increase of the entrance width must more than make up for this. But far from causing delay from choosing, the vestibuled side-door car with center aisle seems to offer the most advantages.

seat 75 passengers, this one 120, a gain in seats of 60 per cent for the same length of car. The writer is still in doubt as to whether this plan of car and arrangement of seats is the best for a moderate amount of suburban business, but will not discuss the question again, referring for the pros and cons to the JOURNAL for April 1, 1905, pages 385-386. But this type of side-door car does offer the greatest economies in the way of compact seating arrangement, reducing the cost of rolling stock needed and wages, the latter being further reduced somewhat by the possibility of short stops. A five-car train would have as many seats as eight ordinary steam cars.

The new car is, of course, vestibuled, having George Gibbs' ingenious door for closing off the front and rear platforms and enclosing apparatus elsewhere. The platforms differ from ordinary wide vestibule practice in having the swinging doors shorter than usual, so as to allow their opening without lift-



VESTIBULED CAR SUGGESTED AS SUITABLE FOR SUBURBAN SERVICE ON AN ELECTRIFIED RAILROAD; TOTAL SEATING CAPACITY, 120

To review again the advantages of this type there is but one door valve or other operating device for a guard to handle in place of two or more with other types. The guard has to look in but one direction and is situated at the side of the car where he can see best along station platforms. Passengers are not concentrated at two or more points to enter or leave cars, but are spread along at eight or nine points. This last raises the question, when it comes to cutting off a stream of people, which is easier, to shove a door through a mass of people crowding in at two points, or to shut doors slowly at a number of points where there is no such concentration? With the side-door type there is plenty of time to shut the doors slowly and carefully, and to empty station platforms more quickly and easily than with other cars.

To illustrate the writer's latest ideas as to a side-door car, the accompanying illustration is given, representing not an elevated or subway car, but a suburban car suitable for electrified steam railroad service, following some of the dimensions of the lastest cars of a well-known railroad. The original cars

ing the trap doors, which makes it possible to enter at the car ends, either by the steps from a low station platform or upon the trap doors at a high platform, an advantage when rain or snow would blow too much into the side doors. As in a previous design, the steel posts are carried on an 8-in. angle fastened to the 9-in. channels of the underframe, for the purpose of allowing the station platform, when on curve, to project under the car floor in places and so fill up gaps elsewhere. The end of the car may be criticised for its heavy appearance, but the position of the apparatus and the avoiding of a transom in the motorman's window will explain any unattractiveness. The side elevation has been criticised in two respects—first, that the window sills were too low, but in this the original steam road height of 28 ins. has merely been kept, and secondly, that the doors were not made distinct enough, which last could be remedied by breaking the horizontal lines at the doors and painting panels on the bottom of the latter. The writer purposely tried to give the car side a somewhat unbroken appearance, thinking thus to please the steam railroad man, but the

doors can easily be emphasized more if considered desirable.

Should toilet rooms be omitted on suburban cars? They seem to have been on the Illinois Central, and are on all the English electrified lines. The original standard car, followed here, had two toilet rooms, but they do seem unnecessary with fast and frequent suburban service. Baggage racks have also been omitted, but could be easily placed over the seats between the two center grab posts and the car walls, as in the Paris-Metropolitan, the St. Gotthard and other European cars. To prevent water from dripping over the side doors, European arrangements might be used.

The side doors would, of course, be operated by guards from the end platforms, either by air or mechanically, as desired. To look along the station platform the guard could open his door or lower the window in it. There he could stand in full

DERRICK WAGON OF THE UNITED RAILWAYS, ST. LOUIS, USED FOR PULLING OUT TROLLEY POLES

view of the station as the train pulls out, in the best possible position to see any accident. For the door mechanism, the writer would try to add to Mr. Sullivan's ingenious features certain others, which would make it possible either to simply unlock all doors at a station, leaving passengers to open any themselves, or to open all the doors at once, this last being a thing not attempted on the Illinois Central cars, and yet quite important for terminals or other large stations. The doors could all be closed at once, but there might be two ways of keeping them closed—first, rigidly, as needed on the outside of the train; secondly, lightly, so that each door might be opened slightly to release any one caught, without any too great effort and without disturbing other doors. The mechanism for effecting these different operations does not seem too complicated and may be illustrated later. While the Boston Elevated door details seem to reduce to a minimum all dangers at entrances, it might be useful some time if a red emergency cord were run along outside the car just over the doors, as found on some English trains, only opening an air-brake valve directly. For door handles the Illinois Central idea seems the best, viz., hand holes with a piece of glass set in the center of the thickness of the door. This leaves no projection, and at night the inside light shining through the little glass pane shows outside passengers where the hole is. The few passengers who wish to stand on steam lines can stand out of the way in the vestibules, where they do not block the entrances, a great advantage of this side-door type.

DERRICK WAGON EQUIPMENT FOR PULLING UP IRON POLES IN ST. LOUIS

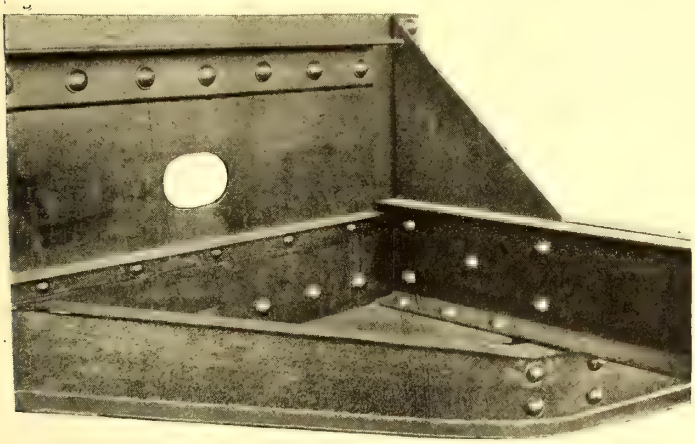
The United Railways Company, of St. Louis, has occasion to move overhead lines and tracks from several streets where they are no longer needed, the necessity for these lines having disappeared upon the consolidation of the St. Louis lines. For pulling up iron poles the derrick wagon illustrated is used, which is capable of pulling up these poles without delay, even where set in concrete. The main mast of the derrick is the lower 16 ft. of a steel pole, which, before it was cut, weighed 900 lbs., and was 30 ft. long. This mast is supported by a jack screw placed under its base and by braces of 1-in. x 4¾-in. bar steel. To prevent the mast bending, a truss of 1¼-in. round iron with a turn-buckle is placed on the side opposite the pole to be lifted. Additional bracing is afforded by a block and tackle passing to the front end of the wagon. Of course, the supporting of the weight on the wheels while the derrick is at work is out of the question. The wagon bed is of such a height as to come just above the curb. It is then possible to quickly block up under the end of the wagon bed so that it rests solidly on the ground. The wagon bed has three longitudinal sills, each consisting of a 3-in. x 4-in. timber, reinforced on each side by a ½-in. x 3-in. bar of steel. The block and tackle which does the lifting is operated from a winding drum, which can be turned either by hand or by a 15-hp

DERRICK WAGON IN ACTION, SHOWING ALSO CHAIN AND TACKLE AND THE USE OF CROWBARS TO LOOSEN THE CONCRETE AROUND THE POLE

Sprague motor. The use of the latter is only possible, of course, where there is a supply of current. To loosen the concrete around the pole, crowbars are driven down alongside the pole, as shown in one of the illustrations. In spite of this, there is likely to be bulging of the ground around the pole when the pole is lifted. It is perhaps remarkable that the poles come up at all without bringing some of the concrete with them.

A NEW STEEL CAR FLOOR FRAMING

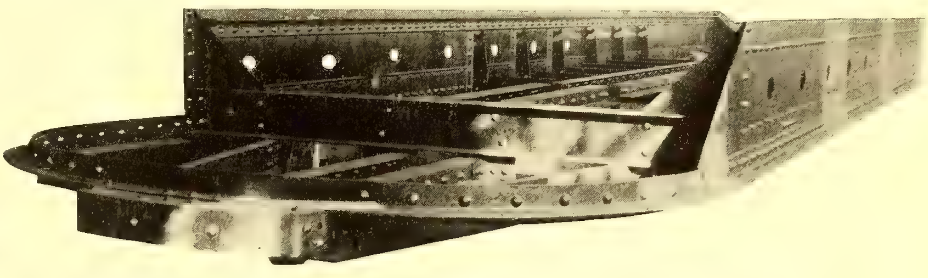
The Twin City Rapid Transit Company, of Minneapolis and St. Paul, will make several extensions to its lines during the coming season. One of these definitely decided upon will con-



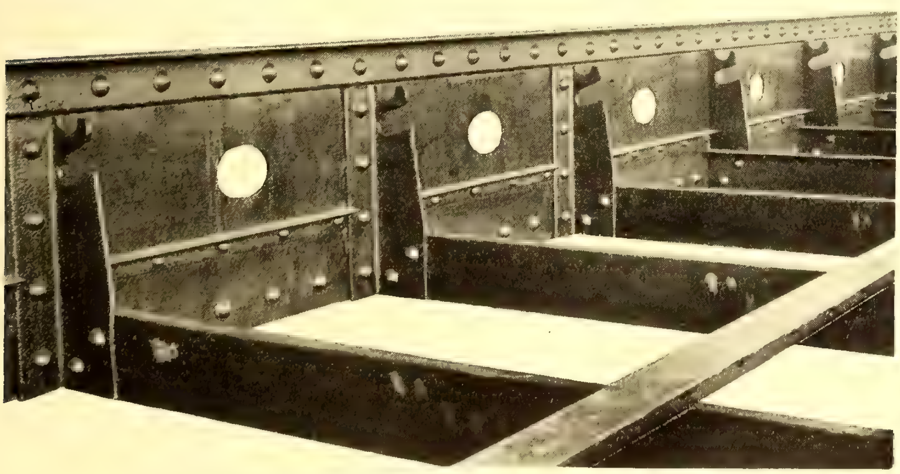
CONSTRUCTION AT THE CORNERS

nect Excelsior and Lake Minnetonka with Minneapolis. The extension will be about 20 miles long. Half of this will be covered by double track, which will be laid on the right of way of the old steam road known as the Minneapolis, Lindale & Minnetonka Railway. Special cars, which will be equipped with four GE 73 motors, are being built for the new line.

The accompanying engravings show the steel bottom framing to be used in their construction. These frames, which were constructed by the American Bridge Company, present many novel features. The side truss or web forms the interior finish of the car, the windows sliding down between the web and the outer sheathing, which will be secured to wood fillers. This arrangement permits the arm rest of the windows to be placed 6 ins. or 7 ins. lower than usual, as the window, when down, drops as low as the bottom of the side sill of a car of the usual construction. The angle iron, riveted on the inner side of the web, serves as a foot rest. Side brackets of steel, which are plainly shown in the illustrations, support the heater pipes. The rigid construction at the corners is well illustrated in the reproductions. Hand holes in the vertical web permit cleaning of the window pockets. Cast-steel bolsters will be used. The remaining portion of the car will be of the usual wood construction.



STEEL UNDER-FRAMING OF CAR FOR THE TWIN CITY RAPID TRANSIT COMPANY



BRACKETS FOR THE SUPPORT OF THE HEATER PIPES

LEAKAGE FROM WOODEN POLES CARRYING HIGH-TENSION WIRES

A recent issue of "Electrotechnische Zeitschrift" publishes the results of a series of tests conducted by the Kristiana Elektricitetsvaerk of Norway in 1903 to determine the leakage from high-tension circuits on wooden poles. A metal band was placed at heights of 1, 2 and 3 meters around a pole carrying a 7000-volt circuit. The differences in voltage between the band and the earth, and the current flow in milliamperes in the pole were determined. The tests indicated that it was highly improbable, though not impossible, for a pole under these conditions to carry a dangerous current. A remedy was suggested of wrapping lightly a metal band around the pole, about 6 ft. above the ground, and it was stated that the protection has been prescribed by law in Norway for about two years.

THE LAKE SHORE & MICHIGAN SOUTHERN RAILWAY EXPERIMENTING WITH GASOLINE CARS

The Lake Shore & Michigan Southern Railway, at its Collinwood shops near Cleveland, is making some experiments with a gasoline car designed by the General Electric Company. While this particular car is not designed exactly for passenger service, it indicates that there is much truth in the report that this well-known steam road is investigating the gasoline type of car with a view to determining its possibilities for interurban service. The car now used was designed for service in the yards for transferring the train crews who handle the distribution of freight cars in the yards at Collinwood. It is fitted with a vertical four-cylinder gasoline engine, which is direct-connected to a G.E. generator supplying current to motors driving the car axles. The car seats about twenty-five men, and it is said to save four or five minutes on each shift, as compared with the locomotive and car heretofore used in this service.

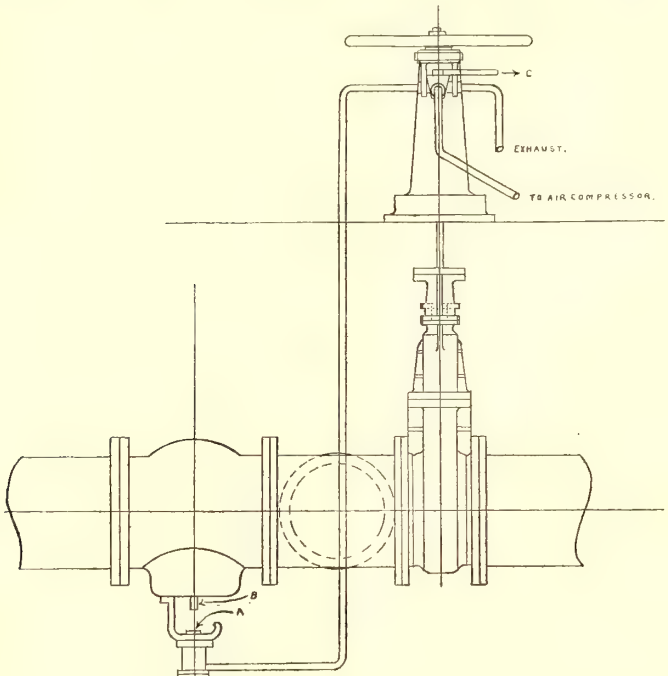
The Jamestown, Chautauqua Lake & Lake Erie Railway, a small steam line which is closely affiliated with the Lake Shore & Michigan Southern, has for some months been making experiments with a gasoline car for interurban passenger service. It is understood that the company is so well pleased with the results that it will build four or six cars and use them with an hourly headway between Jamestown and Westfield, N. Y. The cars will be 46 ft. long and will seat 60 passengers. They will be fitted with eight-cylinder gasoline engines with no electrical equipment.

It is estimated that on Sunday, June 18, the Brooklyn Rapid Transit Company carried a total of 1,780,000 passengers. Of these 1,480,000 were cash fares and 300,000 transfers.

ATMOSPHERIC VALVE

BY JOHN TREGONING

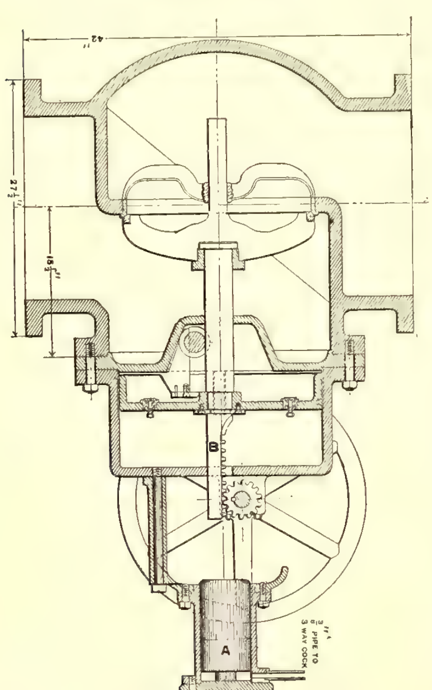
A simple and practical device for closing an atmospheric valve is shown in the accompanying drawing, and was designed by the writer for the 20-in. exhaust leading to the condenser at the power house of the Hartford Street Railway Company.



SKETCH SHOWING OUTLINE OF ATMOSPHERIC VALVE

It has been in operation for two and one-half years and has never been removed from its present position for any cause whatever since it was installed.

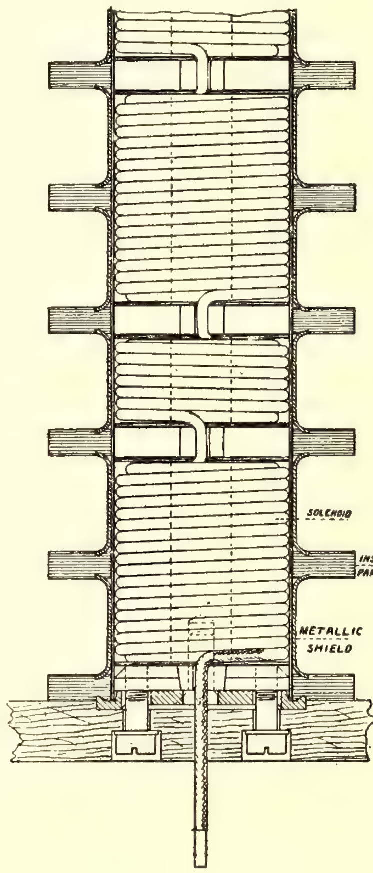
The device is composed of a cylinder mounted on a tripod, which is bolted to the under side of the valve chamber, and is fitted with a solid plunger, as shown. When the valve is open the valve stem rests on the plunger *A*. To the upper end of the floor stand, under the hand wheel, is a three-way cock that controls the pressure that raises the plunger and closes the valve. When the engineer is ready to put the engine on the condenser, he opens the gate valve with the hand wheel, and at the same time he closes the atmospheric valve by opening the three-way cock with the handle *C*, by which the valve is under perfect control. At the proper moment the valve closes with the familiar "thud," and by relieving the pressure in the cylinder the plunger drops to the bottom of the cylinder, ready for the next trip.



CROSS-SECTION OF VALVE

IMPROVED DIRECT-CURRENT CONTROLLERS

In addition to other improvements, Dick, Kerr & Company, Ltd., of London, have embodied in their controller a metallic shield blow-out of the solenoid type. The old series parallel controller with the ordinary magnetic blow-out required the poles of the electro-magnet to be superimposed above the points where the contact was broken, the effect depending upon one electro-magnet. In the original solenoid type developed by this company, the most obvious improvement over the magnetic blow-out was that the contact fingers and cylinder segments were not covered by the pole pieces, but left entirely open for inspection. Aside from this feature its main advantage was that the effectiveness of the solenoid increased in direct proportion to the current, whereas the old magnetic blow-out type could not have its blow-out effect increased above the saturation point of the magnet. Another important advantage of the solenoid blow-out was that the solenoid was never in circuit except at the moment of the formation of the arc, whereas the coils of the ordinary magnetic blow-out were of necessity kept in circuit all the time, otherwise their function would have been entirely destroyed, because the magnets and pole pieces could not have been magnetized quickly enough to blow out the arc before it had burnt the contacts.



SECTION OF SOLENOID

Though the solenoid form of blow-out in principle possesses notable advantages over other types, it has passed through various evolutionary stages, each development having been the result of careful observation made under widely varying conditions. The chief improvement arises in the method of protecting the solenoid. The vulcabeston envelope was fairly satisfactory, but it was liable to be injured by the arc, and the next step was to place the solenoid in a metallic shield (Fig. 1); this in fact now forms the main feature of this controller.

The coil is placed in a casing of copper or other non-magnetic material, and it can be then brought directly into the sweep of the arc. The external magnetic field created round the shield of non-magnetic metal, attracts the arc to the shield and divides it in two, one arc going from the contact finger to the shield and the other from the shield to the contact segment. These two arcs travel rapidly in opposite directions on the copper shield, and finally become united again in the air, but around the coil and shield; the arc at this stage has become attenuated to such an extent as to rupture, and may be in fact ruptured long before it has actually encircled the blow-out device. As shown in the upper left hand diagram of Fig. 2, the arc has just started between the electrodes and a deflection of the arc towards the shield is visible. Then the arc strikes the shield and commences to encircle the section;

the first of the two lower views shows the shield partially enclosed, and the second that the arc has united in the air and has left the shield. Generally speaking, the arc is literally swept over the shield with great rapidity and does not affect the metal in the slightest degree. It is interesting to note the tendency of the arc to travel on the center of the copper shield, and this is of great advantage, as the insulating partitions are not subject to injury.

That the copper ring suffers to no extent from the discharge may be gathered from the fact that on examination after two years continual use no material depreciation could be detected either on the metal ring or on the partitions. It is stated that of some two thousand controllers put in operation since the introduction of this type, not one blow-out has failed either on the metallic shield or insulating partition. The blow-out is hinged on the pivots and can be swung back and lifted out for inspection and cleaning. In swinging it back, the trolley connection is broken and therefore the current can be applied only when the blow-out is closed. This arrangement renders the controller foolproof so far as mishandling is concerned. The winding of the blow-out is in one continuous wire without any joints whatever and the metallic shields as well as the insulating partitions are simply strung on the blow-out, and are therefore easy to remove and assemble. It has been demonstrated on an ordinary service controller, that 60 amperes or more on an inductive load may be broken time after time by slowly separating the finger and contact by barely 1-16 of an inch without the slightest trouble.

The notching gear is made as clear and positive as is possible and consistent with absolute freedom of motion, but even if an inexperienced motorman failed to keep good contact between barrel and finger, it would be impossible for an arc to be maintained in the controller.

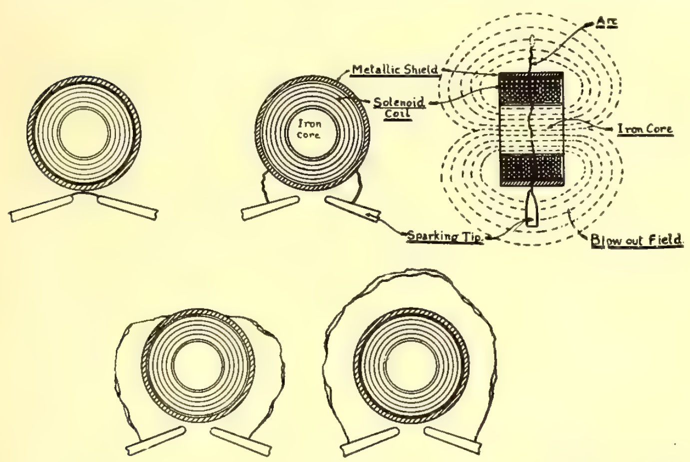


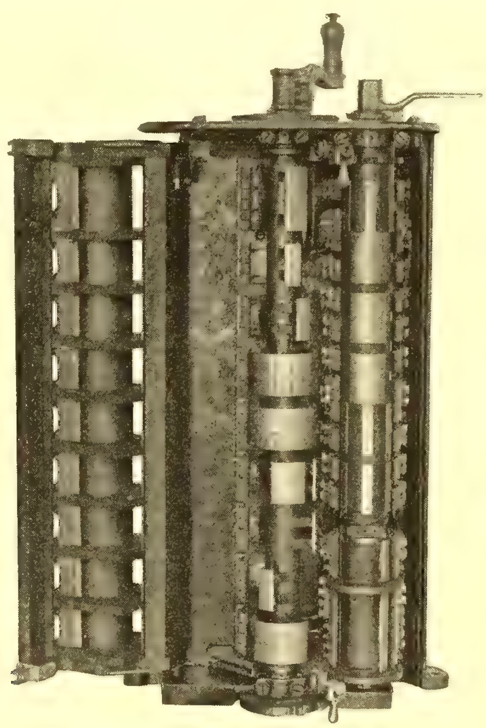
FIG. 2.—DIAGRAM INDICATING THE PRINCIPLE OF THE METALLIC SHIELD MAGNETIC BLOW-OUT DEVICE

There are other features of the controller to which attention should be drawn, one of the most important being in its application to the electrical rheostatic brake. It is, however, necessary to provide a sufficient number of notches on the brake side of the controller to regulate the braking effect in a satisfactory manner, while there must be a proper gradation of power notches to give smooth acceleration.

In most types of controllers it has been usual to divide the space on the top of the controller into the requisite number of power and brake notches with adequate spacing between the "off" position and the first power and first brake notches. The total number of notches on brake controllers varies approximately from 11 to 14, which means that in order to get the requisite length of break between finger and contact it is necessary in many types to increase the size and weight of the controller. This is avoided in the Dick-Kerr controller, by an ingenious arrangement of the connections of the resistances which allows the brake notches to coincide with certain of the power notches, and in consequence reduces the total number of actual notches, though retaining the original number of functions.

The controllers under notice are provided with from seven to nine power and five braking notches, variations being arranged for special purposes. If the controlling handle is swung from the "off" position clock-wise the power circuit is in operation on the notches which are common to both power and brake sides, whilst if the controller handle be brought from the "off" position counter clock-wise to the common notches the brake is in operation. Locking steps are provided to prevent overrunning either the last power or the last brake notch, and to make a transition from the brake to power side, or vice versa, it is necessary to bring the controlling handle through the "off" position, ensuring perfect safety.

Another novel feature is the connection of the motors into generators for the brake action without reversing any motor leads or even disturbing any contacts of the motor leads by throwing the motors in the parallel notches of the power cylinder, and inserting a bridge or equalizer across the two motors between their respective armatures and fields, the motors being arranged so that one armature will lead the field in one motor while the field will lead the armature in the other. This will not only bring the motors into brake action, but will also equalize them. This operation requires only two additional contacts, which simplifies the apparatus considering that ten contacts would otherwise have to come into operation. The regulation is accomplished by inserting or withdrawing the resistance in the bridge of the equalizer.



CONTROLLER WITH METALLIC SHIELD BLOW-OUT

The D. B. 1, form C and D, types of controllers are almost identical with the exception of such structural changes rendered necessary in the case of the latter, which is designed for use on systems where an insulated return is employed, such as open conduit and double trolley construction. These latter controllers have been furnished for the London County Council representing conduit construction, and Tokyo Street Tramways representing double trolley construction. The necessity of adopting some means by which it is impossible for a car to run backwards down hill is met with in controller D. B. 1, form E, which is provided with additional contacts. The movement of the handle to the "off" position short circuits the

motors, in consequence of which there could be only a slow reverse movement of the car. Q. B. 1, form A, is designed for quadruple equipments on tramcars, a number having been supplied in this country.

Controller Q. 4, form D, is designed for four 100-hp motors, and is also built on the metallic shield principle. A feature of this controller lies in the copper shields opposite each contact finger to prevent the arc from traveling on the segments. The idea is simply to let the shield, which consists of a piece of bent copper plate, press lightly on each segment directly in front of and in close proximity to each contact finger. The arc, instead of sweeping over the segment and carbonizing or blackening the lubrication, will travel on the shield and round the protected coil when ruptured.

The reversing cylinder has, besides the usual ahead and reverse positions, also positions for cutting out any pair of motors, the remaining pair being controlled in series and parallel by the power cylinder, as before. The principle of the controller has been successfully applied, even in cases demanding heavy currents—an instance of this is the Lancashire & Yorkshire Railway, where one of the most interesting features of the equipment is the method of control, which may be termed the direct multiple control system, in contradistinction to the multiple unit, the main difference in the systems being that in the case of the former it is possible to control the whole equipment of the train by means of two main cables. This method was described in detail on page 510 of the STREET RAILWAY JOURNAL for April 2, 1904.

The metallic shield blow-out has also been applied to controllers for crane, stationary motors, etc.

COMBINATION CARS FOR BUTTE, MONTANA

The Butte Electric Railway Company, of Butte, Montana, has purchased from the American Car Company two interesting combination open and closed cars mounted on double trucks.

Butte is known principally as a great mining center, although it is also the second city in the State in manufactures and is an important railway center. Its population is 30,500. It is the commercial center of a large district, and the traffic since the comparatively recent installation of the railway lines has rapidly increased, so the new cars are greatly needed. The attractive park, Columbia Gardens, is reached by the lines of the company.

Instead of the usual division of the compartments at the center of the car, the larger portion is given to the closed compartment, which has longitudinal seats. The seats in the open compartment extend across the car—two have reversible backs and two are at either side of the bulkhead. The car seats forty-four, besides affording large standing space. The sashes of the closed compartment and the vestibules are arranged to drop into pockets. The curtains of the upper part may be drawn to the floor, as the seat ends are of the Brill round-corner style. Guard rails, which slide behind grab-handles and

COMBINATION OPEN AND CLOSED CAR OPERATED BY THE BUTTE ELECTRIC RAILWAY COMPANY

are secured under the water boards by gravity catches, are provided for the open compartment. Cars of this type have acquired much popularity, and are usually run through the entire year. The open compartment is used by smokers in winter, thereby meeting a demand which all managers of city systems recognize. The use of the vestibule in addition to the bulkhead in the open part affords ample protection to passengers in stormy weather. The interiors are finished in ash, and the ceilings of both compartments are of three-ply birch-veneer, handsomely decorated. The seats of the closed compartment are of perforated veneer, covered with Wilton carpet. The seats in the open part are composed of ash slats.

VIEW SHOWING SEATING ARRANGEMENT IN CLOSED AND OPEN COMPARTMENTS OF BUTTE CAR

The cars are 18 ft. over the end panels and 36 ft. over the crown pieces. The platforms of the closed compartment ends are 4 ft. 6½ ins. The width over the sills, including the panels, is 7 ft. 7½ ins., and over the posts at the belt, 8 ft. 2 ins. The sweep of the posts is 3½ ins. The distance between the centers of the posts is 2 ft. 11 ins. and 2 ft. 7 ins. The side sills are 4¾ ins. x 7 ins., and the end sills are the same. The sill plates are 7 ins. x ⅝ in. The thickness of the corner posts is 3¾ ins. in the closed compartment and 3⅝ ins. in the open compartment. The thickness of the side posts is 1¾ ins. in the closed compartment and 2¾ ins. in the open compartment. The Brill No. 27-G trucks are used, having a 4-ft. wheel base and 30-in. wheels.

DISINFECTING CAR-WASHING COMPOUND

The ordinary car carrying from day to day large numbers of people of all sorts and conditions necessarily requires frequent cleansing to be kept in healthful condition. The objectionable feature of the soaps or other washes generally used is that the alkali in them eats away the paint and varnish work, and that they do not possess sufficient disinfecting power. For some years past a number of British railways have been using for a car-wash a disinfecting washing compound made by Robert Young & Company, of Glasgow, and known as "Sacarbolate." Owing to the good results achieved in England, the Frank S. De Ronde Company, of New York, recently undertook the introduction of this compound to American electric railways, and at the present time it is already in use on such important electric lines as the Chicago City Railway Company, the International Railway Company, of Buffalo, N. Y.; the Cleveland City Railway Company, the Utica & Mohawk Valley Railway Company, the Connecticut Railway and Lighting Company, and the Syracuse Rapid Transit Company.

Sacarbolate is a washing and disinfecting fluid soap, pos-

sessing all the qualities of a good washing soap, while it is also a disinfectant quite equal to the standard of the average disinfectant fluid and, unlike the latter, does not stain and ruin paint or varnish work; in fact, it is claimed that if sacarbolate is used as directed it will even improve the luster of the surfaces.

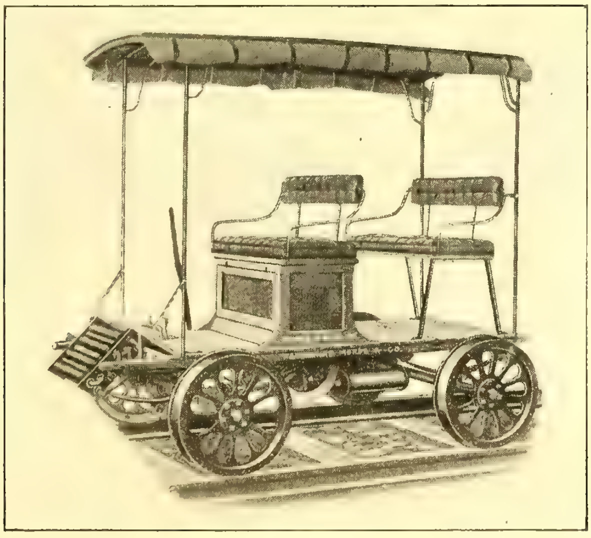
This fluid has been found to be practically non-poisonous and harmless to the skin. If the slight carbolic odor left after its use is objectionable, as in high-class passenger service, other compositions can be furnished of lesser disinfecting power, but more pleasant as deodorizers.

Sacarbolate is equally efficient in both outside and inside work. For outside use a combination of one-half pint and three gallons of tepid water is recommended, and for inside one-half pint of the fluid to one and one-half gallons of tepid water. The outsides should be thoroughly washed each month, and sponged daily on the lower parts. When the weather is wet the exteriors should be washed daily. The seats are kept in good condition by saturating them daily with a sponge saturated in sacarbolate, and floors should be sprinkled daily after brushing. Weekly treatment is considered enough for the floors and the woodwork under the seats. The luster of the varnish and paint work is greatly benefited by being sponged down with cold water after the fluid has been used.

GASOLINE INSPECTION CAR

The Interurban Railway Company, of Des Moines, Ia., has placed in service the gasoline inspection car shown in the accompanying illustration. This car, which is of the automobile type, is the product of the Fairbanks-Morse Company, of Chicago. Exact figures as to cost of maintenance are not yet available, but it is stated that a gallon of gasoline on the car is good for 30 miles.

The power is supplied by a single-cylinder, four-cycle type, improved automobile gasoline engine of 6-hp, having a water-

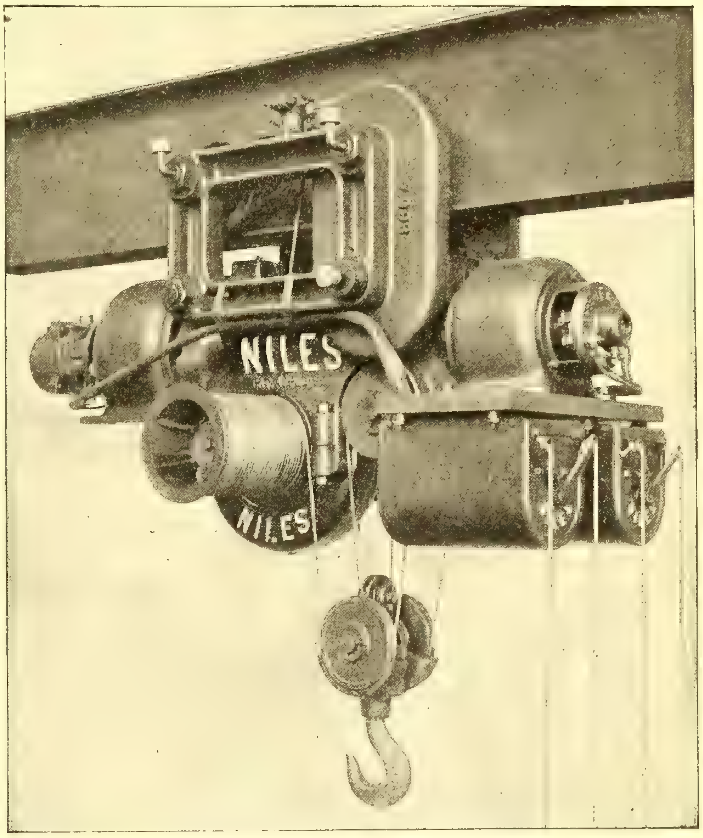


THE INTERURBAN RAILWAY COMPANY'S GASOLINE INSPECTION CAR

cooled cylinder and the force-feed type of lubrication. The transmission is of the planetary type, liberally constructed, enclosed in oil-tight case. The axles are of nickel-steel, enclosed in steel tubing and equipped with roller bearings. The frame is of steel, mounted on springs, and the seats are nicely upholstered. There is a wide range of speed, which allows car to be run at any desired speed from 2 or 3 miles up to maximum speed of 30 miles per hour, with 10 miles an hour on the reverse. All parts are easily accessible and everything about the car is strong and substantial. The weight is 950 lbs.

A NEW ELECTRIC TRAVELING HOIST AND SMALL CAPACITY CRANE FOR ELECTRIC RAILWAY SHOP SERVICE

Now that electric traveling hoists have passed the experimental stage and their use is extending so rapidly, greater care has been given in their design to the question of durability. The new Niles electric traveling hoist is made for hard, continuous service, and as may be seen in the accompanying illustration the hoist is of compact design and is self-contained in one heavy cast-iron frame to which the motors are attached end on. The power is transmitted directly from the armature shaft to the drum shaft through one train of worm and worm-wheel gears. The traversing mechanism is also driven through



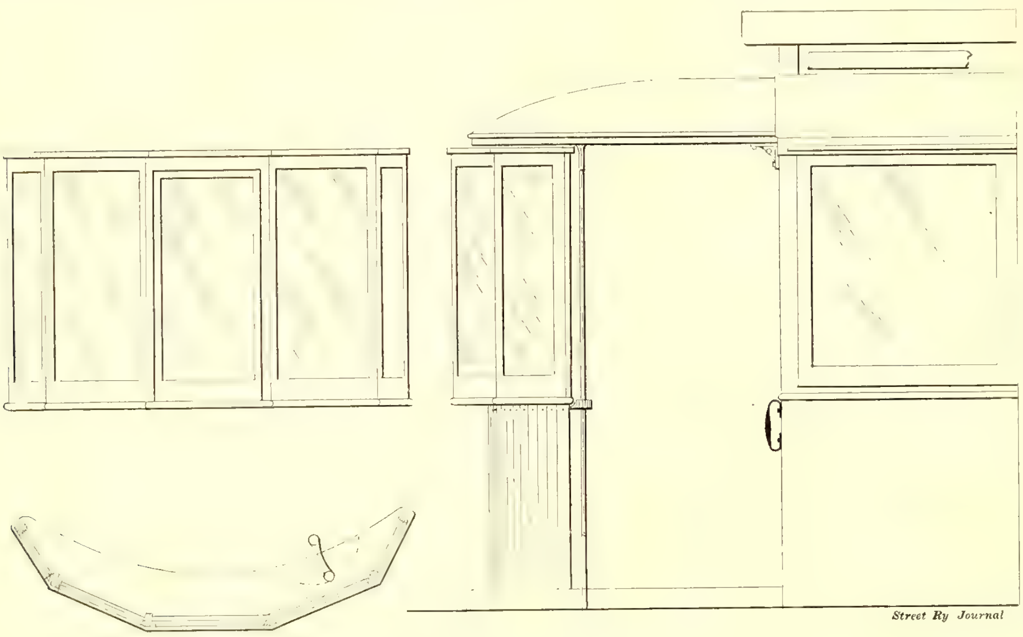
TYPE OF ELECTRIC TRAVELING HOIST, BUILT IN CAPACITIES UP TO 6 TONS

one train of worm and worm-wheel gears, similar to the hoisting mechanism, except that, when the trolley is arranged to run on a single I-beam, a double set of transmission gears are used. All the mechanism is enclosed in oil and dust-proof casings, and is absolutely noiseless in operation. In addition to the braking effect obtained by the use of the worm and worm-wheel, a powerful electric brake is attached to the hoist motor.

These hoists when mounted on a traveling bridge may be used as small capacity cranes. When used as cranes, the hoists are arranged to run between the two I-beams or channels of the bridge, and the controllers for raising and lowering the hook and operating the traversing mechanism may be placed either on the hoist, on the bridge, and operated by cords from the floor, or in an operator's cage attached to the bridge. The hoists are built in capacities of ¾ to 6 tons, and are usually arranged to run on an I-beam track. They will run on straight and curved tracks, and are generally provided with a separate motor for traversing, but if desired, hand traverse may be furnished, or all the traversing mechanism may be omitted and the trolley moved along the track by pushing on the load. The increased service of the electric traverse, however, much more than compensates for the slight additional cost.

PORTABLE VESTIBULES FOR RAILWAY CARS

On many city and suburban electric railways the operating speeds are not high enough to require permanent vestibules, but as the colder months approach the necessity arises for providing some form of vestibule that can be conveniently applied at low cost. The accompanying illustration shows a popular type designed by J. P. Sjoberg & Company, of New York, who recently furnished over 600 vestibules to the Washington railway companies and nearly 300 to the Union Railway Company, of New York.



TWO VIEWS SHOWING THE CONSTRUCTION AND APPLICATION OF A PORTABLE VESTIBULE FOR RAILWAY SERVICE

These vestibules present a very neat appearance, and are made to combine lightness in weight and strength in construction. Each vestibule has six pillars and five lights. The center section has a sliding sash, which works on an overhead track, connected by swivel sheaves, so that it operates on any style and shape of vestibule. When open or closed it is held in position by a special sash-fast, which acts as a handle as well as a lock. Suitable guides are provided at the bottom, with a sash spring to keep the center sash from rattling when open or closed. The vestibules are fastened to the cars very easily by connecting the dash iron rails to the bonnet overhead. They are generally made to allow the controller handle to swing free and clear, but the brake staff must be moved back unless a ratchet brake handle is employed. Another type of portable vestibule made by this firm has three lights instead of five.

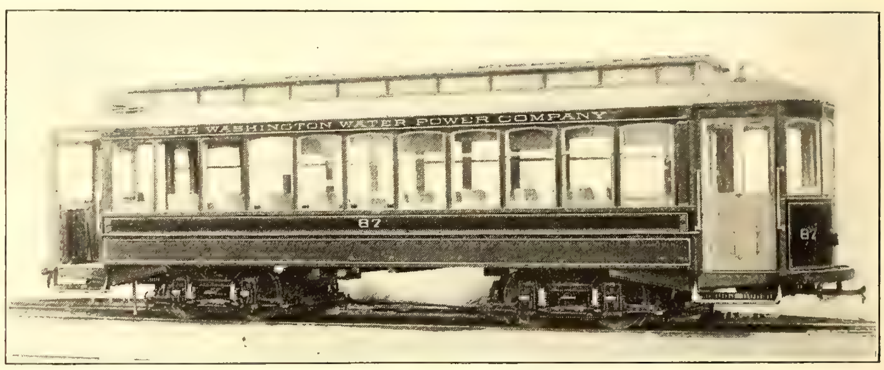
ONE OF THE NEW COMBINATION HIGH-SPEED, SEMI-CONVERTIBLE CARS BUILT FOR THE WASHINGTON WATER POWER COMPANY

Besides making portable vestibules adapted to any type of car, this firm is also a large manufacturer of stationary vestibules with folding doors, and all other kinds of car woodwork, whether for building or renewals.

SEMI-CONVERTIBLE CARS FOR HIGH-SPEED SERVICE

Thirteen large semi-convertible cars built for high-speed service have lately been delivered to the Washington Water Power Company, Spokane, Wash., by the J. G. Brill Company, three of the cars being divided into passenger, smoking and baggage compartments. The semi-convertible window system is thoroughly understood by the railway company, as the builder's full convertible type has been satisfactorily operated on the lines since 1898.

The combinations cars are 39 ft. 6 ins. over the end panels, and are seated for forty-four passengers. They are mounted on No. 27-E-1½ trucks with 75-hp motors. The seats are of spring cane, 38 ins. long, and aisles are 24 ins. wide. The passenger compartment is 22 ft. 6 ins. long, the smoking compartment 9 ft., and the baggage compartment 8 ft. On each side of the baggage compartment is a sliding door 3 ft. 6 ins. wide. Space is economized by having the forward end of the car solidly paneled. Decorated quartered oak constitutes the interior finish of the cars.



DOUBLE-VESTIBULE STRAIGHT PASSENGER CAR FOR THE WASHINGTON WATER POWER COMPANY

The passenger cars are 30 ft. 8 ins. over the end panels, and are seated for forty-four passengers. The seats are also of spring cane, being 36 ins. long, and the aisles are 26 ins. wide. The interior finish is of ash, with decorated birch ceilings. Armrests are provided on the window sills of both types. The builder's specialties used include "Dumpit" sand boxes, angle iron bumpers, "Dedenda" gongs, "Retriever" bells, etc.

The general dimensions of the combination cars are as follows: Length over the crown pieces and the vestibules, 44 ft. 6 ins., and from the panel over the crown piece and the vestibules, 5 ft.; the width over the posts at the belt is 8 ft. 8 ins; the side sills are 4 ins. x 8¾ ins., and the end sills are 5¼ ins. x 6⅞ ins.; the sill plates are 12 ins. x ⅜ in.; the thickness of

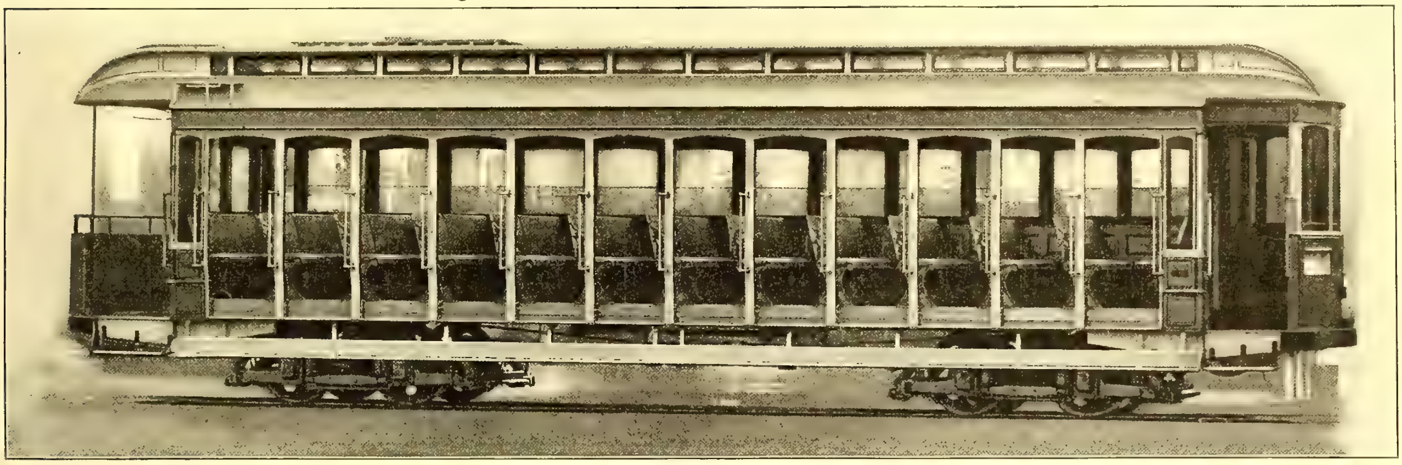
the corner posts is 3¾ ins., and of the side posts 3¼ ins. The passenger cars are 41 ins. over the crown pieces and vestibules, and the platforms are 5 ft. 2 ins. The width over the sills is 8 ft. 2½ ins., and over the posts at the belt, 8 ft. 6 ins. The sweep of the posts is 1¾ ins. The side sill size is 4 ins. x 7¾ ins., and the end sill size 5¼ ins. x 6⅞ ins. The sill plates are 12 ins. x ⅜ in. The thickness of the corner posts is 3¾ ins., and of the side posts 3¼ ins. The trucks are of the No. 27-F-1 type, with a 4-ft. wheel base and 33-in. wheels.

FIFTY CARS OF A NEW TYPE FOR CLEVELAND

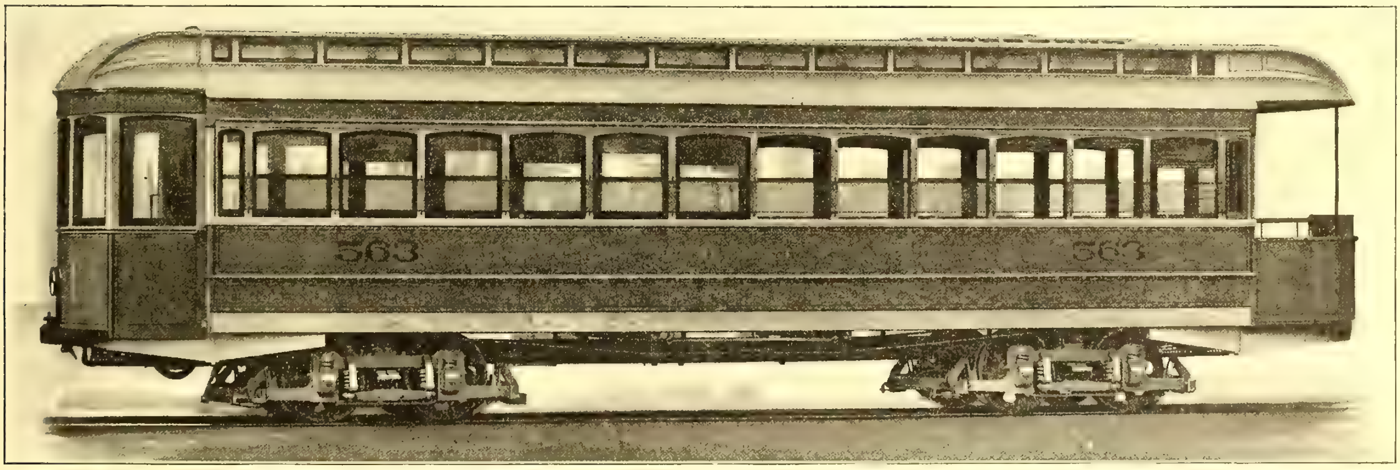
The G. C. Kuhlman Car Company, of Cleveland, Ohio, has recently completed an order for fifty cars for the Cleveland Electric Railway Company which are of an unusually interesting type. The railway system is laid out in such a manner as to enable the cars to run in one direction and thus have the entrances on one side only. This condition permits the use of a type of car which is convertible on the entrance side and has fixed panels on the opposite side. This arrangement of a car has the advantage of not requiring a running board on one side, thereby increasing the space between passing cars, a most valuable feature on lines which traverse narrow streets. It also prevents passengers from entering or leaving on the wrong side of the car, which many are prone to do when there is only a guard rail. The J. G. Brill Company's convertible system is used, and on the closed side the ordinary drop sash arrangement has been adopted. A type similar to this, but for trailer service, was built for this railway by the Brill Company a year ago, and after thoroughly demonstrating the value of having one side convertible, the present order was placed for fifty cars like that illustrated herewith.

An interesting feature of the new type is the unique seating plan, which consists of transverse seats on the convertible side and movable longitudinal seats on the other, probably the most practical of all the plans which were ever conceived to make an aisle car convertible to one with continuous transverse seats and still be self-contained. The longitudinal seats are arranged in sections of a length suitable to be brought around to a transverse position and connected with those on the opposite side to form continuous seats for five passengers each. The movable seats are simply lifted around when it is desirable to change the car from one type to the other, and are held rigidly in a transverse position by strong catches. The cricket legs and back supports of the movable seats correspond to those of the seats on the convertible side of the car.

The Brill No. 27-F truck, upon which the cars are mounted, is the standard type of the Cleveland lines and is a short-base double truck with equal size wheels. Like all other trucks of its class, it carries the car body too high to be used under open cars with a single step or running board at the side. Therefore, to adapt the style of car shown in the illustrations to this type of truck and make the same division of height from the track to the car floor at the side entrances as at the platforms, a double step is used which is a modification of the Narragansett type—an angle iron is used for the sill with the upper step on the outwardly extending lower flange. This arrangement prevents the upper step from projecting beyond the posts and keeps the width over all within the limits required in city service. The sliding panels and sashes of the convertible side are the regular style used with this well-known style of convertible car, and are stored in pockets in the side roofs when the car is opened by a simple arrangement of trunnions and runways. The sliding panels are brought down to



CONVERTIBLE SIDE OF THE NEW CAR FOR THE CLEVELAND ELECTRIC RAILWAY COMPANY



CLOSED SIDE OF THE NEW CAR FOR THE CLEVELAND ELECTRIC RAILWAY COMPANY

rest upon the steps of the angle iron sill when the car is closed, and the step openings in the car floor are covered by metal plates or covers which fold against the back of the steps when the car is opened. Trunnions at the corners of these covers move vertically in slats in the sides of the post brackets, and horizontal flanges on the brackets form a secure resting place for them when they cover the steps. The covered plates can be opened or closed from the outside of the car when the panels are raised, or from the inside when the panels are lowered.

The appropriateness of the semi-accelerator doors, which are used with this car, is apparent at a glance at the illustration of the interior. This arrangement brings the door close to the platform steps, so that persons standing on the platform are not likely to obstruct the passenger from step to door. It also enables the conductor to assist passengers to better advantage, as he will stand near the step instead of at the center of the platform. The motorman's cab, formed by a longitudinal partition at the center of the front platform, is an excellent feature, and made possible by the use of the semi-accelerator door. Another valuable feature, which will be seen in the illustration, is the backward-turned position of the grab-handles of the posts on the convertible side of the car. The handles are so placed that a passenger leaving the car will only see the one at the left, and, therefore, by using it is made to face toward the forward end of the car.

INTERIOR OF NEW CLEVELAND CAR, SHOWING LONGITUDINAL AND CROSS SEATS

The dimensions are as follows: Length over the end panels, 35 ft. 6 ins., and over the vestibules, 45 ft.; from the end panels over the vestibule (front end), 4 ft., and at rear end, 5 ft.; width over the sills, including the plates, 7 ft. 11¼ ins. The width over the posts at the belt is 8 ft. 2¾ ins. The height from the floor to the ceiling is 8 ft. 6¼ ins.; from the under side of the side sills over the trolley board is 9 ft. 6¼ ins., and from the track over the trolley board, 12 ft. The sweep of the posts is 1¾ ins., and the distance between the centers of the posts 2 ft. 9 ins. The thickness of the corner posts is 3⅝ ins., and of the side posts 2¾ ins. on the closed side and and 3⅜ ins. on the convertible side. The side sills are 4¾ ins. x 7¾ ins. on the closed side, and 2½ ins. x 7¾ ins. on the convertible side. The end sills are 4¾ ins. x 7¾ ins. The sill plates on the closed side are 8 ins. x ⅝ in. on the sill angle iron; on the convertible side, 8 ins. x 6 ins. x ⅞ in. The length of the seats on the convertible side is 36 ins., and of the movable seats 53 ins. The width of the aisle is 33 ins. The weight of the car body is 21,664 lbs., and of the car and trucks, without the motors, 33,564 lbs.

A NEW MOVABLE HEADLIGHT

O. E. Mitchell, a Los Angeles Railway Company conductor, has invented a movable headlight which he hopes will be put into use on all of the cars of the various Huntington systems of the city. The light used is the same as those with which the cars are now equipped. By Mitchell's apparatus they are attached to the front cars that, by pressing a lever with his foot, the motorman can throw a shaft of light in any direction he chooses. One is now being used experimentally on a Glendale car. It is being tried upon this line because the route is exceptionally dark at night and has many curves.

A NEW ITALIAN SINGLE-PHASE RAILWAY

The French Westinghouse Company has recently secured the contract for the installation of the Westinghouse single-phase railway system on the Bergama, Valle Brembana Railway, Italy. This is the second single-phase railway contract secured by this company in that country, the first being the Rome-Civita-Castellana Railway. The length of the line is 30 kilometers, and it will be served by five 30-ton locomotives, equipped with four 75-hp single-phase motors, with multiple unit control, and pneumatically-operated bow trolleys. The gage of the track will be 1.44 m.

The power station is to be situated about 1 km. out of Valle Brembana, and will be equipped with three single-phase, 500-kw alternators, running at a speed of 500 r.p.m. There are to be no transforming substations, and the line will be fed at the above pressure direct from the power house.

NEW YORK STATE CONVENTION

As a result of the active efforts of the president and executive committee, the twenty-third annual convention of the Street Railway Association of the State of New York, held at Fort William Henry Hotel, Lake George, N. Y., on June 27 and 28, was in many respects the most successful in the history of the association. All the sessions were well attended, and the papers presented brought out much interesting and valuable discussion. The entertainment features were well planned and were thoroughly enjoyed and appreciated by all of the visitors. While the Fort William Henry Hotel was used by a large number of delegates, others made their headquarters at either The Worden or The Carpenter.

The exhibit feature was one of the best given in connection with any of the conventions of the association. The casino proved a most desirable exhibit place, and, thanks to the careful planning and energetic efforts of Messrs. Nostrand, Green, Evans and Ransom, the booths were all constructed and decorated and ready for the exhibitors the day before the meeting. The date of going to press with this issue precludes more extended reference to the meeting at this time, but a full report will be published next week.

QUESTION BOX OF THE AMERICAN RAILWAY MECHANICAL AND ELECTRICAL ASSOCIATION

The secretary of the American Railway Mechanical and Electrical Association has issued a list of forty-seven questions which will be discussed at the September convention. These queries have been received from different members of the association in response to the circular issued in February, and all members are requested to reply to at least six of those in which he is particularly interested. The plan is to incorporate the answers received, in the pamphlet containing the advance papers, which will be published and distributed at the earliest possible date. Answers are requested before July 10, and should be sent to the secretary, S. W. Mower, at 12 Woodward Avenue, Detroit.

QUESTION BOX

1. What is the best composition to use in setting an engine bed on its foundation?

2. What are the arguments for and against a solid spider in large generators?

3. What is the best kind and grade of carbon brush for a 550-volt d.c. generator, and what has been the experience with the various grades?

4. Which is the better form of brush holder for a generator; one in which the carbon is free to move up and down, necessitating the current passing the entire length of the brush and being taken from the tip; or a holder which firmly grips the brush, and is designed with elasticity enough to allow of the brush following the commutator?

5. Does a storage battery working in conjunction with a power house with moderately fluctuating loads show an ultimate economy?

6. What is a good cleaner for slate switchboards, where burned around the circuit breakers?

7. What economies are shown by buying coal on specification of high B. T. W. contracts?

8. Does the advantage obtained from the use of phono-electric trolley wire outweigh the disadvantage experienced on account of its reduced conductivity?

9. What style of "trolley ear" do you recommend? What are the points of advantage of the "clinch," "semi-clinch," soldered ear, etc.?

10. What is the most common cause of flash-overs on small, four-pole motors?

11. What is the best method of inspecting motors for low bearings?

12. How often should motors be overhauled; if on a mileage basis, how many miles?

13. What should be the composition of babbit metal for motor bearings?

14. Do you use felt wicking or waste packing with oil in your car journal boxes?

15. What should be the chemical composition of a good car oil?

16. What is an economical figure for lubrication (per mile) of a 20-ton car equipped with four 40-hp motors?

17. Is there a satisfactory oil cup for use on old-style motors with gravity grease cups?

18. How shall we do away with the breaking of motor leads where they leave the iron conduit recommended by the board of underwriters?

19. Do you consider it good practice to depend entirely upon car circuit breakers, or do you use a fuse box also?

20. What is the best composition for trolley wheels?

21. What can be done to increase the life and prevent the wearing out of trolley-wheel bearings?

22. How large a trolley wheel can be used to advantage on high-speed interurban lines?

23. What mileage should a trolley wheel run? How often can it be economically turned down?

24. What methods of trolley-wheel lubrication can be employed which will prevent oil from dropping on the car roofs?

25. What tension (in pounds) should a trolley wheel have against the wire?

26. How shall the interurban car of the future be designed, with or without platform; and where shall the entrance be, in the center or at the ends?

How shall they be operated, in trains or singly?

If in trains, shall all be equipped with motors, or will one be a motor car and the balance trailers?

27. On a city, suburban and interurban service, can cars weighing 26 tons complete, equipped with four 50-hp motors, maintain an average speed of 20 miles per hour, making a daily mileage of 300 miles without seriously impairing the electrical equipment?

28. Providing cars are fairly standardized and in fairly good shape, how many men per car should there be employed in shops and car houses on an electric street railway system operating, say, 400 to 1000 cars, in order to keep cars in first-class condition?

29. How can cars be given a thorough weekly washing, without injuring the varnish or causing the woodwork to rot?

Is it injurious to the varnish to wash a car with warm water in an unheated building?

30. In building new paint shops, what is the best form of painters' scaffold to provide for use at the sides of cars?

31. What is the best type of construction for car body hoists; shall they be operated below or above the car house floor?

32. Which is the more economical for the general lighting of shops and car houses, arc or incandescent lamps?

33. What is the best method of pit lighting?

34. What is the best system for heating car shops and pits?

35. Do automatic sprinkler equipments in car houses afford sufficient protection from spread of fire to pay for installation?

36. What difference between wheel and track gage do you use, and where measured on your wheels?

37. Which is the more economical arrangement for getting cars to and from car houses, transfer tables or turn outs?

38. Does high carbon rail for street railway work give better results than rail with less than 55 per cent of carbon?

39. What is the best method for the eradication of weeds along the roadbed?

40. What has been the experience of the members of the association as to the permanency of soldered copper rail bond?

41. What character of sand is best to use for sanding tracks? By what methods can it be dried? Which is most economical?

42. What is the best form of concrete beam construction as evidenced by actual experience?

43. Has experience shown that Portland cement concrete under the tracks in city streets has given results such as to warrant its use in preference to domestic concrete, when the cost of the latter was less than one-half?

44. What character of pavement next to street railway rails gives the best results?

45. Why, in a city where the streets are of ordinary width, cannot a pavement be laid abutting a "T" rail with equal facility and with ultimately as good results, as where some type of grooved or tram girder rail is used?

46. Does the treatment of ties, poles, fence posts, etc., with a preservative fluid sufficiently increase their life to warrant the expense?

What methods are pursued? What do they cost?

47. Has anyone seen an indicator for steam turbines?

Work is progressing rapidly on the new shops of the Oakland Traction Consolidated at Emeryville. It is expected that the first building will be completed within a month, although it will be late in the year before the whole plant will be in running order. When all the buildings are finished the company will have one of the most elaborate electric railway repair and construction plants in the United States. The new shops include a complete car-building plant, as the company, in planning its repair shops, determined to make the plant complete by adding enough buildings and machinery to permit of construction work as well. The buildings are constructed of heavy timber, with galvanized iron covering. With the completion of the plant the present repair shops at Piedmont, Elmhurst, Telegraph Ave., Emeryville and the pier will be abandoned.

The Long Island Railroad, part of whose lines is being equipped with electricity, will introduce an innovation in inspection service by putting in a line of telephone stations and installing two gasoline motor cars. The telephones will be 2000 ft. apart. The motor cars will be in constant service and immediate touch with headquarters by means of the telephones. They will carry crews of workmen and necessary tools and will make 30 miles an hour.

PAPERS READ AT THE LAKE GEORGE CONVENTION OF THE STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK, JUNE 27 AND 28

CONTRASTS BETWEEN COMPANY AND MUNICIPAL OWNERSHIP AND MANAGEMENT OF PUBLIC UTILITIES

BY H. W. BLAKE

Public utilities exist because of public demand. Their value to the public is proportionate to the service they render. They should be gaged by this standard alone. The extent of their adoption in any country or locality is the best evidence whether or not those who are responsible for furnishing them have done their duty to the public and met its requirements.

Where American street railway companies stand in this regard is demonstrated by the fact that the track mileage of street railways in the United States is greater than that of all the other countries in the world combined.

Fundamentally, the responsibility for the existence of public utilities is with the people themselves, through the governments which they have created or under which they live, for it is a well-defined legal theory that the power to grant rights and privileges for creating and conducting public utilities comes from the public as personified by State or municipality.

Four general plans, with many variations in their details, have been adopted the world over for the introduction and maintenance of public utilities.

(1)—Governmental or municipal ownership and operation.

(2)—Governmental or municipal ownership, with private operation.

(3)—Perpetual concessions of franchises to private companies or individuals.

(4)—Concessions to private companies or individuals, limited to a term of years, at the expiration of which the property is usually taken over by the government or municipality, sometimes on a favorable basis to the concessionaire, sometimes on a basis of virtual confiscation of the tangible property.

While, as stated, the power for authorizing public utilities rests with the State, unless the ultra socialistic theory of government and social existence is conceded and adopted, there should be a divisional line somewhere between the proper functions of government and what can be best accomplished by private enterprise. As to where this line should be drawn in a country depends greatly on the form and character of its government. But experience in all countries has demonstrated that the division that is most advantageous for the public is that between what our British friends designate as non-productive undertakings, i. e., those things which are essential to government and of universal public benefit, such as the maintenance of police, fire, street, health, charity and similar departments of public service, and reproductive undertakings, so-called, such as gas, electric lighting, telephone, street railways, etc.

Nevertheless, it must be conceded that if the latter class of enterprises are to be undertaken by the State or municipalities, comparatively better results can be obtained in countries like Great Britain, where politics play but a small part in municipal affairs, where there is permanency in public office and where practically every individual who is permitted to vote at municipal elections must be a local taxpayer, than would be the case under our political system. This difference would exist to a still greater extent in a comparison with Germany, where municipal officials who have demonstrated efficiency and ability in certain positions are promoted to more important ones of the same character in larger cities. Yet even in these countries municipal ownership and operation is by no means an unqualified success, enthusiastic theorists to the contrary.

Existing statistics will prove the truth of this statement and could the accounts of the public utilities owned by European municipalities be rearranged in accordance with the standard systems of accounting adopted by public utility companies in this country, the results from a comparison with what has been accomplished in this country would be disheartening to the advocates of municipal ownership and operation.

Present comparisons of results are generally made between those obtained by the best governed municipalities in the world and those of European companies whose spirit is less progressive, whose methods are more expensive and cumbersome than those of American companies, and whose development and progress has been seriously restricted by onerous and almost impossible franchise and similar conditions.

The American theory of government, up to the present at least, has been "that a people which is the least governed is the best governed," and under this theory America has progressed and prospered beyond all other nations. Where least success has been secured here is where our governments, National, State and municipal, have too closely approached or crossed the line of proper governmental functions. Illustrations of this are before us on every hand.

Fortunately, the American plan of treating with public utilities has generally been for the States directly, or through the municipalities to whom they have delegated such authority, to issue franchises to semi-public companies, authorizing them to conduct the development. True, these franchises are of widely different provisions and character; some crude and defective, others almost ideal; all are inharmonious in their provisions and in the sources from which they have originated. *Yet the work done under them stands unequalled in the world in what has been accomplished for the public good, both in the extent of development and service rendered.*

With all of this there is not an absolute incurable monopoly connected with any public utility company in the United States. American courts have held that exclusive franchises were against public policy and are consequently invalid. American State and municipal governments are to-day receiving from the public utilities as taxes and similar payments, a larger total than is similarly contributed by all of the public utilities of Europe, whether these are owned by municipalities or by companies.

In America, vested rights and expenditures of those who have pioneered the way on public utilities have been respected and paid for by the larger companies which have followed the pioneer work to the advantage of the public. Those, therefore, who have participated in the development of American public utilities, can justly be proud of what they have accomplished, yet no matter how excellent the record may be, there are always theorists and others who will claim that it could have been improved upon, and still others who desire to change and interfere with anything which has been successful in which they themselves have not participated; and these mislead others.

The great public, however, which, under our American system, is the State and municipality, is sincere and zealous for good government and the best results and generally gets what is the best to meet its conditions, but in ways which are almost incomprehensible to the European mind. It is rarely misled, when a full honest statement of facts on any great question is properly laid before it, but without such a presentation of truths, it will temporarily listen to, and be influenced by, whatever is submitted to it through sensational newspapers or by public utterances which may not be in accordance with the facts.

The effect of this last tendency is now apparent in that a serious wave of agitation, in favor of municipal ownership, so-called, is sweeping over the country, but the principle is un-American and contrary to our theories of government which have so far proved so successful.

What has been or can be accomplished in this direction under autocratic, bureaucratic or socialistic governments, is not the question in America unless we adopt one or the other of these forms of government. The question is, can or cannot municipal ownership and management be more successful under our present forms of State and municipal government, than the system which has operated so successfully in this country? So far, the education of the American people upon the subject of municipal ownership has principally been academic, theoretical, haphazard and unbusinesslike, generally conducted by those who have no practical familiarity with the subject.

Referring more especially to that public utility in which you play so prominent a part, and which you and your associates in our other States have conducted more successfully than has been done in any other country:

Are not you and they most competent to conduct the proper educational campaign on this great subject? Who knows so much concerning local transportation and the public requirements in connection therewith?

You are public servants as well as representatives of large private investments; that you have not been unmindful of your duty

as public servants is evidenced by all that you have accomplished for the public good. It is not exaggeration to state that a comparison of returns from American street railway investments with the public service rendered, demonstrates that the public interest has been the better cared for of the two.

But you are public servants to perhaps a greater extent than is included in simply well meeting local transportation requirements within your day and generation, for it is seemingly incumbent on you to see that this is well provided for in the future. To accomplish this, it is your duty to educate the public aright in connection with the present great agitation. Your motives may be misconstrued, although, as you are aware, looking at the situation in a purely selfish way, it might be better for your stockholders to let the municipalities acquire your properties if they wish to do so.

Few would dare to suggest that American street railway properties should be confiscated, and were it attempted to carry out such a suggestion, the Constitution of the United States remains to prevent it. So it is reasonable to suppose that if municipalization of American street railways should be accomplished, their present owners must first be fully compensated therefor. This done, the investors in your properties would have little to complain of in a financial way. The question consequently becomes entirely one of public policy as to whether or not a better and cheaper service would be rendered under such a system than now obtains; whether the policy of constantly extending facilities could and would be continued, and whether or not the financial burdens involved would be more equitably distributed than now; and above all else, whether there would not be introduced into our American political system a corrupting influence and power far greater than any encountered in past American history.

You practically stand in the position of public advisors with a grave responsibility on your shoulders, as you have demonstrated that you are the most successful local transportation experts of the world.

Much has been said on the question of municipal ownership abroad, where it has made its greatest progress, so we must naturally look there for all the important experience that is available thereon. Distance lends enchantment to the view, but how much is really known in this country, or in fact elsewhere, as to the actual results that have been secured?

In the United Kingdom, where the greatest experience has been had, two special Parliamentary commissions who have investigated the subject, and these commissions, as well as the Local Government Board, have apparently been unable to ascertain all the facts definitely. This is shown in their reports, which are lacking in recommendations other than that greater care should be exercised in the auditing of the accounts relating to municipal productive undertakings and that a more uniform system of accounting should be adopted.

While there is a superfluity of literature in existence on the subject, and while reports of municipally owned public utilities are available from Great Britain and elsewhere in Europe, this material is of little value in forming conclusions here, either as to the actual net results that have been accomplished from municipal ownership and management in Europe, or on the feasibility of introducing the system here to advantage. To permit of proper comparisons being made and correct conclusions reached, two most important things must be done:

(1)—The account of those European municipalities which have made the most favorable showing for their reproductive undertakings (so-called) should be rearranged by expert American accountants in accordance with standard American practice, to the end that definite comparisons may be made with results obtained in this country by public utility companies.

(2)—A definite setting forth of differences in conditions between Europe and America should be made, showing those of every name or nature which have either a direct or indirect bearing on public utility service, such as suffrage, tenure of office, municipal methods, density of population, rates of wages, character of population, its use of public utilities, service rendered, etc.

With this material available and properly presented, it would be easy for the American public to form opinions and act in accordance with the best interests.

If our present system of caring for public utilities is wrong, the sooner such a situation is realized the better; *if it is right*, every good citizen should be placed in a position to conscientiously uphold it. In demonstrating the truth, the responsibility for ascertaining and promulgating it may rest upon you and your kindred associations.

Returning to the definition given early in this paper, as to the general methods adopted throughout the world for the creation and maintenance of public utilities, certain facts should be stated which have seemingly been demonstrated by experience everywhere.

The best of service for the present cannot be had, unless the future is anticipated, so far as financial investments are concerned. These necessary investments cannot and will not be made unless there is a permanent franchise for the investor, or its equivalent in the form of an agreement to take his investment off his hands at a stipulated time, for its value. Franchises for public utilities which are limited as to time, without provision for the purchase of the property involved at its full value, always and naturally mean poor service in the later years of the existence of the franchise. These facts should be constantly borne in mind on considering British tramway conditions of the past and present, and in contrasting them with similar conditions here.

British tramway companies have, and have had, very limited franchises. Britain is a country where the theory of vested rights, and due compensation therefor, has been carried to the furthest degree on everything excepting tramways. A few years since British owners were awakened with a shock to a realization of the fact that, in addition to the severe restrictions under which they had labored, at the expiration of the franchises they were at the mercy of the respective municipalities where their properties were located in regard to their disposal, and that values which they had created were to be practically ignored. What but poor service and neglect of repairs and maintenance could result on a property whose franchise had nearly expired? At the expiration of the franchise the municipality slipped in, with the equivalent of an exclusive perpetual franchise, taking the existing property, or so much as it wished, at a nominal valuation; with its municipal credit available to raise capital so far as Parliament approved, with the results of a tax rate to make good deficiencies, with very few restrictions, and with the experience of America in electric traction, which had cost us here hundreds of millions of dollars to develop, as a guide in the construction of an up-to-date street railway system.

Under these conditions, it is not strange that municipal ownership and management of street railways in Great Britain is able to make a somewhat favorable showing as contrasted with company ownership and management there in the past. What American street railway management could not have accomplished wonders under like conditions?

While the municipalities of the United Kingdom enjoy exclusive perpetual franchises, and the other advantages recited for conducting a successful street railway business, with few exceptions they are prohibited from constructing lines beyond their municipal boundaries. In consequence, the essential is lacking for constructing systems radiating out through the surrounding districts, and thus affording the public the facilities and services which it requires and which would tend to redistribute the population, as has been done about every American city. With very few exceptions, the British municipalities have opposed the construction of suburban and interurban lines to connect with their municipal street railway systems, and in only two or three cases in the entire United Kingdom have trackage rights for such systems been granted over municipal lines, or have they been permitted to enter municipalities where the tramways were under municipal control.

Not only has the great essential to a most important public utility, *i. e.*, the best possible service, been prevented, but in the method of adjusting fares the fact has apparently been lost sight of that one of the greatest advantages which can arise to a community from its street railway system, is in encouraging its poorer classes to reside in its suburbs under more healthful conditions than is possible in crowded tenements within the city; because, while charging lower fares for shorter distances than the universal American fare, for greater distances the British rate is higher than in this country, and no transfers are given in Great Britain.

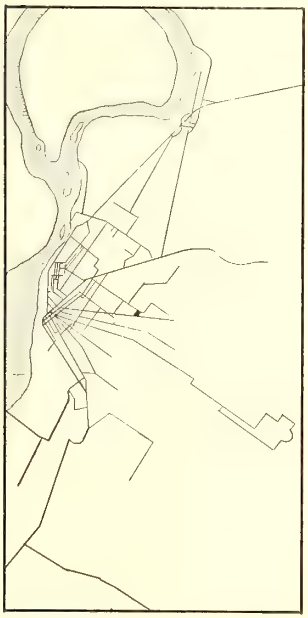
The accompanying maps, all of which have been reproduced to the same scale (8 miles to the inch), give a better idea than any figures of the small size of a number of the principal European systems as compared with those of American cities of the same population. The maps of the American cities do not represent, of course, the entire extent of the interurban lines, because in the case of Boston and Milwaukee the interurban connecting lines extend beyond the confines of the State, and in the case of Buffalo far beyond the limits of the map. They show, however, that the American policy of a 5-cent fare encourages the development of the suburbs, while the European policy of a zone system of fares congests the population into tenement districts. The population figures given under the several maps are those of the 1900 census for the American cities, and for 1901 in the case of the British cities.

So far as the British municipal tramways are concerned, it is safe to say that an American syndicate could be organized which would give each and all British municipalities a better service than they now have, providing the syndicate were simply permitted to enjoy the same franchise privileges, and this without calling for a dollar of public funds to accomplish such results. It would seem, there-

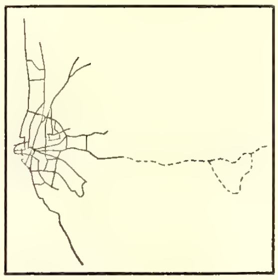
fore, as if the one argument in favor of municipal ownership of street railways would be the profit which the municipalities may derive from operation. Let us glance at what the results have so far been in this respect.

In 1904 there was invested in all the tramways, municipal and company, of the United Kingdom, practically $232,000,000, of which about $140,000,000 was the direct investment of the municipalities.

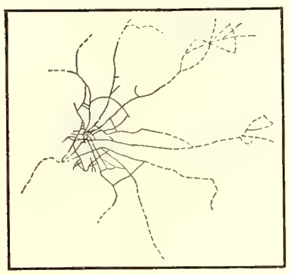
Upon the above investment practically $1,438,000 was directly paid as taxes by the municipalities and tramway companies. Of this presumably, however, about $790,000 was paid as national income tax, leaving the amount paid for municipal taxation about $538,000. To this should be added not over $150,000 paid as municipal taxes by the holders of tramway companies' securities; also $1,035,000 contributed to the respective public treasuries by municipal tramways as earnings.



Electric Railway System of Buffalo. (Pop. 352,387)



Electric Railway System of Liverpool. (Pop. 684,947)



Electric Railway System of Manchester. (Pop. 543 969)

So the total financial benefits which British municipalities derived as taxes from the operation of all street railways in Great Britain, and in which their funds to the amount of $140,000,000 were invested, was $1,723,000.

For the same fiscal year the street railways of the State of New York paid directly as State and municipal taxes $2,656,233.74. Considering that the individual holders of street railway securities issued in this State contributed as personal taxes thereon at the low rate of three-fourths of 1 per cent on the face value of their securities, they turned into our public treasuries $3,516,000. That is, the total financial benefits which the people of the State of New York have derived from street railway taxation for this year was $6,172,233, and this without the investment of a dollar of public fund in the properties.

Under the British system, on the 1st of July, 1904, there were in operation but 2900 miles of street railway track in the entire United Kingdom. At the same time in the United States there were in operation over 31,000 miles of track.

In Great Britain alone there were but 2529 miles for a population of over 37,000,000. In this Empire State, with a population of, say, 7,500,000, there were at the same time 3062 miles of track.

In Great Britain the average population per mile of track was approximately 14,630; in this State it was approximately 2375.

In Great Britain 183,352,706 car-miles were run and 1,712,424,198 passengers carried; in New York State 199,767,097 car-miles were run and 1,341,766,931 passengers carried. From this it is seen that the average passengers carried per car-mile were 9.34 in Great Britain, and in New York State 6.71. In this connection it should not be forgotten that the average American street car is 50 per cent longer and much heavier than the corresponding English car.

The above facts tell their own story as regards facilities and service afforded the public.

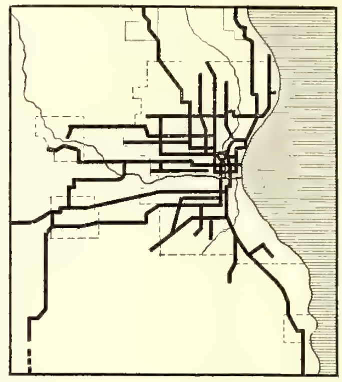
Now for a glimpse of results from operation, which may demonstrate the comparative ability shown by British street railway managers and those of the Empire State.

As is well known, the rates of salaries and wages paid on British municipal tramways is not over one-half those paid in this State.

In the fiscal year of 1904 the tramways in Great Britain earned from operation $40,690,000 in round figures; the operating expenses, excluding taxes, were approximately $25,510,000, leaving net earnings from operation $15,180,000; from which it will be seen that the percentage of operating expenses to gross earnings was 62.7.

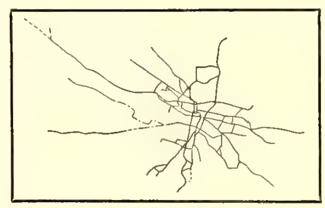
The street railways of New York earned from operation $51,964,744, and their operating expenses were $31,397,623, leaving net earnings from operation $20,567,122, such operating expenses being 60.42 per cent of gross earnings from operation.

In the operating expenses for the street railways of New York State are included $19,812,227 paid for salaries and wages. If the rates were the same here as those paid in Great Britain, and the present efficiency of employees maintained, it is clearly apparent that New York street railways could afford to give still greater facilities to the public than is now possible, or could pay much larger dividends.



Electric Railway System of Milwaukee. (Pop. 285,315)

Electric Railway System of Newcastle-on-Tyne. (Pop. 215,900)



Electric Railway System of Glasgow. (Pop. 735,906)

Electric Railway System of Boston. (Pop. 560,892)

Let us look at another most important feature of operating expenses:

The British tramways, in the fiscal year of 1904, paid less than $575,000 on account of accidents, or, say, a little above 2.26 per cent of their operating expenses. The street railways of New York for that year paid approximately $2,615,000 on account of their accidents, or, say, 8.32 per cent of their operating expenses.

It is to be regretted that statistics are not available which will show the average distance ridden by passengers in Great Britain and in this State, but it is safe to say that the average ride per passenger in New York State is more than twice as long as in Great Britain. Here the average fare paid per passenger for his longer ride is 3.83 cents; in Great Britain it is an average of 2.3 cents for the shorter ride.

In view of what has been stated as regards comparative rates of wages and accident accounts, it will be seen at a glance that the passenger in New York State is receiving greater value for the fare which he pays than does the passenger in Great Britain. This would only be possible under our superior American management, which is best demonstrated by some comparisons on the more important features of operating expense.

While fuel is cheap in Great Britain, and although light cars are used, the cost of tractive power, as it is officially designated there, averages over 3.3 cents per car-mile. In New York State, with much heavier cars and higher speeds, the expense averages about 2.42 cents.

This fact, of course, demonstrates that either greater engineering skill and business judgment have been displayed in constructing power stations here than in Great Britain, or that they are much more economically operated than in Great Britain, despite the lower rate of wages prevailing there.

For traffic expense, as it is termed there, or operation of cars, as it is designated by our railroad commissioners, the average expense in Great Britain is about 6.28 cents per car-mile. In this State this average expense is approximately 7.35 cents, or a difference against us of 1.7 cents; but as approximately 70 per cent of this particular expense in America is represented by wages, it is seen at a glance how much more efficiently American managers utilize their high-priced transportation labor.

It is obvious that on the recently reconstructed tramway lines of Great Britain present repairs and maintenance are less than they will be a few years hence, and it is to be questioned if this has been duly considered by their management.

The expenditures in 1904 for track line and car repairs and maintenance there were approximately $4,150,000, averaging $1,645 per mile of track and 2.26 cents per car-mile. In New York State the total expenditure for similar repairs and maintenance was $6,049,054, averaging $1,975 per mile of track and 3.03 cents per car-mile.

In all probability we have not yet reached our maximum expense for repairs and maintenance. Naturally Great Britain must go through this same experience, and as these expenses increase one of three things must happen in Great Britain: either fares must be increased, payments to sinking funds that have been created to pay indebtedness incurred for tramway development cannot be made, or the deficits paid out of public funds raised from taxation.

As to how serious the question of local indebtedness and consequent taxation is at present in the United Kingdom, it should be stated that the total local indebtedness at the present time is practically $1,800,000,000, an increase of about $1,000,000,000 in thirty years.

In England and Wales alone, from 1884 to 1900, the population had increased but approximately 18 per cent; taxable valuation had increased but 21 per cent; local indebtedness, however, had increased about 78 per cent, and the rate of local taxation had increased about 73 per cent. Over half the increase of local indebtedness has resulted from the embarkation of municipalities in what is there known as municipal trading, i. e., purchase and operation of public utilities and similar enterprises.

The present financial condition of certain British municipalities on such matters is seemingly not unlike that which existed two or three decades ago in the United States, where municipalities, counties and States pledged their credit to aid in the construction of railroads and other similar enterprises, which eventually resulted in financial disaster. It would not be strange if, in many instances, time would show a like final result in Great Britain.

Do we here in America wish to profit by our past experience, or return to one of the most unfortunate episodes in our local financial history through a little different channel? At the same time, do we wish also to add to the strength of local political machines by transforming independent, self-respecting American workingmen into an army of municipal employees, which must follow the dictation of some local boss? This should not come unless there be some great compensating advantage not yet apparent from European experience with municipal ownership and management of public utilities.

PUBLICITY

BY J. HARVEY WHITE,

Boston Elevated Railway Company

How to obtain fair treatment from the local press is a problem that puzzles a great many railway managers. A persistently hostile press not only exasperates and embarrasses, but tends to create an unfriendly public sentiment that might in an extreme case jeopardize the success and even threaten the existence of a company. Many street railway men seem to think that it is the deliberate policy of most, if not all, newspapers to attack and misrepresent all public service corporations. They treat and talk about a spirit of fairness on the part of the public press as the silly imaginings of an impractical and inexperienced theorist.

It is not in the nature of things that all newspaper stories and editorials, written in the rush of newspaper life and necessity, can ever be made as judiciously fair as court decisions or as accurate as mathematical calculations, but it does not follow that because there are some grounds for criticism, that either the inaccuracy or injustice necessarily springs from a desire on the part of publishers to either misrepresent or injure. On the contrary, newspaper men as a class are both fair-minded and honorable, and whoever holds a contrary opinion has either been peculiarly unfortunate in his experience or has been blinded in his observation.

Every street railway manager desires the good will of the newspapers toward his corporation and, ordinarily, it is not a difficult thing to obtain. The most effective means of securing it are persistent courtesy, good temper and frankness. The battle is more than half won if the newspapers understand that a company is ready at all times to supply them with any information that may be desired, unless there are serious reasons for not doing so. An occasional refusal of news, particularly if an explanation is made as to why the information is withheld, does not create ill will, but when reporters and city editors find themselves thwarted in every effort to obtain news, the result is quite certain to be that the columns of the papers will not furnish much reading matter that will delight the corporation management.

When the Boston Elevated Railway Company began operation in 1897, it was decided to assign to some person the special duty of looking after the needs of ten daily and forty odd weekly newspapers published in the territory in which the company operates. The writer of this article was selected for that purpose, and for the past seven years has devoted much of his time to dealing with newspapers and newspaper men. The experiment has proved sufficiently successful to warrant its continuance, and it is hoped and expected that as time goes on a larger measure of success will be brought about.

It would be pleasant to be able to state that nothing ever appears in the papers to which the company can find valid grounds for objecting, but the lamentable truth is that no such Utopian state has ever been brought about. This much, however, has been accomplished. The newspapers generally recognize that the management of the company is endeavoring conscientiously to please the public and to provide a good service, and, what is of more importance, they are willing to say so. Furthermore, the reporters and news editors, as a rule, make an honest effort to be perfectly just to the company in the presentation of news. The occasional misrepresentations usually spring not from malice, but either from inaccurate information from outside sources, or too great zeal to make a story interesting. In brief, it may be said that the policy of the company has contributed materially toward the creation of an atmosphere of good will between the press and the corporation, although it has not resulted in the entire elimination of newspaper comment to which objection can fairly be made.

The president of your association has seen fit to ask for a description of how the press department, if it can be dignified by the name of department, of the Boston Elevated Railway Company is conducted. It is all so simple, and the details follow so much as a matter of course, that it is a discouraging undertaking to attempt to find items of sufficient importance to justify an encroachment upon the time and attention of such a body as will assemble at your convention. But as the request has been made, and made under circumstances that precluded a refusal, the task will be essayed without apology or further justification.

The work of the press agent of this company differs from that of most men occupying corresponding positions in that there is practically no advertising to be handled. The only regular advertising, if it can be so termed, is the publication of time tables in the suburban papers. These are paid for in cash and not in transportation, as is customary with many companies. The company is-

sues no passes or other free transportation to anybody, except that during the summer months it places in the hands of certain charitable institutions and associations upwards of 50,000 free tickets to be distributed among the sick and children of the poor who cannot afford even a nickel for a fresh-air outing away from the tenement districts.

Practically the only other advertising is the occasional publication of statements or facts that the company wishes to place before the public. When it is desired to insure the publication in full in every edition of a paper, or when the company wishes to secure the publication of a certain matter at greater length than its strict news value calls for, then the company pays for the space that is required. Such occasions are, however, very rare and practically all of the work of the department is confined strictly to supplying news which the papers use in their own way.

Success in dealing with newspapers along the lines indicated requires some general understanding of the purposes, practices and ethics of the newspaper business. The aim of all publishers is to attract readers, for upon the number and character of the readers depends the value of the paper as an advertising medium, and upon the advertising receipts depends the prosperity of the paper. Most newspapers are ambitions for a larger circulation. This they aim to secure by meeting the demands of the public for news. Therefore, all newspapers try to print the news their readers desire, try to present it in an interesting way, and try to make their news columns reliable sources of information.

The recital of these elementary principles of newspaper practice and policy may appear unnecessary and not germane to the subject matter under discussion, but the writer considers an understanding of them of much consequence. When dealing with another person it is often useful to know in advance what the other fellow wants. Many persons who have seen little of the inside of newspaper management imagine that newspapers strive more for sensation than they do for accuracy. This idea is fallacious. To be sure, newspapers delight in sensational facts, but no paper can afford to gain a reputation for being unreliable. Nothing piques the pride of a reporter or editor more than to have an "esteemed contemporary" show that a write-up is a fake.

The aim of newspapers to secure accuracy has been thus emphasized in order to give point to the assertion that if a street railway management finds itself constantly misrepresented as to facts, the chances are that the company itself is at fault. If public service corporations generally would adopt the policy of giving as much, instead of as little, news to the papers as possible, it is quite certain that the papers would not only print the facts with reasonable accuracy but would welcome such action.

Some men are timid or over-cautious in dealing with newspaper men for fear that they are not to be trusted. In an experience of seven years the writer has had a confidence abused but once, and that was in a matter of no vital importance. As a class, reporters and editors have a sense of professional honor that may be relied upon implicitly. In fact, it reaches a point that the outside public would scarcely credit. The greenest cub reporter learns among his first lessons that the violation of a confidence is sufficient grounds for discharge. If a person desired to keep something out of a paper his best course in many cases would be to tell the whole story in confidence to a reporter or the city editor and trust to the honor of the newspaper not to abuse the confidence. It may appear that the writer entertains a too exalted opinion of the men who are engaged in the profession of journalism, as the business is usually termed by those who are not engaged in it, but it is founded on an experience that makes it impossible to hold any other opinion.

When a reporter enters the office he is given immediate attention. He is offered a chair, usually given a cigar and made to feel that he is welcome. He states his business and is given the information he desires as fully and explicitly as possible. If the subject appears difficult for him to fully grasp, as technical subjects are apt to prove, he is supplied with a memorandum of the principal points. Oftentimes it happens that a reporter does not really know what is wanted, as assignments are frequently given to reporters in very vague terms. In such cases every possible assistance is given to help him out of his dilemma.

It sometimes happens that it is unwise, improper or impossible to supply the information. In such cases, especially if the reporter is a new man who is trying to establish himself with his paper, the city or managing editor is called up and the situation explained to him. Ordinarily a city editor will promptly relieve a reporter from his assignment under such circumstances. The reporter then goes away contented, for he feels that although he has not obtained his story he will not be held accountable for a failure. This is an illustration of the many little things that persons not familiar with newspaper methods seldom think of. When a reporter is assigned to secure a particular story he is expected to get it. If he is unsuccessful it injures his standing with his paper. Under such circumstances there is always a temptation to exercise the imagination a little and fake up some kind of a story, which would not be written in a spirit of especial friendliness toward the person or corporation that refused the material. It is therefore a good rule, if one desires to win the heart of a newsgatherer, to either give a reporter what he asks or ask his superior to relieve him of the obligation of getting it.

One very important policy that must be strictly adhered to if one wishes to have any influence with newspapers is to be strictly truthful and sincere. If the confidence of newsgatherers is ever shaken in the good faith of a press agent he will forever stand discredited. He must have an unimpeachable reputation for truth-telling, or his statement will be neither sought nor valued.

A press department such as is being described is, in a sense, a bureau of information of unusual scope. The head of the department is called upon to answer a range of questions that is almost beyond imagination, for it must be understood that one of the principal aims of city editors in general and Sunday editors in particular is to discover subjects for stories that no one else has ever thought of. In order to meet these demands, that are often strange and whimsical, the press agent must have access at all times to information in every department.

The questions that are asked deal not only with the routine of the service, operation of the system and allied technical subjects; such as engineering, electricity and mechanics, but they also include legal questions, relations between the public and public service corporations, labor matters, finance, political economy, sociology and a multiplicity of other topics of popular and academic discussion. The range is wide and does not lack variety.

If a press agent has any doubts as to the propriety of answering the questions asked, he should seek instruction from the management, but he ought to be able to decide upon the expediency of giving out news matter in most cases without bothering his superior officer, whose time is so fully occupied that it should be trespassed upon only in cases of real necessity. The rule is, consult the management in case of doubt, but do not be in doubt too often.

Another fairly important work of the department is the preparation of complete articles for use in newspapers and magazines. There is considerable demand for authoritative and popular articles of this kind, not only in this country, but in Canada, England and Germany. Some of these articles are often "syndicated," that is to say, they are sent to a considerable number of papers for simultaneous publication, if they are believed to be of general interest. Sometimes fifty or more papers use a single story of this kind. This service can be supplied to the newspapers at small cost. The greatest care must be exercised to keep these articles strictly within the field of legitimate news and not permit them to encroach upon the advertising field. Such stories deal with subjects of considerable magnitude and general interest, such as the construction of a tunnel or the installation of important and novel equipment.

A corporation that takes the position that what it is doing is its own business and not the public's, is apt to find itself in hot water a large portion of the time. The public insists not only in being well treated, but upon having the means of judging for itself as to whether or not it is being well used. A company that is giving good service cannot to-day afford to hide its light under a bushel, but should do all in its power to demonstrate to the public that the service is good. A company that is unable to supply a really satisfactory service will usually find that it has much to gain and little to lose by frankness with the press and the public. If the public is convinced that the management is really doing its best, the amount of fault-finding will be reduced to a minimum, and some sympathy will be given to a management that is battling against adverse conditions and difficulties. It is quite as important to explain the faults as it is to extol the virtues of a company, for it is a trait of human nature to regard with reasonable complaisance many things that have to be endured if a sufficiently good reason is given for their existence.

The press affords the best and most available medium for a street railway to keep itself before the public in its true guise. Most companies would be happy if they could make the public see them as they really are. The thing that managers complain of is not that they and their companies are exposed to public criticism, but that they are misrepresented. The most effective remedy is co-operation with the newspapers upon the basis of frankness on the part of the company and fairness on the part of the paper. Such an arrangement is usually feasible and agreeable to both parties.

UNIFORM STANDARDS OF EXAMINATION OF RAILWAY EMPLOYEES

BY DR. F. H. PECK

I am placed in a position of some embarrassment in coming before a convention of men engaged in the executive departments of railway management, with a paper which has to deal solely with medical questions, in their relation to the policy of the railway surgical department. In order to make myself perfectly clear to the lay mind, I shall endeavor to divest my subject of all technical terms as much as possible.

To increase the factor of safety to the utmost, compatible with the rapid transportation demanded by the strenuous times in which we live, must be the endeavor of all railway managers. A recent newspaper article informs me that in 1903 the number of persons killed and injured on the railways in the United States reached a total of more than 86,000. Of this great number I believe that a large proportion were injured through their own carelessness, or contributory negligence. But it is possible to reduce the number of casualties by improving the personnel of railway employees. The only way to accomplish this result is by the establishment of uniform standards of examination, in the hands of competent surgeons, of all applicants for positions in the operative service of the railways, with rules requiring the re-examination of these employees, as often as once in five years, or after recovery from serious illness or injury.

At the first glance it would seem that the responsibilities of the electric motorman are not nearly so great as those of the engine-driver on the steam roads, as the lighter load renders the momentum of the electric car but a small fraction of that of the heavy steam train, and emergency stops can be made in much shorter space. This difference in momentum, and the difference in center of gravity in favor of the electric car staying on the track, should make the trolley much less hazardous both to the passenger and to those on crossings and in streets used by the respective roads. On the other hand, the fact that the trolley traverses the thickly peopled streets of our cities tends to act as an offset to the extra factor of safety inherent in the car and its mode of propulsion.

The factor of safety to the public is best conserved by the rigid examination of all candidates for employment as motormen and conductors. Both should be men of sobriety, with sound minds in healthy bodies, of good nerve—quick and decisive in an emergency—and in the perfect possession of visual and auditory faculties.

In the examination I would recommend two classifications or standards of requirements: one for new applicants for employment and one for old employees seeking promotion, which should most rigidly insist on the possession of full normal vision and hearing; the other for re-examination of experienced employees not seeking promotion, and which should require at least two-thirds normal vision and hearing. This for the reason that the man who has for years been a motorman or conductor has by experience gained a knowledge of his work, which renders him quite as capable as the novice possessing unimpaired faculties, though the former may have but two-thirds the normal faculty of vision and hearing.

TESTS FOR VISION

The Snellen test cards are recognized as standards of tests for accuracy of vision the world over. They consist of sheets of white paper on which are printed block letters in types of various sizes, each line of type bearing a number which shows the distance in feet at which the line should be read by the normal eye. Thus on the card which I exhibit the top line is numbered "70," and should be read at the distance of 70 ft.; the bottom line marked "20" should be read at the distance of 20 ft. In testing vision the card is placed in good illumination at a distance of 20 ft. from the candidate. Each eye is tested separately, by directing the applicant to cover the other. He is then required to read the lines as far down the card as possible, and his acuity of vision is recorded as a fraction; the numerator being the distance in feet at which he reads the types; the denominator being the numeral corresponding to the smallest line correctly read. Thus normal vision is indicated by the fraction 20-20, which means that he can read the line marked "20" at 20 ft. If he cannot read this line but can read the one next above, his defect in vision is indicated by the fraction 20-30, which means that he reads at 20 ft. the line which he should read at 30 ft. If he reads all but three of the letters in the line marked "20" correctly, and mistakes those three for letters of somewhat similar appearance, he should be passed as possessing normal vision.

New applicants for the position of motorman should be possessed of normal vision, and their examination papers should bear the fraction 20-20 as recording the vision of each eye without the aid of glasses. This rule should also apply to motormen in the service seeking promotion. Candidates for the position of conductor whose vision equals 20-30 with each eye without glasses, and is suspectible of correction by the use of glasses so that they can read 20-20, are marked as "average" for employment.

COLOR TESTS

In testing for defects in color perception, I use both the Holengren test worsteds and the Williams color test lantern—both of which I exhibit. By the worsted skeins color vision is tested by selecting one of the large untagged skeins and requiring the candidate to pick out and lay beside it all the skeins of the same color in its various shades. The small skeins have each a metal tag stamped with a number. Those corresponding to the test skeins have odd numbers, while those liable to be confused with the test colors by the color-blind subject, and called "confusion skeins," bear even numbers. The colors which are liable to be mistaken for each other by the person who is color blind, are green for red, and vice versa, gray for green, and brown for red.

Color blindness varies in degree in different individuals; those who pick out red or rose-colored skeins and place them with the green as being all of a color, or those who select light greens when picking out the reds are radically color blind; while those who choose light brown or gray in selecting reds and greens respectively have a seriously defective color perception, and are none of them fitted for positions requiring prompt recognition of red and green signals. Those who handle all the colors over and over with marked hesitation before coming to a decision, though they may finally be correct in grouping the colors, have a slow and therefore defective color perception, and it is my practice to further test them with the lantern.

The lantern is so arranged that by turning a circular disc in front of the lights different primary colored glasses are successively illuminated, as well as their corresponding numbers; though the latter are concealed behind a smaller disc and can only be seen by the operator. There is in addition a sliding diaphragm perforated with apertures of different sizes to give the effect of various distances to the test colored lights. If the applicant can correctly and readily call the names of the colors illuminated he is accepted. If he mistakes reds for greens, or vice versa, he is rejected. One thing in which the examiner should exercise great care is to differentiate between color ignorance and color blindness. Many men of the class who apply for positions as trolley employees have a defective color education and cannot readily name the colors, though their color perception may be normally acute. The grouping of the worsted skeins is manifestly the fairer test in these cases.

TESTS FOR HEARING

For testing the hearing I use the voice test and the tuning fork. In the former, after testing the vision of each eye separately by the Snellen test cards, I direct the candidate to plug one ear with his finger; then standing by the test cards, at a distance of 20 ft. from him, I ask him in a low voice, what is the last letter in the line he has just read; then with the other ear stopped, I ask him what is the first letter in the line, or if he can read any of the letters next smaller. Usually he will repeat my question, or will show by his answer whether he has heard correctly, and will be unconscious that I am testing his hearing, imagining that reading the letters with his ears successively obstructed is a continuation of the visual test. If he shows any doubt in regard to the voice test, I further test his hearing with the tuning fork. Standing behind him, I direct him to tell me the point at which he begins to hear the instrument as I approach it to either ear. I set the fork ringing by pinching the ends between my thumb and forefinger and suddenly releasing them, so that his attention would not be called to the loud noise which would be caused by striking the fork against any hard substance. Asking him to describe the character of the noise he hears, I can judge whether he is honestly telling when he hears the fork. The hum of the fork should be heard at about 20 ins., while its tone should be clearly heard and described at 5 or 6 ins. The record of his hearing is made in a fraction of which 20 is the denominator, representing the distance at which the examiner stands from him in the voice test. Perfect hearing is indicated by the fraction 20-20; one-half perfect by 10-20, etc.

PHYSICAL HEALTH EXAMINATION

The application blank should show applicant's name, occupation, residence, age, height, weight, color of eyes and hair; the pulse and respiration should be recorded; also history of any illness subsequent to the diseases of childhood. Specific examination should be made as to the presence of hernia or any deformity. The history of any injury or accident should be elicited and sig-

nificant scars or deformities marked on the diagrammatic figures on the blank. Special examination should be made as to the existence of any disease of heart, lungs, kidneys and urinary organs, joints, veins, hands and feet, arms and legs, and spine. Examination for hernia, hydrocele, varicocele or varicose veins should not be omitted. The question as to the use of intoxicants should be supplemented by the examiner's opinion as to whether applicant shows evidences of using liquor. A history of recent vaccination should be required, or in its absence revaccination. The examiner should express the opinion as to whether the candidate appears bright and alert, or dull and slow in his mental processes, and finally, the surgeon should state whether he considers the applicant to be first-class, average or defective for the position sought, giving his reasons, in case of rejection, in a space left for supplementary remarks.

TYPES OF INTERURBAN CARS

BY J. N. SHANNAHAN,
General Superintendent Electric Division, Fonda, Johnstown & Gloversville Railroad.

It is the purpose of this paper to describe two of the types of interurban cars in service on the Fonda, Johnstown & Gloversville Railroad, the service in which they are used, and to point out their advantages and disadvantages for that service. It may perhaps be well to describe first the conditions of service which were to be satisfied by these two cars.

The cities to be connected were Gloversville, Johnstown, Amsterdam and Schenectady, the total length of line being 33 miles. The builders of the line realized that two distinct kinds of travel must be provided for: the through long-distance rider who must be carried in the shortest possible time, and with a maximum of comfort, and the local short-distance rider, who desires to be carried from his own door to that of his neighbor, a few miles distant.

To provide for the long-distance rider the company arranged what was termed a limited service, which made the run of 33 miles in a little less than an hour and a half, and provided for no stops outside of the cities. To care for this limited service the management caused to be designed a car capable of making an average speed of 45 miles per hour, and with every convenience possible to a passenger in an electric car.

The dimensions of the car are: Length over all, 55 ft. 4 ins., and the width over all, 8 ft. 9 ins. The trucks are spaced 33 ft. center to center. The weight of the car-body is 53,500 lbs., and of car complete with trucks and motors is 86,500 lbs. The great weight is a result of the steel floor frame, which has been illustrated and described in several of the technical journals in the past. The management of the company felt that inasmuch as the cars were to run at high speed, every precaution should be taken to safeguard the passengers against possible accident, hence the steel floor frame. The great weight of the car has, however, aided in bringing about another most desirable result, namely, an easy and comfortable riding car. The writer does not wish to be understood as stating that this result is accomplished by the weight of the car-body alone, but that it is the combination of trucks with the heavy body which has brought it about. In a run occupying an hour and a half the following points must be considered in looking to the comfort of the passenger:

1. Easy riding qualities in the car and trucks.
2. Comfortable seats.
3. Toilet conveniences.
4. A smoking room which shall be comfortable for the occupants, but unobjectionable to the other passengers.
5. Ice water, luggage racks, etc.

The first has already been considered and need not be referred to, further than to state that the trucks were manufactured by the Taylor Electric Truck Company. The second point, with reference to the seats, need not be particularly discussed beyond stating that they are of the Walkover type, with head-roll back made by the Hale & Kilburn Company, and upholstered in plush. The seats are 37½ ins. long, 19½ ins. deep, with a back 24½ ins. high, and an arm rest. These seats were designed especially for this car, and have proven most comfortable in every way.

After considerable discussion it was decided to place in the cars a toilet room similar to those in a first-class steam coach.

The proper location for the smoking room was carefully studied, and it was finally decided to pattern after that in use in Pullman cars, except that the seats should be longitudinal rather than lateral. That the occupants of the smoking room are entirely isolated, and ladies not obliged to pass through the compartment in entering or leaving the car, have proven a most satisfactory arrangement.

Each car is equipped with an ice-water tank, which is given attention at the end of each round trip. The luggage racks run the entire length of the main compartment on each side of the car. Another feature especially designed for the convenience of the passenger is the window. When closed the view is not obstructed by any wire guard or grating, but when the window is dropped in warm weather, a brass grill, placed above the top of the sash, and attached to it, provides the necessary protection. When the window is raised the grill passes entirely out of sight.

Care was taken that the car should be so well lighted that passengers would have no difficulty in reading in any part. The result is that the car is brilliantly lighted, there being 40 16-candle-power incandescent lamps in the main compartment alone.

The vestibules are arranged in a manner similar to those of a Pullman car. The steps do not project beyond the side of the car, and are covered by a trap door when not in use. Each vestibule is provided with a motorman's cab.

The heating of the cars is accomplished by a Peter Smith hot-water heater. The further precaution has been taken of applying storm sash to these cars, and we experience no difficulty in keeping them properly warmed at all times.

The cars are equipped with the Westinghouse straight air brakes, and also with the Sterling safety hand brake.

The interior of the car is finished in tabasco mahogany, with Marquetrie design in border and panel.

The electrical equipment consists of four General Electric Company's No. 73 motors (75 hp each) with type-M train control. The motors appear to be admirably adapted to the service, as no difficulty has been experienced in making the run of 33 miles, of which 8 miles is in streets or highways, regularly in an hour and twenty-four minutes.

The particular advantages claimed for the car are:

(a) The ability to make the run at high-speed, thus successfully competing with the steam railroads.

(b) The possession by the passenger of all the comforts found in a modern steam railroad coach.

(c) The minimum liability of injuries to passengers, which was admirably demonstrated a few months ago in an accident in which one of these cars running at a speed of 45 miles per hour crashed into a 15-ton steam road roller. The roller was almost completely demolished while the damage to the car was confined almost entirely to the front vestibule, and was repaired for the sum of $625. Though the car carried 34 passengers, none were seriously injured.

For the conditions under which this car operates it is admirably designed, and the writer is at a loss to point out any particular disadvantage. It might perhaps be urged that slowness in loading and unloading is one, but that is not possible to correct without a general rearrangement of the entire car. The placing of the smoking compartment in one end and toilet room in the other end of car makes a narrow entrance compulsory. This is not with us a serious objection, for the time lost in unloading and loading can be provided for in stand time at terminals or made up by slightly faster running en route.

The car was designed in the office of C. H. Ledlie, consulting engineer for the railroad company, and under his immediate supervision, and was built by the St. Louis Car Company. The cost of car complete was about $15,000. The wisdom of purchasing so expensive a car may be questioned, but it was the belief of this company that sufficient additional traffic would be attracted by such a car to justify its purchase, and the results of 18 months' operation completely demonstrate the correctness of this belief.

No reference has been made to the value of such a car as an advertisement for the railway, but there is no doubt that the company has received much favorable notice for operating so fine a type of car.

To provide for the short-haul business the company arranged what is known as the accommodation service, which provides for slower speed than the limited cars make, and for a large number of additional stops. To cover the accommodation runs we purchased 8 cars manufactured by the St. Louis Car Company as one of their standard types of interurban car. The dimensions of the car are: length over all, 45 ft. 4 ins., and width over all, 9 ft. The trucks are spaced 22 ft. center to center. The weight of car body is 36,000 lbs., and of car complete with trucks and motors, 58,700 lbs.

The car has side or main sills of 5-in. x 8-in. yellow pine, reinforced by a ¾-in. x 8-in. steel plate, and intermediate sills of 4-in. x 5-in. yellow pine, reinforced by 5-in. channels.

The car is equipped with the St. Louis Car Company's walkover seats, upholstered with rattan. The seats are not provided with an arm rest. The car is mounted on the St. Louis Car Company's No. 23 trucks, and equipped with the Christensen straight air

brakes, and four of the General Electric Company's No. 57 motors.

The interior is finished in quartered oak. The heating is accomplished by a Peter Smith hot-water heater.

These cars make the run of 33 miles in two hours.

The advantages of the heavier car for the limited and fast service have been spoken of, and I believe are quite apparent. As to whether the advantages of the lighter car for the accommodation service are as real may be questioned. That its passengers can be unloaded and loaded in less time is unquestionable, and that it can make the accommodation runs with the frequent stops with a much less consumption of power is equally true. But whether the amount saved in these ways will equal the increase in the damage account due to the lighter construction of the wooden car is a question which is not easily answered.

NEW YORK STATE QUESTION BOX

The questions and answers in the Question Box prepared for the Street Railway Association of the State of New York, were based to some extent upon the Question Box that has been conducted for the past four months as a regular department of the STREET RAILWAY JOURNAL. Several of the more important questions appearing in this paper were selected and these, with certain explanatory comments, were mailed as a preliminary canvass to representatives of all the electric railway companies in the State of New York. A large number of replies was received as the result of this canvass, and these answers, together with a few of the answers selected from the STREET RAILWAY JOURNAL, made up the report. The following answers are some of the replies that have not yet appeared in this paper. The rest of the new answers will be published in an early issue:

GENERAL

ADVERTISING

No. 2.—What means of advertising have you found most effective?

Display cards on the inside of end windows have been found to be a very successful method of advertising attractions, because they are a conspicuous announcement to every person who rides on the cars daily, and as people, generally, when riding on the cars have little to do except to read advertisements, a very large majority of them are likely to take notice of the display card. Also it is a reminder to persons as they are going home in the evening where they can be entertained after supper. We think this means of advertising the most effective and economical. We also use boards to hang over the dash announcing ball games and other attractions along the line of the road.

E. G. CONNETTE, V. Pres. & Gen. Mgr.,
Syracuse Rapid Transit Ry. Co.

We advertise attractions by means of banners, which are placed on the fenders of the cars. Posters are sometimes displayed in the windows. I think the best results are obtained from banner advertising, as the banners are continually before the public.

F. J. GERDON, Supt. Trans., Utica & Mohawk Valley Ry. Co.

The International Railway Company uses newspapers, illustrated folders, time cards, bill-board posting with three-sheets and half-sheet posters in car windows.

As to the relative merits of the different kinds of advertising, it is our opinion that the conditions of the locality govern to a great extent according to the class of people it is desired to reach. Newspaper advertising, while expensive, if judiciously placed in the shape of three to five-inch display at amusement rate, which carries the privilege of liberal reading notices, is undoubtedly a good medium. With such an arrangement or contract with newspapers, the advertising agent should be able to secure from time to time interesting stories of a news nature, for instance, following a day of a big event on the line. Such information given out as news is good reading matter for the newspapers and of value to the railway company.

In large cities it is difficult to secure much window space except in the outlying districts, where the advertising is not of great value. In return for such advertising it is customary to give one or two tickets to the place advertised, and if their value does not exceed the 25-cent rate, this remuneration for 10 days' display is reasonable. In some cases, however, the fare to such points is 40 or 50 cents, at which rate two tickets would be an excessive payment. In downtown districts it is almost impossible to secure window space for any length of time, and this plan of advertising in large cities does not appeal to the writer as one to bring results.

Souvenir postal cards appear more or less as a great effort to reach a very small circulation, although the printing of such cards at the rate of 1 cent each or less enables the railway company to give them gratis to souvenir stands, where they can be offered for sale.

The plan of railway companies publishing small leaflets weekly and distributing same in folder racks on all the cars appears to be a good form of publicity, inasmuch as the public is brought closely in touch with the business of the railway, and can be advised through this medium of all changes in car service, as well as up-to-date news of parks and resorts reached by the company. This company has found the method of advertising in car windows most effective for local purposes, inasmuch as the entire territory governed by the railway lines can be thoroughly covered and good publicity given to resort features and events.

J. E. STEPHENSON, Pass. & Fr. Agt.,
International Ry. Co., Buffalo.

Folder containing small map giving general idea of the system and principal points reached by it and a company publication of our own are combined in one published weekly during the summer—this year from May 27 to September 2 inclusive—under the name of "Trolley Topics." This magazine, which consists of 36 pages, 4 ins. x 8 ins., contains time tables and map of all divisions of the Rochester Railway and Rochester & Eastern Rapid Railway, which latter road enters Rochester over the line of this company; also time tables of the steamboat lines with which we connect at Summerville for points in Canada and the Thousand Islands, general information regarding the parks and resorts in and near Rochester and what is going on there, theatre and baseball news, yachting items, etc. A short story and a few jokes are mixed in with this, and these with several pages of advertisements at either end complete the magazine. Mention is also made of the pleasantest trips to be taken on our lines, the price of tickets, and where to obtain same.

We believe that a certain amount of newspaper advertising is indispensable if one would obtain the best results. Short locals, an occasional write-up and now and then, for special occasions, a good strong display advertisement keeps you before the public and brings results. We recently inserted an advertisement in rhyme, which caused considerable comment, and, we believe, brought about some extra business.

Banners or signs on cars and car-window advertising were all used by this company to some extent until recently for advertising many things outside of the railway company's own affairs. This has now been entirely done away with, except that we now allow one sign on either dash of the car, 9¼ ins. x 25¼ ins., and these signs are only for advertising the company's business or something directly connected with it, such as "Baseball To-day," "To the Circus," "1000 Island Excursion," "Lilacs in Bloom—Highland Park," etc. We have the signs printed on cardboard by a printer, and these are then tacked on to boards of the same size which are made with iron hooks on the back. These are hooked on to an iron plate on dash of car, and can be changed at a moment's notice. We find that these tersely worded signs call the people's attention to the main fact. The details they learn from the papers, sometimes in an advertisement, but often in the news column, the car signs simply serving as a reminder.

Display cards in cars are used by us for calling attention to certain popular or to-be-made-popular trips, and, we believe, are a good medium. We advertised our "Apple Blossom Route" (the Rochester & Sodus Bay Railway) this year with a card gotten up in pink, green and white, showing a branch of apple blossoms and reading:

DON'T MISS
APPLE BLOSSOM WEEK
on the
ROCHESTER & SODUS BAY RAILWAY.
Round trip tickets 75 cents, at Amsden's.

The Rochester & Sodus Bay Railway runs through one of the richest fruit and garden sections in the State, and during the early part of May, when the apple blossoms are out, the line is advertised as the "Apple Blossom Route—40 miles of Apple Blossoms," etc. A regular car, holding from forty to fifty persons, can be chartered for this trip for $40, or single daily excursion tickets for 75 cents. In the case of private parties, souvenir cards, decorated with apple blossoms, and containing an eloquent invitation to see the real apple blossoms in all their glory, have been issued in one or more instances. We had more apple blossom passengers than ever before.

For advertising special attractions we have found that house-to-

house distribution of hand-bills has proved a very good medium. We get up the bill in neat and attractive form, and put it in the hands of a distributing agency for distribution.

We believe that our own publication, which is put directly into the hands of passengers on the cars, as well as being distributed at all stations and agencies on our outside lines, in connection with the newspaper advertising, perhaps brings the largest returns. Attractive display cards in cars no doubt contribute a good share, and the dash signs assist also.

We have mentioned six methods of putting ourselves before the public, and while each would bring us good results, we believe none of them is complete without the support of the others. The several different methods when united make a strong combination. All railway companies are "held up" to a certain extent by certain large social organizations who get out "Official Programs," "Souvenirs," etc., in which the railway is obliged to place its advertisement. This is more in the nature of a donation, however, as there are no direct results to the company.

Band concerts at parks and resorts are always good advertisements, and in Rochester these park concerts are held every Saturday and Sunday, the railway company paying one-half the expense of the band. The newspapers publish this as news, and the railway company puts on its dash signs, "Band Concert To-day." The people do the rest.

Geo. G. Morehouse, Sec.,
Rochester Ry. Co.

Folders, cards in cars, small hangers, souvenir postal cards and newspaper advertising, which includes both paid advertising and all the news items that can be furnished. We have found the newspapers and folder time tables the most effective mediums for advertising our road and its attractions.

J. H. Pardee, Gen. Mgr.,
Rochester & Eastern Rapid Ry.

This company has not as yet gone into any general advertising of its road and attractions. We have been going through a period of construction for the past three years, and, on account of the rapid growth of the business in this city, our time and attention have been so taken up with handling the traffic and building extensions that we have not found time as yet for the developing of new business through advertising. We have been spending about $1,000 a year for advertising our time tables, and have just started out preparing folders containing maps, time cards and general information. Inasmuch as we have not gone into any general advertising, it is not possible for us to determine the most effective means of increasing business through advertising.

E. J. Ryan, Supt., Schenectady Ry. Co.

No. 3.—How much money can be spent profitably by an electric railway company for advertising, and how much does your company spend each year for advertising? Please answer this in detail.

The amount of money to be spent for advertising depends upon what a street railway company has to advertise. The average company has nothing to advertise except attractions along the line of the road, and the advertising then should be done within reasonable limits to induce pleasure travel.

E. G. Connette, V. Pres. & Gen. Mgr.,
Syracuse Rapid Transit Ry. Co.

For advertising banners for our park attractions during the season we spend approximately $50.

F. J. Gerdon, Supt. Trans.,
Utica & Mohawk Valley Ry. Co.

This question is most difficult to answer, but the percentage of gross receipts which the railway can afford to spend for advertising would seem to depend largely upon the amount of business over normal traffic which can be attracted to the trolley cars. The expenditure of this company per annum, which includes all items charged to advertising, is approximately $10,000.

J. E. Stephenson, Pass. & Frt. Agt.,
International Ry. Co., Buffalo.

Depends entirely upon class of road and results of advertising. Expenditure must be governed entirely by results.

J. H. Pardee, Gen. Mgr.,
Rochester & Eastern Rapid Ry.

This company has been spending about $1,000 a year for advertising time tables. We can better determine how much money can be spent for advertising after giving the matter a thorough trial.

E. J. Ryan, Supt., Schenectady Ry. Co.

Last year this company spent about $8,000, which was charged to advertising and attractions. This included salary of excursion agent, expense for company publication, percentage of receipts paid on account of carnival held at one of our resorts, newspaper advertising, cards on outside of cars, advertising cards inside of cars, miscellaneous advertising in programs, souvenirs, etc., appropriation for park band concerts, other band concerts, hand-bill distribution, and all concesions made to picnics either in cash or prizes. For our purposes we believe the advertising for the year can be done for about one per cent. of the gross receipts for the six months from April 15 to October 15.

Geo. G. Morehouse, Sec., Rochester Ry. Co.

CLAIMS

No. 4.—Do you have a sinking fund for the settlement of accident claims? Please give details of the methods you use for handling this matter.

We estimate a certain percentage of the gross earnings of the company to take care of accident claims. At the present time we are charging out 4 per cent of our gross earnings to what we term "Accident Fund Account." At the end of our fiscal year if we find that during the previous year the percentage charged to this account has not been sufficient, we increase the rate. All money actually paid out on account of accidents is charged to this accident fund account, and the percentage mentioned above charged to the proper expense accounts monthly.

R. B. Hamilton, Claim Agent,
Utica & Mohawk Valley Ry. Co.

We have no sinking fund for the settlement of accident claims, but charge off a certain amount each month sufficient to take care of the entire expense for each fiscal year.

E. G. Connette, V. Pres. & Gen. Mgr.,
Syracuse Rapid Transit Ry. Co.

This company has no sinking fund; its claims are paid from the current earnings of the road.

A. J. Farrell, Claim Agt.,
International Ry. Co., Buffalo.

Yes, we charge to damage operating account a certain percentage of our gross income each month, and the moneys disbursed in the payment of claims is charged to a damage reserve fund account.

J. H. Pardee, Gen. Mgr.,
Rochester & Eastern Rapid Ry.

This company has such a sinking fund. Every month $3,000 is credited to an account known as "Accrued Damages." This amount is fixed at this figure as our experience has taught us that such an amount is sufficient for this purpose. All payments in settlement of claims are charged to this account.

Mr. Robinson, Claim Dept., Schenectady Ry. Co.

Every month we credit 5 per cent of the railroad's gross receipts to an accident insurance fund. From that fund we pay all damage claims and legal expenses in connection with the claim department. We have been following this practice for about a year and a half, and find it very satisfactory.

B. B. Nostrand, Jr., Pres. & Gen. Mgr.,
Pe kskill Lighting & R. R. Co.

We charge off a percentage of our gross receipts to an accident fund, from which are paid all expenses resulting from accident claims.

R. E. Danforth, Gen. Mgr.,
Rochester Ry. Co.

No. 5.—How can the claim department best co-operate with the operating department in the prevention of accidents?

By having the claim department and the superintendent, their assistants and road officers have a conference at least weekly, on the previous week's accidents, with suggestions from the representatives of both departments as to the best way to avoid a repetition of such accidents.

R. B. Hamilton, Claim Agent.,
Utica & Mohawk Valley Ry. Co.

I do not know how the claim department can assist the operating department in the *prevention* of accidents, except in an advisory capacity. The claim department should, however, notify the operating department of all acts of negligence causing accidents.

E. G. Connette, V. Pres. & Gen. Mgr.,
Syracuse Rapid Transit Ry. Co.

The claim department can help the operating department by giving to the latter a full report of every case settled, with remarks and suggestions, which may lead to the betterment of the service by improved discipline.

Carleton Banker and Julian Du Bois,
Div. Supts., F. J. & G. R. R.

After full investigation of claims, all papers are turned over to the operating department for its inspection and information as to the cause of the accident, and for proper action. Benefits may be derived as to the prevention of accidents by suggestions made by the claim department to the operating department, as the claim department is obliged to go into each and every accident minutely, and, therefore, suggestions from the claim department should prove of value to the operating department in the prevention of re-occurrence of similar accidents. A. J. FARRELL, Claim Agt., International Ry. Co., Buffalo.

Complete co-operation between head of claim department and head of operating department will have excellent results in the prevention of accidents. The claim department can furnish much information to the operating department regarding the little things which ha.e caused accidents, the remedy for which should be supplied by the operating department. And the operating department can furnish much valuable information to the claim department for use in the settlement of claims. J. H. PARDEE, Gen. Mgr., Rochester & Eastern Rapid Ry.

Our experience has taught us that the old adage, "An ounce of prevention is worth a pound of cure," can be very advantageously applied in the operation of a railroad. The members of the claim department are constantly on the alert for any practices on the part of the car crews that might result in an accident, and also for anything defective in the mechanical equipment that can be observed by anyone riding on the cars. Our men are riding on the various lines of the road daily, and whenever they see anything which, in their opinion, might be the cause of an accident, a note is made of it and sent to the transportation department or mechanical department, as the case may be. Upon the receipt of these notes these departments take the matter up at once, and the remedy is applied. Many accidents are thus averted. These suggestions are never made in any captious or critical manner, but with a sole view of keeping down the cost of the operating of the road from the standpoint of damages, and they are always received in the spirit in which they are made. This will depend somewhat upon the character of the men in charge of the different departments, and occasionally one meets with the head of a department who seems to think that suggestions of this character are personal criticisms, and instead of endeavoring to correct the dangerous practice, seeks to justify it. The best of feeling should exist between the heads of departments, as without it co-operation is impossible.

When an accident does occur, a rigid investigation is made, both from a legal and a transportation standpoint, and every effort is made by both the claim department and the transportation department to avoid a recurrence of the same. Another practice of this company, which we believe is a good one, is that all car men report to the office of the claim agent before they are permitted to take charge of a car. They are carefully instructed as to the legal rights of the company and of passengers, and are notified just what to do in case of accidents, and how to do it. An effort is made to impress upon their minds that the safety of passengers is the first and most important requirement, and that everything else is subordinate to that. Often instructions of this kind made by a man whose work consists chiefly in the investigation of accidents, and who realizes keenly the importance of what he says in regard to prevention of accidents, are more emphatic than instructions by a transportation man whose chief point of view is that of the transportation department. It is necessary for the applicant to have the signature of the claim agent upon his practice slip, which certifies that he has been properly instructed by that department, before he can begin work MR. ROBINSON, Claim Dpt., Schenectady Ry. Co.

Claim department should assist in instructing new motormen and conductors in matters relating to accidents, and post them concerning the most frequent kinds of accidents and methods of preventing same. R. E. DANFORTH, Gen. Mgr., Rochester Ry. Co.

No. 6.—Have you ever used the camera to good advantage in adjusting damage claims? Please give details.

The camera is used to good advantage occasionally in the defense of damage suits. Photographs should be taken showing the conditions and the surroundings of certain kinds of accidents, to be used not only in adjusting claims but also in defending suits in the courts. E. G. CONNETTE, V. Pres. & Gen. Mgr., Syracuse Rapid Transit Ry. Co.

We have used the camera to very good advantage in the preparation of evidence in damage claims. It is our custom in cases of serious accident, where the question of the exact locality may be a factor, to have photographs taken immediately after the occurrence of the accident. We aim to have these photographs show what evidences there may be of the accident, and our experience has been that the photographs can be used to very good advantage, not only in the adjusting of claims but in court. R. B. HAMILTON, Claim Agent, Utica & Mohawk Valley Ry. Co.

We have done so by photographing cars and places where accidents have occurred. This method gives an accurate reproduction of the conditions. CARLETON BANKER and JULIAN DU BOIS, Div. Supts., F. J. & G. R. R.

This company has never used the camera in the adjustment of claims, but has been very successful in the trial of cases in using photographs taken at scenes of accidents. In this connection, it often has suggested itself to the claim department that in large cities of mixed population, among some classes of claimants a system of identification should be adopted, by photograph or otherwise, to prevent fraud in future claims. It has occurred several times where the same person, under an assumed name, has made repeated claims for damages arising out of alleged accidents of which the company has no report and which it has reason to believe did not occur. A. J. FARRELL, Claim Dept., International Ry. Co., Buffalo.

TRAILERS

No. 7.—Please give your ideas and experience relative to trailers.

I do not believe that it pays in the long run to operate what are usually called trailers, on account of the extra hazard connected with their use. I do believe in the train system, using the multiple-unit control, for interurban roads and for city lines where the traffic is congested and heavy. E. G. CONNETTE, V. Pres. & Gen. Mgr., Syracuse Rapid Transit Ry. Co.

I do not favor trailers for city service for short hauls. I think that frequent service is the better and less dangerous of the two. Trailers on interurban or elevated roads, where cars are run in trains of two or more, I think could be used to good advantage where stops were not too frequent. Where stops are frequent the two or more car-train consumes more power in starting and stopping, and there is also additional delay to a great number of passengers on the train, whereas if the cars were run at intervals the stopping and starting load would be greatly reduced. I think trailers have a tendency to increase accidents. The economy, if there is any economy in running trailers, is simply that two cars can be operated by three men, if that can be called economy when the additional risk referred to is considered. F. J. GERDON, Supt. Trans., Utica & Mohawk Valley Ry. Co.

We have used trailers on our local lines, but had trouble with derailments at switches and special work. We have also had difficulty in maintaining the schedule. With a comparatively straight and level track, with a loop at each terminal or with a belt line, trailers could be used to advantage during rush hours or on days of heavy traffic. Trailers should be equipped with air brakes and run with train control. The draw-bars and couplings between the cars should be carefully designed. The chief economy in running trailers is, of course, the saving of one man in each crew. CARLETON BANKER and JULIAN DU BOIS, Div. Supt., F. J. & G. R. R.

The running of trail cars is an economical way of handling travel night and morning during rush hours, or on special days when travel is heavy. I am of the opinion that trailers decrease the number of accidents. The economy is in the saving of time of one man, equipment and power. C. A. COONS, Supt. Trans., International Ry. Co., Buffalo.

On a high-speed road containing heavy grades as we have, we do not consider that trailers, so called, should be used. But when it becomes necessary to run more than one car in a train we make up the same, operated by multiple control. We have, however, operated three-car trains, with the center car dead and the two live cars at the ends. This class of trains with us has worked very satisfactorily for handling excursion parties or any other class of special passenger work when we do not have to maintain the regular schedule train running time. On our road we have found that we are unable to take two cars, one of which is a dead trailer, and maintain the regular schedule running time making the necessary stops. Consequently, this is the reason why we invariably make up our two-car trains with both cars having a full equip-

ment of four motors. It has not been our experience that trains of two or more cars have increased our accidents in any way; therefore, we do not consider them any more unsafe than the single car trains. On our single track road, where regular trains are an hour apart, we find that two and three-car trains help us out very materially at certain times of the day when traffic is congested, also when the excursion business is heavy, it can be handled advantageously in this way. From a power standpoint at the present time, we are unable to state the exact economy of running cars in trains, but trains of this class require less labor and are therefore cheaper on that account, besides being much easier to handle in the single unit than the same number of cars would be in separate units.

W. R. W. GRIFFIN, Supt.,
Rochester & Eastern Rapid Ry.

This company does not operate trailers on its lines, and, therefore, we have had no experience. From a general point of view, trailers cannot be conveniently operated unless there are loops at all terminals. Trailers properly find a place in the operation of a railway where the traffic is so heavy that close headway is necessary in order to handle the business. Trailers can then be used and the headway decreased, thereby economizing in operation. As this company runs no trailers, we can give no data as to accidents. However, I do not think that the use of trailer cars should increase the number of accidents, provided they are properly handled.

E. J. RYAN, Supt., Schenectady Ry. Co.

Trailers add to flexibility of equipment at small cost, but increase number of accidents. Trail cars are properly used for excursion travel occurring at irregular or infrequent intervals. The economy is in decrease in power consumption per passenger and increase in carrying capacity per trainman.

R. E. DANFORTH, Gen. Mgr., Rochester Ry. Co.

No. 11.—If trail cars are used, should cars be equipped with some form of multiple-unit control? If so, would you favor using four motors on the first car and none on the second, or two motors on each car, or four motors on each car? Should cars be equipped with master controllers at both ends? What are the factors entering into the question?

If trailers are used as trippers only I would favor four motor equipment with no motors in the trailer. If cars are run in trains on a single-track road, where there are no "Ys" or terminal loops, cars should be equipped with controllers on both ends. In this case two motors to each car I should think would be sufficient.

F. J. GERDON, Supt. Trans.,
Utica & Mohawk Valley Ry. Co.

Decidedly, if cars are run in trains they should be equipped with multiple-unit control. Unless there are loops at all terminals there should be master controllers at both ends of the train.

CARLETON BANKER and JULIAN DU BOIS,
Div. Supts., F. J. & G. R. R.

Would recommend that the motor car be equipped with four motors, and that both motor car and trailer be equipped with air brake connections. Our conditions here make it advisable to have master controllers at both ends of motor cars.

C. A. COONS, Supt. Trans.,
International Ry. Co., Buffalo.

We are very much in favor of always running cars in trains with the multiple unit control. When using two cars in a train on our road with its present profile, we find that we have to use both with four motors, on account of being unable otherwise to make our regular schedule. When using three cars in a train on excursion work, we find that the center car running light without motors makes a very fine combination, but, as before stated, we are unable to place trains of this make-up on our regular schedule time on account of their being unable to make the running time with the necessary stops. On our road we do not use the master controllers on both ends, except on two cars, which are used in places where we have no place for turning. All of our trains are turned at both terminals.

W. R. W. GRIFFIN, Supt.,
Rochester & Eastern Rapid Ry.

If trailer cars are used, I should advise multiple unit control, with motors on both cars. The question of number of motors depends upon the class of the car. It would not be necessary to have controllers on both ends, provided the cars could be looped at the terminals.

E. J. RYAN, Supt.,
Schenectady Ry. Co.

FARES

No. 12.—In making up a schedule of fares for an interurban road, is it better to base rates on mileage or with reference to municipal boundaries, and what is the proper rate per mile for passenger business? Also to what extent should the rates be reduced by the sale of commutation tickets, monthly tickets, coupon books, etc.?

It is frequently wise to base fares on municipal boundaries rather than on mileage. Local conditions should be consulted. Commutation rates should be about 50 per cent of the regular fare.

CARLETON BANKER and JULIAN DU BOIS,
Div. Supts., F. J. & G. R. R.

We have no commutation tickets. We have single and round-trip tickets, which are sold at regular ticket offices along the line, the return ticket being sold at a reduction of 5 cents on the round-trip. We do not make any reduction except on round-trip tickets. Whether rates were based on mileage or municipal boundaries I should think would depend on franchise conditions.

F. J. GERDON, Supt. Trans.,
Utica & Mohawk Valley Ry. Co.

It does not appear that any basis of rates per mile could be arrived at which would govern very many localities, as the conditions in each territory are very different, and as most municipalities, whether thickly populated or not, impose certain rates of fare in franchises where the right of way is along the public road, the plan of basing rates on mileage cannot well be carried out.

In the case of an interurban line operating on private right of way, the rates of fare doubtless depend largely upon the expense of operation and other liabilities. For the reason that interurban lines must compete with steam roads, 1½ cents per mile should be a very reasonable basis of interurban rates, and as very few towns through which interurban lines run cover a distance of more than three miles, the customary 5 cent fare for such territory seldom brings the rate below 1½ cents per mile. Competition must also be considered.

Commutation rates, where there is a daily travel between points, play their part in promoting travel. These rates are also governed by competition, and, on the basis of 1½ cents per mile for regular travel, should be about ¾ cents per mile to be attractive to the person who travels daily.

J. E. STEPHENSON, Pass. & Frt. Agt.,
International Ry. Co., Buffalo.

I should advise that in every instance fares be based on mileage, and I think that 1½ cents per mile is a proper rate for interurban business. However, this would depend in a very large measure on the locality of the road and the conditions. It is our practice to make the price of commutation tickets 33⅓ per cent. less than our regular rates.

E. J. RYAN, Supt.,
Schenectady Ry. Co.

In operating our interurban line, the Rochester & Sodus Bay Railway, about 40 miles between Rochester and Sodus Point, we have divided the distance into 12 5-cent zones, or limits, with reference to the village boundaries rather than on a mileage basis. This makes a single fare 60 cents for 40 miles, or 1½ cents per mile. The round-trip rate (unlimited) is 90 cents (for 80 miles), or 1⅛ cents per mile, and 75 cents for daily excursion ticket, or 15-16 cents per mile. Commutation tickets are sold in books containing 250 5-cent limit tickets (value $12.50) for $10, or 20 per cent. less than full regular fare. School tickets are sold to children not over 18 years of age, when properly signed certificate from principal of school is presented to agent. These books contain 40 limit tickets (regular value $2), and sell for $1, or 2½ cents for each limit. School tickets are good only on school days, and are not accepted during July and August. Half-fare round-trip tickets (unlimited) are sold for 50 cents, or 33⅓ per cent. less than regular full fare unlimited ticket (Rochester to Sodus Point).

GEO. G. MOREHOUSE, Sec., Rochester Ry. Co.

No. 13.—What is the best method of collecting and checking fares on suburban and interurban roads?

The duplex ticket system.

CARLETON BANKER and JULIAN DU BOIS,
Div. Supts., F. J. & G. R. R.

There are many good methods of fare collection, but it would seem that the system by which passengers can be encouraged to buy tickets before boarding cars is the best of all, as the less cash a conductor is required to handle the more time he has for other

duties, and this is greatly simplified if passengers present tickets for the distance traveled.

A recording register that will enable conductor to ring up actual amount paid by passenger, as cash fares, seems to be the best method and safeguard that can be employed.

J. E. Stephenson, Pass. & Frt. Agt.,
International Ry. Co., Buffalo.

Make cash fares paid on trains considerably higher than regular ticket fares, and place tickets on sale at all principal points and as conveniently as possible, so that number of cash fares paid on trains will be reduced to the minimum. Issue mileage books in denominations of 100, 500 and 1000 miles. Place 100-mile books on sale with the conductors of all trains, so that patrons boarding trains at stops at which there are no ticket offices can obtain the 100-mile books from the conductors at the same rate per mile as charged for tickets. We issue duplex for all of our cash fares, form of which is substantially the same as used by steam roads. We register our 5-cent cash fares on ordinary fare register.

J. H. Pardee, Gen. Mgr.,
Rochester & Eastern Rapid Ry.

The best system of collecting and checking fares on suburban and interurban roads depends in a very large measure upon the road and the conditions. On account of the high speed of our interurban lines, it is not possible for us to use a zone system, although that system has been worked out satisfactorily on a great many roads. Each of our interurban lines is about the same length—namely, 15 miles— and we make two collections and two registrations. One collection is for the local city, and the other the interurban. We find this is very satisfactory, and it is possible for us to check the road very easily.

E. J. Ryan, Supt.,
Schenectady Ry. Co.

We use a recording fare register which, in combination with the conductor's day sheet, is entirely satisfactory to us as a means for checking fares.

O. G. Pouch, Supt.,
Orange Co. Tract. Co., Newburgh, N. Y.

We use recording registers, and fares are classified as 3-cent, 5-cent, 10-cent ticket, etc., and rung up accordingly. The printed slip inside register is taken out when car comes in, and is sent to cashier. It is then checked against the conductor's report of receipts.

Geo. G. Morehouse, Sec.,
Rochester Ry. Co.

No. 14.—How do you handle your half fares?

We have no half-fare rates.

Carleton Banker and Julian Du Bois,
Div. Supts., F. J. & G. R. R.

We do not have any half-fare. Children under eight ride free, and over that pay full fare.

F. J. Gerdon, Supt. Trans.,
Utica & Mohawk Valley Ry. Co.

Interurban rates on this company's lines do not provide for half fares, children being carried free at ages up to eight years.

J. E. Stephenson, Pass. & Frt. Agt.,
International Ry. Co., Buffalo.

We have no half fares, except on Sunday school excursions. Otherwise, we carry children under ten years of age, when accompanied by adults, free; when ten years of age or over, or when unaccompanied by adults, full fare. We find that this works out satisfactorily.

J. H. Pardee, Gen. Mgr.,
Rochester & Eastern Rapid Ry.

We have no half fares on our system, except school tickets on the city lines.

E. J. Ryan, Supt.,
Schenectady Ry. Co.

We sell half-fare tickets on suburban lines and ten school tickets for 25 cents on the city division. The half-fare tickets are sold only from our office, and they are returned by the conductors as whole tickets, and are recorded on the conductor's day sheets as whole tickets. We find that by confining the sale of half-fare tickets to our office, any misuse of them by the public or the employees is avoided.

O. G. Pouch, Supt.,
Orange Co. Tract. Co., Newburgh, N. Y.

Half-fares, if cash, are rung up as 3-cent fares. If tickets, they are rung up as such.

Geo. G. Morehouse, Sec.,
Rochester Ry. Co.

DESPATCHING

No. 14 A.—Information is requested relative to good despatching systems on interurban roads.

We are firmly of the opinion that for a high-speed long-distance interurban electric railroad the only proper method of despatching is the same method that is adopted by the American Railway Association, or, in other words, the "complete" system, as given by the American Railway Association standard code. This class of despatching, by telephone, necessarily has to be modified slightly. The modification that we use is in the form of delivering orders to train crews.

On 44 miles of track, we maintain seven ticket offices and operating stations. At these stations train orders are received and written by the operator. After writing, the operator repeats the order back to the despatcher, and, if correct, receives an O.K. The completion of the order is made by the conductor of the train reading this same order to the despatcher over the telephone, and if read correctly, or is written correctly, the despatcher gives the conductor the completion of the order.

Orders are always written in triplicate. One copy is left at the station, and the conductor takes two copies, giving one to the motorman retaining the other for himself. The motorman then reads his order to the conductor, who is comparing them at the same time, thereby detecting any mistakes which the motorman may make in his reading.

After the conductor sees that the motorman understands his orders, he signals to proceed.

Outside of the regular stations in which operators are maintained, the train crews are always able to obtain orders at any of the sidings, as our road is equipped with telephone jack-boxes at each siding, and each car carries an independent telephone.

In cases where train crews obtain their own orders the motorman of the train becomes the operator, and after he receives the order he writes it and gets the O.K., and it is again completed by the conductor with the same procedure as at the stations.

This method of handling orders, we consider, if anything, a little better than the methods used on the steam railroad by telegraph, for the reason that we are always sure that one of the train crew has obtained the order, and has read it properly.

W. R. W. Griffin, Supt., Rochester & Eastern Rapid Ry.

No. 15.—What is the proper method of numbering trains?

East and southbound trains should have even numbers. West and northbound trains should have odd numbers. In a good many cases the class of train can also be denoted by its number.

Carleton Banker and Julian Du Bois,
Div. Supts., F. J. & G. R. R.

Trains should be numbered consecutively, odd numbers being applied to northbound and even numbers to southbound trains. We find this is the simplest and briefest method. When necessary to refer to a train in a train order or otherwise the number indicates the time and direction in which the train is moving.

M. Sheehan, Supt. Lockport Div.,
International Ry. Co., Buffalo.

We are very much in favor of handling all trains numbered even in one direction and odd in the other. Train numbers end with the end of the trip in the stated direction. In fact, we follow the universal steam railroad practice in this matter.

W. R. W. Griffin, Supt., Rochester & Eastern Rapid Ry.

Odd numbers west bond; even numbers east bond.

O. G. Pouch, Supt.,
Orange Co. Tract. Co., Newburgh, N. Y.

All our interurban lines are double-track lines, and we do not have any system of numbering trains.

E. J. Ryan, Supt.,
Schenectady Ry. Co.

This is a matter of opinion. We believe in carrying in plain sight, on the front end of each train, the train number corresponding with the number indicated on time table.

R. E. Danforth, Gen. Mgr., Rochester Ry. Co.

No. 16.—What is the best method of keeping records of orders given in order to insure accuracy?

All orders given should be written in full in a book provided for that purpose at the superintendent's office, showing the time the order was issued, to whom it was issued and the despatcher's initials. CARLETON BANKER and JULIAN DU BOIS, Div. Supts., F. J. & G. R. R.

The despatcher telephones the order to the sub-station attendant, who repeats the message back to the despatcher. The sub-station attendant then sends a copy to the train crew, keeps a copy himself and forwards a copy to the superintendent.

F. J. GERDON, Supt. Trans., Utica & Mohawk Valley Ry. Co.

Train orders should be numbered consecutively for each day as issued, beginning with No. 1 at midnight. They should be addressed to those who are to execute them, naming the place at which each is to receive his copy. Each order must be addressed in full in a book provided for the purpose at the train despatcher's office, and with it must be recorded the names of trainmen and others who have signed for the order, showing the time, also from what offices the responses were transmitted, and the train despatcher's initials. These records should be made at once on the original copy, and not afterwards from memory. We find this method of recording train orders simple and accurate.

M. SHEEHAN, Supt. Lockport Div., International Ry. Co., Buffalo.

By entering orders in a despatcher's record book having permanent numbered pages with spaces, giving the order, time of O.K. and completion, together with the initials of the operator and the conductor of the train. The despatcher's book is practically the same as those used on steam roads.

W. R. W. GRIFFIN, Supt., Rochester & Eastern Rapid Ry.

We issue no train orders on our road covering the movements of cars, and as yet have failed to find where it is practical. A report of orders should be given in duplicate, and the signatures of all employees concerned should be taken.

E. J. RYAN, Supt., Schenectady Ry. Co.

Orders should be written by conductor in triplicates, one for the conductor, one for the motorman and one for the superintendent or despatcher. These should be checked over with train sheet.

O. G. POUCH, Supt., Orange Co. Tract. Co., Newburgh, N. Y.

Despatching orders should be made in manifold, last copy being retained in the despatcher's office. R. E. DANFORTH, Gen. Mgr., Rochester Ry. Co.

No. 17.—What special precautions do you take to insure that employees understand the orders and carry them out properly?

The agent taking the order after getting "Complete" from the despatcher, reads the same to the conductor, who signs for it on the regular order blank. The conductor reads the order to his motorman, who places it in a clip before him until executed, superseded or annulled. CARLETON BANKER and JULIAN DU BOIS, Div. Supts., F. J. & G. R. R.

Train men receiving train orders should read them aloud to the operator. When telephone is used by trainmen the conductor should receive the order and motorman repeat it back from copy made by conductor. In case the order is not understood by trainmen, they must get an explanation from train despatcher, and must not proceed until it is fully understood. Train despatchers should report persons failing to carry out train orders properly.

We see that our men are well drilled in train rules and understand train orders before allowing them to take charge of a train, and by strictly carrying out precautions as outlined it insures employees understanding train orders and carrying them out properly.

M. SHEEHAN, Supt. Lockport Div., International Ry. Co., Buffalo.

By having the conductor of the train repeat the order to the despatcher over the telephone, as made out by the operator, and thereby getting the completion of the order. In other words, we never allow an order that alters the movement of trains from the regular time table schedule to be completed except by the conductor. This assures us that at least one of the train crew thoroughly understands the order before it is acted upon. After the order is completed by the conductor, one copy is given to the motorman, who has also to read the same aloud to the conductor. We consider that by handling the orders in this way we are sure of our trainmen properly understanding them. We also have a rule by which our men are instructed that in case any one of the three men involved, namely, the operator, motorman or conductor, does not understand the meaning of the order, it is their duty to immediately call the despatcher and have him explain it, instead of any one of the three trying to influence the others.

W. R. W. GRIFFIN, Supt., Rochester & Eastern Rapid Ry.

Despatcher gives order over telephone to conductor; conductor writes order in triplicate and retains one for himself, gives one to motorman, and the other is turned in at office. Motorman then reads order over telephone to despatcher and receives O.K., and proceeds. O. G. POUCH, Supt., Orange Co. Tract. Co., Newburgh, N. Y.

When train orders are received by the trainmen they are repeated to the despatcher or operator. Trainmen are required to register at each end of the line and at two intermediate stations, in standard steam road register book. Passage of trains is reported by station agents to despatcher.

R. E. DANFORTH, Gen. Mgr., Rochester Ry. Co.

All important orders or notices on this road are given in writing, and bulletins are posted daily. When bulletins are removed from the board they are placed in a file which is always open for the inspection of the trainmen, and no excuse is taken for failure to familiarize themselves with all orders. E. J. RYAN, Supt., Schenectady Ry Co.

No. 18.—Please describe a simple board for despatcher's use, showing location of all trains at all times.

A despatcher's sheet is preferable to a board.

CARLETON BANKER and JULIAN DU BOIS, Div. Supts., F. J. & G. R. R.

Have board made about 2 ft. long by 12 ins. wide, with diagram of switches placed on same. Number switches, and have about three holes in each side of switch. This will allow six cars to pass on switch if necessary. Have plugs with run numbers on same to represent cars. By the movements of these plugs despatcher will be able to follow the movements of cars.

O. G. POUCH, Supt., Orange Co. Tract. Co., Newburgh, N. Y.

A train sheet should be used by train desptacher to record the movement of trains at all times, beginning with a new sheet at midnight. We prefer the train sheet, because we think it makes a more complete record, and is easily filed for future reference. It provides for the explanation of delays or accidents as well as for the movement of trains, and makes a complete record for each day's work. M. SHEEHAN, Supt. Lockport Div., International Ry. Co., Buffalo.

We use a despatcher's standard sheet, cross-sectioned, with the station and siding numbers on the horizontal line, and train numbers on the vertical lines. All of our stations have operators, and as trains are reported out of such stations, the despatcher checks the actual time in the cross section opposite the station and under that particular train. This is always done at the time that train is reported out of such station, consequently the despatcher always has his trains closely located. W. R. W. GRIFFIN, Supt., Rochester & Eastern Rapid Ry.

We do not use any despatching system on this road.

E. J. RYAN, Supt., Schenectady Ry. Co.

SPECIAL REWARDS TO EMPLOYEES

No. 19.—Has any system of giving special rewards or prizes to conductors and motormen for meritorious service proven practical and satisfactory? Please give details of the system, and the results secured.

My experience and information on the subject is against giving any special rewards or prizes to conductors or motormen. Pay them in wages what the earnings of the company will justify. Promote the men to the best runs according to their age in the service.

Have them all render meritorious service if possible, and get rid of men who have no interest in their work. This is the best system in my judgment. E. G. Connette, V. Pres. & Gen. Mgr., Syracuse Rapid Transit Ry. Co.

We have no system of giving special rewards or prizes to conductors or motormen, and while we have had no experience in this line, we do not approve of such a plan, for the simple reason that a trainman would be inclined to withhold information and not make reports in order to secure rewards.

E. J. Ryan, Supt., Schenectady, Ry. Co.

SAFETY PRECAUTIONS

No. 19 B.—Please describe some of the SPECIAL things you are doing to reduce accidents and to introduce a greater element of safety in the operation of your lines. In other words, describe any means, devices or methods you are using that are in the nature of special safety precautions.

We take particular trouble to instruct our motormen how to stop a runaway car in case the brakes refuse to work or the trolley pole leaves the wire. Our road has a number of bad hills, and in the event of a car getting beyond control, the motorman, after trying all other means for stopping the car, is instructed to go through the following procedure: If the car is running forward down the hill, first throw off the hood switch, thus cutting off the line current. Then throw the reverse lever to the reverse position. Then swing the controller handle to the first multiple notch. With the K-10 controller the effect of this is, of course, to start the two motors bucking each other. In a very short interval of time the stronger motor will overcome the other and the effect will be that the stronger motor will act as a generator, and will tend to drive the other motor, as a motor, in the reverse direction. The tendency will be to reduce the speed of the car at once. It is, of course, evident that it is not possible to stop the car absolutely on a hill by this method, for as soon as the motors cease turning, the car will immediately start forward again, but the effect will be to jerk along down the hill at greatly reduced speed. We have prevented a number of bad accidents to our cars by motormen following out these instructions, and we have sometimes wondered why this rule for stopping a car has not been included in the rule books of more companies. If the car happens to be running backward down the hill, the same motions should be carried out, with the exception that it is not necessary to throw the reverse lever.

B. B. Nostrand, Jr., Pres. & Gen. Mgr., Peekskill Lighting & R. R. Co.

MECHANICAL

FIRE PROOFING CARS

No. 20.—What can the master mechanic of the average surface road do to prevent fires on cars, and to render his cars more nearly fireproof?

Steel cars are used on the New York subway and on the Long Island Railroad electrified lines, and are to be employed on the New York Central for electric service. These cars, of which the writer is the originator, have demonstrated not only that an all-metal car can be built at a moderate cost, but that the cars can be made as light as a well constructed wooden car, and much stronger than the latter.

The wooden cars used on the subway are also from the writer's designs, and have a steel underframe and special protection in the way of asbestos board and sheet steel underneath, so that in case of a derangement of the electrical apparatus fire will not be readily communicated to the woodwork of the car. The outside of these cars has a copper-covered wood sheathing, thus forming a slow-burning construction. In ordinary service, and except in case of derailment or collision, it is difficult to see how danger can arise from fires by electrical causes. In case of derailment or collision, which would break up the structure of the car, I see no method of absolutely avoiding fires except by making the car entirely of metal, and this latter form of construction, I believe, will come into universal use for electric motor cars, especially where the attendant results of fires are serious, as they are in congested city transportation lines, in tunnels or on an elevated road.

In the case of the ordinary street trolley car, where the speeds are slow, and where the car can be readily stopped, the situation is somewhat different, because the means of escape from a burning car are so much greater. For this service steel underframes and forms of asbestos and other fireproof floor construction can doubtless be devised which will be a very efficient protection against fire in the electrical apparatus underneath the car. There is, however, in my mind, no valid reason why the all-metal construction cannot be applied to street cars as well as elevated and tunnel cars, and I think that the use of metal for this service will be a development of the very near future, and I also believe that the development will be found a paying one from an operating standpoint, as it will make a stronger construction and one from which there is less hazard from fire, either on the road or in the car house, than where wood is employed to any extent. George Gibbs, Consulting Eng., Pennsylvania, New York & Long Island R. R. Co.

Cover the motor leads with wire-wound hose well taped at the ends, and this will probably remove two-thirds of the trouble. For the rest hang the resistance from the supporting frame work, which frame work is bolted to the car framing. This gives ample ventilation and no possibility for leakage. Keep cables well painted.

W. J. Harvie, Elec. Eng., Utica & Mohawk Valley Ry. Co.

In installing electrical equipment and wiring cars, follow as closely as local conditions will permit the car-wiring specifications as drawn up by the Underwriters' Electrical Bureau. Make and enforce a rule that all trolley poles be pulled down when cars are housed in car houses and storage yards.

J. A. Hanf, Gen. Foreman Shops, International Ry. Co., Buffalo.

The master mechanic can do a great deal towards preventing fire on cars. In the first place, all cables should be carried in iron pipe, and at the end of the pipes, where the cable leaves the pipe, the pipe should be provided with a bell mouth, and the bell mouth should be furnished with a bushing so as prevent chafing of the insulation on electric cable. Too little attention has been paid in the past to taking care of chafing of insulation. The use of transite or any other fire-proof material over the rheostats will also do a great deal towards preventing fires in cars. The Schenectady Railway Company has adopted the following standard: All new cars have the under-flooring lined with transite and afterwards with sheet iron, and it has been found that on cars taken care of in this way very little damage was done in case of a bad burnout.

J. G. Baukat, Master Mechanic, Schenectady Ry. Co.

Run the cables through asbestos or transite line troughs, and lead wires on porcelain knobs and tubes. Also line floor of car around resistance with protective material.

F. P. Maize, Master Mechanic, Rochester Ry. Co.

BEARING LUBRICATION

No. 21.—State experience with use of oil instead of grease for lubricating motor and axle bearings.

We use oil on all motors of 40 hp or over, on the armature bearings only, and grease for the axle bearings. On single-truck equipment we use grease exclusively. W. J. Harvie, Elec. Eng., Utica & Mohawk Valley Ry. Co.

Our experience with oil is still in an experimental state, therefore is limited to too short a period to give comparative costs. We have been using oil long enough, however, to convince us that a good oil is the proper lubricant.

J. A. Hanf, Gen. Foreman Shops, International Ry. Co., Buffalo.

We use oil for both motor and axle bearings, with good results, and have effected a considerable reduction in cost of lubrication by the use of same. We also get a longer life out of bearings, and the danger of armatures getting down on pole pieces, by reason of bearings melting out, has been greatly lessened.

W. H. Collins, Master Mechanic, F. J. & G. Ry. Co.

We find that we get double the mileage with oil, and less wear on the armature shaft. F. P. Maize, Master Mechanic, Rochester Ry. Co.

Oil lubrication is far better and cleaner and involves less labor than grease. It is not necessary to take a stick and prod down the oil as you have to do with grease, nor do you have so much grit and dust mixed with the oil when the cups are refilled as you do with grease. Oil lubrication is 5 per cent cheaper than grease, considering the saving in wear and labor. Of course, the condition of the weather influences the amount of oil used. During the season when the nights are cool the amount of oil necessary will be less, but when the weather is warm the amount of oil used will be greater. Our double-truck cars lubricated with a standard oil compound make on the average 195 miles a day and use one pint of oil.

Homer Tice, Master Mechanic, Poughkeepsie City & Wappingers Falls Elec. Ry. Co.

LONDON LETTER

(From Our Regular Correspondent.)

The result of the year's working of the London County Council's electric tramways on the southern side of the river makes more satisfactory reading this year, when compared with the results for 1903-1904. The total surplus amounts to £182,269, which, after deducting the usual interest and sinking fund charges, income tax, etc., and after transferring £35,000 to renewals fund, leaves a surplus of £7054 appropriation account. In 1903-04 it will be remembered that there was a deficiency of £8283, when nothing was set aside for renewals, but in that year a large amount of construction work was being done, and the full value of the tramways service was not received. The amount this year is not by any means entirely satisfactory, but it shows a great improvement on last year, and the figures for operating expenses are not yet as low as they probably will be. The operating expenses this year work out at the figure of 8.03d. per car-mile run, which is, of course, too high a figure for a large installation like that of the London County Council, but it must be understood that it has not yet got its own power house in working order, so the cost of current is still considerably too high. When the new Greenwich power house is in working order it is confidently expected that this figure will be reduced to the vicinity of 7d. per car-mile run. The number of passengers and the number of car-miles run are both increased, the number of passengers being 164,000,000, and the number of car-miles run 14,000,000. Both of these figures, however, include the results of a small portion of horse car service which still exists in the south of London. On the leased northern lines which are still run by horse cars, a profit of £22,836 was realized after meeting all charges, but nothing has been put aside for renewals, as this system will doubtless at an early date be changed over to electricity. The Highways Committee are also recommending the construction of a number of new tramways. One from Camberwell Green via Denmark Hill to the Junction of Lordship Lane and Crystal Palace Road; the second from the terminus in Lordship Lane to Forest Hill; the third from Grove Vale by East Dulwich and Peckham Rye to Peckham; the fourth from existing tramways in New Cross Road by way of Lewisham to Rushey Green, and the fifth a line extending from Greenwich to a pont near Blackwall Tunnel. The total length of these tramways is about 17 miles, and the cost is estimated to be about £287,150.

In connection with the London County Council Tramways, reference was made last month to the effort which the Council was making to get the sanction of Parliament to construct tramways across Westminster and Blackfriars Bridges and along the Embankment. So far as the House of Commons is concerned, the bill has now been returned for the third reading, after a hard fight. It is, therefore, very probable now that the electric tramways of the southern system will be carried across both of these bridges, and also along the Embankment, but Parliament has not permitted the London County Council to make any actual contract connecting the proposed Embankment Tramways with the new system of tramways which is intended to run down through the underground tunnel extending from Holborn to the Embankment, and which has been created during the past two years at a very large expense. As will be remembered, this tunnel is of the shallow type, and has been constructed under the new streets called Kings Way and Aldwych, something on the same style as the underground tramways in Boston and Budapest. A petition has also been made that if the tramways are brought across the Blackfriars Bridge, that that bridge will have to be widened, which will also involve a large expenditure, but is an improvement undoubtedly required.

There has been much disappointment about the delay in opening the District Railway and the Metropolitan Railway to electric traction. For some time the power house at Lots Road, Chelsea, has been in complete readiness to deliver power. The whole feeder system and the electrification of the tracks, the sub-stations, and, in fact, the whole electric installation has been in readiness, but the delay has occurred on account of the non-delivery of the rolling stock. For some time past, of course, the Metropolitan Railway Company has been operating some electric trains from the Baker Street Station outwards, but no electric trains have yet been run on the Inner Circle which is the portion of the railway that the public are most interested to see electrified, and which is, of course, completely in tunnel. The District Railway now has some of its electric trains running on one of the outside lines connected with its inner system, and it is understood that the rolling stock for the Inner Circle will now be delivered in a very short time, so that it is stated confidently that some time in July the steam trains on the Inner Circle will be displaced by these new electric trains. The Metropolitan Company has really been ahead of the District Railway Company, as it has been fully ready to commence its portion of the work since about the beginning of this year. It is hoped, therefore, that before the great heat of the summer comes on that all of the steam trains will have disappeared, and that the cooler and much more pleasant service of electric trains will have become operated.

In the May 6 issue, an interesting description was published of the power house which has recently been completed in Manchester, and which is known as the Stuart Street Station. Unfortunately, a printer's error was made in regard to the insulation of the cables which was given in millimeters instead of mils. We also regret that we stated in that article that Mr. G. F. Metzger, who designed the whole station, and who was responsible for the whole of the work of that station, was still the city electrical engineer of Manchester. This is, of course, an error, as Mr. Metzger resigned his position as city electrical engineer something like a year ago, and is now in consulting business with an office at 3 York Street, Manchester. We regret having made these errors, and take this early opportunity of making the necessary correction.

References have been made recently in these columns to the tremendous battle which has been going on before Lord Camperdown's Committee in the House of Lords between the sponsors of the various electric power bills which have been brought before that committee. It will be remembered that the most important of these bills was that of the Administrative County of London and District Electric Power Company, a new company which desired very comprehensive powers for the whole district of London. The company desired to supply electricity in bulk to the whole of the northern area, and naturally was opposed by all the existing companies who already have rights in London, and by the municipalities who are supplying current in their own areas. The committee has come to a very prompt decision, and the result has been a compromise, the administrative county bill having been passed with certain important modifications, so as to safeguard the interests of the existing companies. The area of this company which overlapped the Metropolitan Company's area has been struck out. The North Metropolitan electric power bill and a portion of the County of London Company's bill and the Central Electric Company's bill have been passed, but the bills of the Charing Cross Company and the City of London Company have been rejected.

A rather interesting experiment is being made at present by the Lancashire & Yorkshire Railway on its electric railway from Manchester to Southport. This is, as everyone now knows, a third-rail system, and the experiment of their engineers is to find out if a special ballast between the rails will assist in improving the insulation of the third rail, and prevent possible leakage and also accident to any one coming in contact with the live rail. A small portion of the line just outside Southport Station, therefore, has been ballasted with a special white limestone ballast at a portion of the line where there are some specially complicated points and crossings. All broken stone ballast is of a much more non-conducting nature than cinder or ash ballast, which contains a large percentage of carbon. This white limestone ballast, however, is even a poorer conductor than the ordinary ballast used for railways, and good results have so far been secured.

The Electric Lighting, Traction and Tramway Committee of the Batley Corporation has decided to accept the tender of Dick, Kerr & Company for the laying of the track and the erection of the standards and overhead wires. The paving will be done by the corporation. Dick, Kerr & Company have now obtained the contracts for the laying of the whole of the double set of rails from Dewsbury market place to Birkenshaw, and it is expected that the work will be commenced almost forthwith. Electric cars will be running on some part of the route, it is confidently predicted, by the end of August at the latest.

The Folkestone Corporation has now under consideration the offers of two companies to construct tramways from the harbor through Cheriton to Shorncliffe Camp and Hythe. The Traction & Powers Securities Company proposes to put down the overhead system, and the National Electric Construction Company specifies the Dolter surface contact plan. Each company offers to pay the Town Council £15,000 towards the expense which it has incurred in widening Cheriton road, and £1,200 to reimburse the corporation in regard to the cost incurred in securing a provisional order to construct its own tramways. Under that order there is an agreement with the Earl of Radnor not to adopt the trolley system, and his Lordship has refused to waive his objection.

The Town Clerk has reported to the Streets and Buildings Committee of the York Corporation that he has received a letter from the Tramways Committee asking the municipal body to consent to the company working the trams by electricity, and grant them the privilege of extending the system. The committee, after considering the matter, have decided to inform the company that

it is their intention to recommend the Council to purchase the tramways at the expiration of the next septennial period.

A substantial commencement has at length been made with the work of extension of the tramways from the terminus on the eastern side of the Bournemouth system to Christcurch, via Southbourne. The contractors are J. G. White & Company, of London, who carried out the Bournemouth borough tramways scheme. It is hoped to have the line as far as Tuckton Bridge completed by August.

The Birmingham Corporation Tramways Committee, in its report to the City Council, states that under the terms of the agreement with the City of Birmingham Tramways Company the latter has informed the committee that the order in which it desires the reconstruction of the under-mentioned tramways under lease to it to be proceeded with is as follows: 1, Saltley and Nechell's route; 2, King's Heath route; 3, Moseley Road route; 4, Stratford Road route. Specifications for the necessary materials and the works of reconstruction having been prepared by the city surveyor and tramways manager, tenders for the same were invited, and the following have been accepted: 1650 tons of tram rails, with the necessary number of fishplates, Bolckow, Vaughan & Company, of Middlesbrough, £5 10s. per ton; special tramway work, Hadfield's Steel Foundry Company, Sheffield, £1,703 10s.; for the work of reconstructing the permanent way on the above mentioned routes, Dick, Kerr & Company, of Preston, £42,261 15s. 1d. (this amount is exclusive of the cost of paving the sides of the roads, which will be carried out by the same firm at the same time for the Public Works Committee; it is also exclusive of the cost of the overhead electrical equipment). The work of reconstruction will commence shortly, and it is hoped will be completed by the end of October. The committee have accepted the lowest competitive tender, that of Dick, Kerr & Company, for 200 electric cars, including provision of spare parts and contingencies, of £110,411 12s.

At Aberdeen Town Council recently a protracted discussion arose over the management of the Corporation electric tramways. David Moonie, the present superintendent, is to retire on an allowance of £110 a year. Two proposals were made for the future management of the tramways—one being that J. A. Bell, city electrical engineer, should have entire control of the system, and the other that J. D. Caird, the present acting superintendent, should be appointed manager. In the end the Council, by a large majority, remitted to the Tramways Committee to define the duties of the manager and fix the salary, with a view to advertising the vacancy.

The latest addition to the network of council-owned electric tramways rapidly covering suburban Essex was recently inaugurated when eleven miles of the Walthamstow system were declared open by C. J. Wilkes. This is the first electric tramway to enter Epping Forest, through which it runs for two miles. Inter-communication is also now opened up between Walthamstow, Leyton, Chingford, Woodford, and Tottenham, and the Great Eastern Railway is to be asked to issue through tickets from Liverpool street to the portions of the forest lying around Walthamstow and Woodford, available at the forest end of the journey on the council's trams.

As showing the trend of railway companies to keep the local traffic in outlying lines in their own hands, and to enable them at a moderate cost to give a frequent and economical service, hitherto unobtainable by regular train service, the following orders which have recently been placed will be found interesting.

The directors of the London, Brighton & South Coast Railway Company have recently placed a contract with Beyer, Peacock & Company, Limited, of the Gorton Foundry, Manchester, for two steam motor cars, to be run this summer between Hastings and Eastbourne, of somewhat similar design to those the Gorton firm has just completed for the North Staffordshire Railway Company. The same company has ordered from Dick, Kerr & Company, of Preston, Lancs., two petrol-driven motor vehicles, which will be of similar type to those recently put on the G. N. R.'s Hatfield-Hertford branch line. The Great Northern is also to start a motor car service on its St. Alban's Hertford section, and has ordered two steam motor cars from Messrs. Kitson & Company, of Leeds, two from Kerr, Stuart & Company, Limited, of Stoke-on-Trent, and two from the Avonside Engine Company, of Bristol. These vehicles are to be fitted with locomotive type boilers and will have a seating accommodation for 50 passengers.

It is proposed to promote in the next session of Parliament a bill asking for powers to construct the South Manchester Electric Railway to connect the outer Cheshire suburbs and the city of Manchester. The proposed railway will be an express suburban cross-country "belt line" of standard gage and constructed as a light railway, the main line being about 16 1-2 miles long, and the branches bringing the total mileage up to about 26 miles. The line is intended for both passenger and goods traffic, and will transversely intersect and connect all the existing southern trunk lines from Manchester to London. It will commence from a proposed new centrally situated terminal station on the southern outskirts of the city, thence running out about seven miles southwestwards direct into Cheshire, and thence through the outer belt of North Cheshire suburban residental districts, at an average radius of nine miles from the Manchester Town Hall, and terminating at a proposed new station at Hazel Grove, adjacent to the Stockport Corporation tramways terminus, and to the Midland Railway Company's new main line station. A. C. S.

COOLED AIR FOR THE NEW YORK SUBWAY

Refrigerating plants and forced-air apparatus are to be installed in the subway to cool the air and improve the ventilation. This was announced by Controller Grout, on June 22, after the Rapid Transit Commission had discussed various ventilation plans. Tests are to be made as soon as possible at two or three of the stations, and then, if the apparatus proves efficient, the entire subway will be equipped with the plants. Chief Engineer Rice was instructed to install some device "at once," and later it was determined to make the first test with refrigeration and forced air, the impression of the engineers and of the commissioners being that the air in the subway was pure enough, but that it needed cooling.

The subject of subway air came before the commissioners when the secretary read a letter from Dr. Darlington, health commissioner, requesting the Rapid Transit Commission to consult with his department before taking any steps toward the ventilation of the subway, and also submitting to him any and all plans for the ventilation of future subways. Controller Grout immediately announced that action should be taken at once to improve the condition of the subway air, and on his motion the resolution was passed instructing the chief engineer to act. Commissioner Smith wanted to have a fan system installed in the tunnel on the ground that even if this did not cool the air it would make the people believe it was cooler, and would look cooler. Commissioner Starin wanted a partition between the north and south bound tracks so that the suction in each section of the tunnel would be entirely in one direction. Chief Engineer Rice said that this was not feasible.

Mr. Rice said he already had engaged George A. Soper, a bacteriologist, to make a scientific investigation of the subway to ascertain just what the defects are. Mr. Rice will seek to have drip pans installed on cars so as to catch the surplus oils.

INDIANA SANITARY RULES ADOPTED

At a conference held between the Indiana State Board of Health and representatives of the interurban and street railway companies, rules were agreed upon governing the sanitation of interurban and city trolley cars. The board had drawn up a system of proposed rules as published in the Street Railway Journal of June 17, and these were discussed, modified to some extent and adopted. The rules provide for a thorough cleaning and scrubbing of the cars, and disinfecting the same. Similar, if not more stringent, rules were adopted for steam cars. The following interurban men were present at the conference: A. A. Anderson, general superintendent of the Indianapolis & Cincinnati Traction Company; W. G. Irwin, Indianapolis, president and general manager of the Columbus & Southern Traction Company line; H. A. Nicholl, general manager of the Union Traction Company, and L. M. Clark, master mechanic of the Indianapolis & Northwestern Traction Company.

TWELVE HUNDRED MILES BY TROLLEY

Robert H. Derrah, the originator of the Boston-New York trolley trip, and the general passenger agent of the Massachusetts Electric Companies, is the author of "Twelve Hundred Miles by Trolley," a small booklet distributed through the Metropolitan News Company, of Boston. Mr. Derrah has crowded into the 64 pages of text all the information that the most exacting traveler by trolley could desire about the historical places, seashore resorts, rivers, valleys, lakes and picturesque suburban scenery of Eastern Massachusetts. The traveler by trolley in New England would do well to call upon Mr. Derrah at his office at 309 Washington Street, Boston. Here he will find a corps of assistants at his service, and may be benefited by suggestions which they may make. It is a base from which to plan the most strategic operations. In any event, Mr. Derrah's guide will prove of great assistance and should be included as a part of one's equipment. The price is 10 cents a copy.

CHICAGO TRACTION MATTERS

The traction companies of Chicago, through their attorneys, met the local transportation committee and Mayor Dunne last week, and presented a proposition by which the city could acquire the street railways for municipal ownership. The following is an outline of the plan proposed:

1. That steps be taken in the immediate future for a thorough rehabilitation of the properties, so that the service shall be of the best, all at the expense of the owners.

2. That such work be done upon plans to be agreed upon with the city and subject to the approval of the city's experts.

3. That the city shall have immediate representation upon the board of directors or otherwise provide for co-operation between the city and the companies to the common end.

4. That an ordinance be passed and accepted and submitted to popular vote providing that at the end of the period required for rehabilitation the city shall have the right to acquire the properties so rehabilitated, upon the following terms:

(a) The amount hereafter expended upon the properties under the city's supervision.

(b) The value of the present tangible properties to be determined by arbitration either now or later.

(c) The arbitrated value of such franchise rights as the courts of last resort may determine the owners are entitled to. Upon the legal questions being finally determined the arbitrators to decide the values, based upon such decision. If desired, a number of names of men of high standing, well-known integrity and of experience, from whom such arbitrators shall be selected, to be agreed upon in advance.

5. Payment for the properties to be made in Mueller certificates, their validity being sustained in the interim by the Supreme Court, with such provisions in connection with the same as to render them a reasonably safe security.

6. If an understanding can be reached on the foregoing, the city to join in arguing a speedy hearing at Washington of the question of franchise rights; to make no fresh attacks upon the properties in the meantime, but to co-operate in bringing about at the earliest practicable moment the best of service for the public.

The Chicago City Railway Company suggested the following as a method of arriving at a settlement of the value of the property:

1. The value of its tangible property to be determined, if possible, by agreement; if not, the same to be determined by appraisers agreed upon prior to the passing of the ordinance for the purchase of the property.

2. Value of the rights of the company in the streets to be determined by appraisement immediately after the final determination of the suits now pending in relation to said rights; the appraisers to be agreed upon prior to the passage of the ordinance for the purchase of the property.

3. Plans to be prepared at once, under the joint supervision of the city and the company, for the rehabilitation of the railway property; also draft of mortgage to secure Mueller certificates; and ordinance, prescribing the terms upon which company shall operate until purchase by city is completed, shall be prepared. Upon value of company's property being ascertained, as above provided, city to purchase and pay for the same at the value thereof as so ascertained, either in cash or in Mueller certificates (provided the validity of said certificates shall have been sustained by the Supreme Court of Illinois), unless the city shall elect to have the property rehabilitated before purchase.

4. When the validity of the Mueller certificates shall have been sustained by the Supreme Court of Illinois, and plans for the rehabilitation of the railway property shall have been agreed upon between the company and the city, such rehabilitation shall, if the city shall so elect, be proceeded with at once under the supervision and control of the city, at the expense of the company, but such rehabilitation of the property shall not be proceeded with until an ordinance providing for the issuance of Mueller certificates to pay for the company's property shall have been submitted to a vote, and been ratified by such a vote, as required by law.

In the event of the rehabilitation of the property at the expense of the company, the cost thereof shall be added to the purchase price of the property, and the city shall complete its purchase when the property shall have been rehabilitated.

In the event of the rehabilitation of the property before purchase by the city, such rehabilitation may be made either by the company or its nominee or assigns, the company guaranteeing the performance thereof.

Mayor Dunne objects to the plans proposed. He said at the conference:

"My objections to the plan proposed by the traction companies are two: First, that it provides for the settlement of the alleged rights under the ninety-nine-year act in the Federal courts at Washington as the tribunal of last resort. I am of the opinion that the State courts are the courts of proper jurisdiction in the determination of these rights.

"Second, I am opposed to the proposition submitted by the traction companies because it provides for the arbitration of the so-called ninety-nine-year franchise at some time in the dim and distant future, thus leaving the value of the property to be acquired by the people of this city uncertain and undetermined, while in the meantime the city will be locked up by a contract with these companies under which they would have the right to occupy our streets without the people being informed as to what they would eventually have to pay for the property.

"My proposition for the determination of the value of these unexpired franchises is to settle the value of these franchises by agreement now as follows: First, upon the assumption that the city's contention in reference to the ninety-nine-year act is correct; second, upon the assumption that the companies' contention is correct as to their right; third, upon the assumption that Judge Grosscup rightly and properly decided the ninety-nine-year question.

"If the companies would agree to three prices in the alternative, and the three prices were fair, just and reasonable, it might be possible to arrive at some conclusion. Otherwise, I am not in favor of accepting the proposition in its present condition, providing, as it does, for the determination of the value of the ninety-nine-year franchises in the distant future."

Negotiations appear to be off between the city and companies. Mayor Dunne's "immediate municipal ownership" plank upon which he was elected last April, appears to be about as much of a dream as those who were familiar with the Chicago traction situation knew it to be at that time. In the meantime the Mayor is going ahead with plans to build 100 miles of municipal street railway on streets where franchises have or soon will expire.

THE PHILADELPHIA AND WESTERN

Recent developments indicate that the Pennsylvania Railroad is financially interested in the Philadelphia & Western Railway, the third-rail electric line being built from Sixty-Third and Market Streets to Wayne. It is said that this line is to be a part of a general plan devised by the Pennsylvania Railroad for the relief of its increasing suburban traffic along the main line, and to provide a right of way for the completion of the low-grade freight line which it is proposed to extend into West Philadelphia. It is possible that the ownership of the electric line may eventually pass into the hands of the Pennsylvania. Much secrecy has been maintained by President Van Brunt and General Manager Bramlette, of the Philadelphia & Western, as to their plans. Contracts for the construction of the line have been awarded to the Southern Construction Company.

STEAM TURBINE EQUIPMENT FOR RAILWAY SERVICE

An important contract for a 10,000-hp power house equipment has just been awarded to the Westinghouse Companies, Pittsburg, Pa., by the Fort Wayne & Wabash Valley Traction Company, of Fort Wayne, Ind. The entire electrical equipment, comprising both three-phase and two-phase apparatus, the former for railway, and the latter for lighting service, will be built by the Westinghouse Electric & Manufacturing Company, and the steam turbines by the Westinghouse Machine Company.

The principal apparatus covered by the contract comprises two 1500-kw and one 400-kw turbo-generator units, delivering 375 volts, three-phase, 25-cycle current to rotary converters, and two 1500-kw and one 500-kw turbo units, delivering 2300 volts, two-phase, 60-cycle current to step-up transformers for the lighting system; four rotary converters; seven 375 kw, fifteen 75-kw, six 100 kw, and three 150-kw oil-insulated self-cooling transformers; four switchboards for 125, 550, 600 and 2300 volts, and low equivalent ligtning arresters, choke coils and disconnecting switches are included in the equipment. The steam turbine equipment is to be of the standard Westinghouse-Parsons type, operating under 150 lbs. steam pressure. Many distinctive features will be embodied in the arrangement of the new power house now building.

TWO HUNDRED CARS FOR BALTIMORE

The J. G. Brill Company has just received an order for 200 semi-convertible cars from the Baltimore United Railways, of Baltimore, Md. The order calls for 160 cars to be mounted on the builders' No. 27-GE-1 truck, which is a short base double truck with solid forged side frames, and 40 cars to be mounted on the builders' high-speed, No. 27-E-1, which also has solid forged side frames. The cars are all to be 30 ft. 8 ins. over the bodies, and will have 5-ft. platforms. The 160 cars mounted on the short-base trucks are for city service and will have portable vestibules, and the 40 mounted on the high-speed trucks will have stationary vestibules, and will be run on a division extending for some distance out of the city. The semi-convertible window system will include the recent improvement which eliminates the sash trunnions and runways formerly used, and simplifies the method of connecting each pair of sashes. The general plan of the lower sash carrying the upper into pockets in the side roofs is preserved. The arrangement has come to be known as the "grooveless post semi-convertible." The decks are to be the standard monitor type, and the seating plan consists of transverse seats with reversible backs and longitudinal corner seats accommodating four passengers each.

THE YARDVILLE CROSSING LITIGATION

The Trenton Street Railway Company has received another setback in the famous Yardville crossing case, in which the Court of Errors and Appeals reverses the decision of the Court of Chancery, by the terms of which the Trenton Street Railway, or its subsidiary company, the Mercer County Traction Company, was permitted to cross the Pennsylvania Railroad tracks at Yardville, 5 miles southeast of Trenton, N. J., at grade. The court's opinion is to the effect that the ordinance passed by the Hamilton Township authorities for the benefit of the Mercer County Traction Company, was void because the proper number of consents had not been secured from the property owners fronting upon the public highway, alongside of which the track is built.

The case has been before the courts of the State five years or more. First of all, the Trenton Street Railway Company extended its Broad Street Park line to White Horse and Yardville, building the road also on the south side of the Pennsylvania Railroad at Yardville to Crosswicks, pending the settlement of a crossing of the Pennsylvania tracks. No agreement being reached, the street railway company sought the courts to have the method of crossing determined, and the Pennsylvania company went into the fight with a vim. After carrying the case through all the courts it was decided that the Trenton Street Railway had no legal existence at Yardville, because the extension from Broad Street Park was an extension of a short extension which had no legal existence, since one of the formed companies operating the line had failed to accept the ordinance, although building a small piece of track under its provisions.

With this first decision from the highest court was an injunction restraining the Trenton Street Railway Company from operating any part of the line beyond Broad Street Park.

The Trenton Street Railway immediately transferred its Broad Street Park-Yardville line to the Mercer County Traction Company, and that company sought a crossing at Yardville. After long delays in the courts and a wandering through small technicalities, it was first decided that this road could have no legal existence, because the Trenton Street Railway already operated a line over the route chosen, but this was practically disproved, and it was then held that the road was not legal because it had no franchise. In the last decision handed down in the Court of Chancery, Vice-Chancellor Reed held that the new franchise granted by Hamilton Township was legal because, technically, no street railway existed over the route covered by the ordinance. He also held that the consents given by the property owners were legal, although given prior to the time the Mercer County Traction Company filed with the Secretary of State a map of its proposed route. On this latter point the Court of Errors differs with him, although agreeing with him in the first instance, as to the legal existence of the Trenton Street Railway tracks.

The various decisions emphasize the necessity of watching the small technicalities of the street railway laws in New Jersey, and conforming to them in every particular, so that when a legal battle is fought with a steam railroad company it may be upon equal grounds. Not a single thing has been brought to show that the street railway is not wanted or needed at Yardville, nor that the crossing would be dangerous.

PERSONAL MENTION

MR. LEVERETT M. CLARK, prominently connected with the engineering department of the Indianapolis Traction & Terminal Company, of Indianapolis, was married in Willimantic, Conn., on Wednesday, June 21, to Miss May A. Murphy, of the latter city. Mr. and Mrs. Clark will spend a few days in Boston, after which they will locate permanently in Indianapolis. Mr. Clark formerly was connected with the Willimantic Traction Company.

MR. ARTHUR W. PRATT has severed his connection with the Public Service Corporation to accept a position with the United Railways & Electric Company of Baltimore. Mr. Pratt has been in the employ of the street railways now operated by the Public Service Corporation for the last fourteen years, having personally superintended the construction of most of the tracks and several of the car houses, besides having been operating superintendent of two of the divisions and of District No. 2

MR. JAMES H. BRYAN, who has been president and general manager of the Woronoco Street Railway Company for a number of years, has resigned as general manager. Mr. Bryan will remain as president of the company, but feels that his health will not allow him to continue as general manager. He has devoted much time looking after the interests of the road, and his efforts have been greatly appreciated by his fellow-directors. The new manager elected is Mr. A. D. Robinson, of Pittsfield, formerly of Westfield. Mr. Robinson has been associated with the Berkshire Street Railway Company ever since it was organized, serving as secretary. He had much to do with the construction of the road, and has been active in its management ever since.

MR. CHARLES H. BIGELOW, inspecting engineer in the department of motive power and machinery, of the Boston Elevated Railway Company, has resigned and accepted a position with Stone & Webster, his first duty being to take charge of the installation of a large power plant at Dallas, Tex. Mr. Bigelow has had an extended experience in electrical and mechanical work, both before and after graduating from the Massachusetts Institute of Technology in 1892, having been with the Bell Telephone Company, of Canada, four years before entering the institute. He entered the employ of Stone & Webster after his graduation, and in 1894 entered the employ of the West End Street Railway as superintendent of construction of the East Boston power plant. Mr. Bigelow remained in the employ of the West End and Elevated ever since, holding the positions of inspector of power stations, inspecting engineer and chief mechanical draftsman of the department of motive power and machinery.

MR. EDWARD G. CONNETTE, vice-president and general manager of the Syracuse Rapid Transit Railway Company, has accepted the position of general manager of the Consolidated Street Railroad Company, of Worcester, Mass., the acceptance being contingent upon the board of directors of the Rapid Transit Company releasing him from his contract at Syracuse, which has a year and a half to run. This announcement was made upon Mr. Connette's return to Syracuse June 24, after an inspection of the Worcester lines.

EDWARD G. CONNETTE

Mr. Connette will succeed Mr. Frederick W. Huntress, who recently went to Rio de Janeiro, Brazil, to manage the street railway and electric lighting plant. The Worcester Consolidated Company owns all the trolley lines in that city, and all of the suburban lines running out of the city with the exception of the line to Boston. There are 140 miles of track in the system. Mr. Connette is one of the ablest and most progressive electric railway managers of the country. He appreciates fully that in point of service the interests of the company and the public are mutual. His progressive policy in this respect has greatly added to the prosperity of the Syracuse Rapid Transit Railway Company. During his five years at Syracuse he has improved the service and equipment, and the system has been extended in several directions. Mr. Connette has been very popular with the employees and citizens generally. Three times in the last five years he has raised the wages of the conductors and motormen voluntarily, and there has been no suggestion of labor troubles. Mr. Connette is a former president of the New York State Street Railway Association, and a member of the committee on rules of the American Street Railway Association. He has been connected with the street railway industry for over fifteen years, ten of which were spent in Nashville, Tenn., where he was manager of the Nashville street railway system, and later of the combined railway and lighting properties of that city.

MR. HAROLD ULMER WALLACE has resigned as chief engineer of the Illinois Central Railroad to become third vice-president of J. G. White & Company, and to direct the management of its construction department from the company's main offices in New York. Mr. Wallace graduated from the Chicago Manual Training School in 1892, after which he took a special course in civil engineering at Purdue University. He entered the service of the Illinois Central Railroad in 1894 as assistant engineer, and had charge of the construction work and of new concrete and masonry work. In 1896 he was appointed resident engineer of the Lake Front improvement work at Chicago, which was completed in eight months, and cost $1,000,000. From 1896 to 1900 he was roadmaster of the Chicago Terminals and the Louisville division. During the two years of his assignment to the Louisville division, its main line was entirely reconstructed. From 1900 to 1902 he was superintendent of the Freeport & Louisville division. Since 1902 Mr. Wallace has been chief engineer of the Illinois Central Railroad, and has had charge of the maintenance of way, bridges and buildings and reconstruction work, including the building and rebuilding of yards, double-tracking and grade reductions. He has also directed the construction of elevators and wharves at New Orleans, and a ten-story office building at Chicago.

TABLE OF OPERATING STATISTICS

Notice.—These statistics will be carefully revised from month to month, upon information received from the companies direct, or from official sources. The table should be used in connection with our Financial Supplement "American Street Railway Investments," which contains the annual operating reports to the ends of the various financial years. Similar statistics in regard to roads not reporting are solicited by the editors. * Including taxes. † Deficit. ‡ Decrease due to strike.

Company	Period	Total Gross Earnings	Operating Expenses	Net Earnings	Deductions From Income	Net Income, Amount Available for Dividends
AKRON, O. Northern Ohio Tr. & Light Co	1 m., May '05	78,587	40 792	37 795	22,917	14,878
	1 " " '04	74,917	39,614	35 303	22,467	12,836
	5 " " '05	340,315	191,077	149,239	114,587	31,655
	5 " " '04	316,582	184,987	131,594	112,535	19,059
AURORA, ILL. Elgin, Aurora & Southern Tr. Co	1 m., Apr. '05	35,409	20,393	15,016	9,233	5,783
	1 " " '04	33 425	22,011	11,414	9,133	2,280
	10" " '05	374,316	215,208	159,107	92,773	66,335
	10" " '04	378,055	229,589	148,466	91,774	56,692
BINGHAMTON, N. Y. Binghamton Ry. Co.	1 m., May '05	23,277	10,895	12,382	......	......
	1 " " '04	21,217	11,197	10 020	......	......
	11" " '05	234,395	124,900	109,495	......	......
	11" " '04	216,369	119,513	96,856	......	......
BUFFALO, N. Y. International Tr. Co.	1 m., Apr. '05	330,279	182,105	148,174	135,994	12,180
	1 " " '04	312,708	216,248	96,460	132,704	†36,244
	4 " " '05	1,276,511	771,852	504,659	538,821	†34,162
	4 " " '04	1,209,047	832,561	376,486	533,530	†157,044
	10" " '05	3,529,240	1,921,136	1,608,104	1,372 162	235,942
	10" " '04	3,383,812	1,997,338	1,386,474	1,329,975	56,499
CHICAGO, ILL. Aurora, Elgin & Chicago Ry. Co	1 m., Apr. '05	44,140	27,021	17,119	......	......
	1 " " '04	28 585	20,901	7,685	......	......
	2 " " '05	79,370	50,527	28,843	......	......
	2 " " '04	52,967	39,592	13,375	......	......
Chicago & Milwaukee Elec. R. R. Co	1 m., May '05	44,213	20,557	23,655	......	......
	1 " " '04	34,476	13,773	20,703	......	......
	5 " " '05	158,756	81,751	77,005	......	......
	5 " " '04	122,412	57,451	64,962	......	......
CLEVELAND, O. Cleveland Painesville & Eastern, R. R. Co.	1 m., May '05	20,681	*11,463	9,218	......	......
	1 " " '04	19 052	*10,597	8,455	......	......
	5 " " '05	75,475	*49,946	25,529	......	......
	5 " " '04	72,396	*47,420	24,976	......	......
Cleveland & Southwestern Traction Co.	1 m., May '05	47,028	26,253	20,775	......	......
	1 " " '04	41,441	25,567	15,874	......	......
	5 " " '05	188,818	121,963	66,855	......	......
	5 " " '04	160,621	119,872	40,749	......	......
DETROIT, MICH. Detroit United Ry.	1 m., May '05	433,734	*251 917	181,817	92,806	89,011
	1 " " '04	391,473	*230,536	160,937	87,395	73,542
	5 " " '05	1,884,455	*1167493	716,962	460,559	256,403
	5 " " '04	1,673,971	*1104778	569,193	443,369	125,824
DULUTH, MINN. Duluth St. Ry. Co	1 m., May '05	54,501	28 832	25,669	16,810	8,859
	1 " " '04	52,259	27,885	24,374	16 513	7,861
	5 " " '05	249,2[illegible]6	13[illegible],09[illegible]	110,196	83,752	26 444
	5 " " '04	239,368	142,695	96,673	82,362	14,311
EAST ST. LOUIS ILL. East St. Louis & Suburban Ry. Co	1 m., May '05	113,183	56.790	66,393	......	......
	1 " " '04	105,[illegible]34	55,459	49,675	......	......
	5 " " '05	530,327	237,105	293,222	......	......
	5 " " '04	478,108	240,413	237,695	......	......
FINDLAY, O. Toledo, Bowling Green & Southern Tr. Co	1 m., May '05	25,575	14,050	11,525	6,495	5,030
	1 " " '04	23,096	15,996	7,100	......	......
FORT WORTH, TEX. Northern Texas Traction Co	1 m., May '05	57,080	29,766	27,314	11,526	15,787
	1 " " '04	50,737	25,116	25,620	12,194	13,426
	5 " " '05	244,732	139 673	105,059	53,770	51,289
	5 " " '04	211,722	121,945	89,777	50,519	39,258
HANCOCK, MICH. Houghton County St. Ry. Co	1 m., Apr. '05	‡2,056	25,985	†23,929	3,615	†27,544
	1 " " '04	16,919	11,395	5,524	3,446	2,077
	12" " '05	173,308	160,148	13,160	41,280	†28,120
	12" " '04	188,189	129,226	58,963	36,332	22,630
HOUSTON, TEX. Houston Electric Co.	1 m., Apr. '05	40,377	25,311	15,066	8,713	6,354
	1 " " '04	32,049	22,078	9,971	7,941	2,030
	9 " " '05	322 737	207,116	115,621	75 708	39,913
	9 " " '04	292,239	203,875	88,365	68,922	19.443
INDIANAPOLIS, IND. Indianapolis & Eastern Ry. Co	1 m., May, 05	19,031	11 750	7,281	5,167	2,114
	1 " " '04	17,556	8,789	8,767	4,167	4,600
	5 " " '05	83,156	53,889	29,267	21,834	7,433
	5 " " '04	75,675	42,637	33,038	20,833	12,205
LONDON, ONT. London St. Ry. Co.	1 m., Apr. '05	13,508	10 510	2,998	2,063	935
	1 " " '04	12 140	9,518	2,622	2,159	463
	4 " " '05	52,520	43,692	8,828	8,235	593
	4 " " '04	44,802	39,768	5,033	8,217	†3,183
MILWAUKEE, WIS. Milwaukee El. Ry. & Lt. Co.	1 m., May '05	268,334	133,285	135,049	77,089	57,960
	1 " " '04	261,994	128 331	133,662	74 465	59 197
	5 " " '05	1 270,836	649 117	621,719	371,708	250,011
	5 " " '04	1,272,767	672,950	599,817	368,269	231,548
Milwaukee Lt., Ht. & Tr. Co	1 m., May '05	47,398	21,166	26,232	20,435	5,798
	1 " " '04	36,484	17,428	19,055	16,430	2,625
	5 " " '05	201,661	99 840	101,821	96,311	5,480
	5 " " '04	154,504	88,029	66,475	77,077	†10,602
MINNEAPOLIS, MINN. Twin City R. T. Co	1 m., Apr. '05	355,213	170,808	184,405	97,325	87,080
	1 " " '04	337,403	160,803	176,599	72,177	103,822
	4 " " '05	1,389,516	689,169	700,347	389,300	311,047
	4 " " '04	1,325,475	641,464	684,011	......	......
MONTREAL, QUE. Montreal St. Ry. Co.	1 m., May '05	236,399	134 693	101.706	28,749	72,958
	1 " " '04	220 154	126.612	93.513	22 641	70,871
	8 " " '05	1,675.791	1,120,927	554,865	169,654	385.211
	8 " " '04	1,529,307	1,018,348	510,959	149,076	361,883
OAKLAND, CAL. Oakland Traction Consolidated	1 m., May '05	124,426	62.185	62,241	32,151	30,090
	1 " " '04	113 897	53,420	60,477	26,562	33,915
	5 " " '05	567,426	298,391	269 033	......	......
	5 " " '04	497,783	258,948	238,836	......	......
OLEAN, N. Y. Olean St. Ry	1 m., Apr. '05	10 935	6,487	4,448	2,968	1,480
	1 " " '04	7,877	4,841	3 035	2,528	508
	10" " '05	94,340	48,079	46,261	26 868	19,393
	10" " '04	83,9[illegible]7	41 9[illegible]2	41,956	24,596	17,359
PHILADELPHIA, PA. American Rys. Co.	1 m., May '05	126,914	......	......	......	......
	1 " " '04	119,829	......	......	......	......
	11" " '05	1,332,660	......	......	......	......
	11" " '04	1 276,062	......	......	......	......
ROCHESTER, N. Y. Rochester Ry. Co.	1 m., May '05	146,474	75,550	70,924	27 840	43,084
	1 " " '04	123 171	66,943	56,228	26,525	29 703
	5 " " '05	672,659	371,550	301,109	136,348	164,761
	5 " " '04	580,602	338,312	242,290	131,577	110,713
SAN FRANCISCO, CAL. California Gas & Electric Corporation	1 m., Apr. '05	442 585	339,650	102 935	49,329	53,606
	1 " " '04	322 969	233,441	89,528	48 958	40,570
	4 " " '05	1,712 903	1,267,453	445 450	196 980	248,470
	4 " " '04	1,202,195	840,302	361,893	189,582	172,311
SAVANNAH, GA. Savannah Electric Co.	1 m., Apr. '05	46,333	26,521	19,811	10,554	9,257
	1 " " '04	40 941	26,004	1[illegible],937	10,306	4,631
	12" " '05	557,209	320,882	2[illegible]6 327	127,247	109,080
	12" " '04	528,067	303,224	224,843	121,883	102,960
SEATTLE, WASH. Seattle Electric Co.	1 m., Apr. '05	203,425	144,124	59,301	24,765	34,536
	1 " " '04	187 874	131,317	56 557	24,949	31,608
	12" " '05	2,367,280	1,633 666	733,614	299,948	433,666
	12" " '04	2,197,847	1,538,177	659,671	276,231	383,440
SYRACUSE, N. Y. Syracuse R. T. Co.	1 m., Apr. '05	75,743	43,875	31,868	20,450	11,418
	1 " " '04	69,040	41,223	27 817	20,348	7,469
	10" " '05	736,290	422,743	313,547	203,292	110 255
	10" " '04	695,611	405,799	289,812	202,975	86,837
TAMPA, FLA. Tampa Elec. Co	1 m., Apr, '05	33 716	20,453	13,263	1,885	11,378
	1 " " '04	30,484	18,750	11,734	2 093	9,641
	4 " " '05	128 968	78,370	50 598	7,609	42,989
	4 " " '04	111,984	65,413	46,571	8,352	38,219
TERRE HAUTE, IND. Terre Haute Tr. & Lt. Co	1 m., Apr. '05	46,761	34,779	11,982	8 744	3,238
	1 " " '04	42,045	31 586	10,459	9,178	1,281
	12" " '05	583.446	374,228	209,217	113,048	96,168
	12" " '04	507,456	336,795	170,661	98,622	72,040
TOLEDO, O. Toledo Rys. & Lt. Co.	1 m., May '05	154,492	*82 740	71,752	41,894	29.858
	1 " " '04	142,581	*78,864	63,717	41.862	21,855
	5 " " '05	732,567	*382,889	349 678	212,043	137,635
	5 " " '04	677,222	*380,023	297,199	208,706	88,493
YOUNGSTOWN, O. Youngstown-Sharon Ry. & Lt. Co	1 m., Apr. '05	43,763	*23 152	20,611	......	......
	1 " " '04	37,602	*22,856	14,746	......	......
	4 " " '05	169,547	*95,487	74,060	......	......
	4 " " '04	148,233	*92,242	55,990	......	......

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office by 10 a. m. Monday preceding the date of publication, except the first issue of the month, for which changes of copy should be received two weeks prior to publication date. New advertisements for any issue will be accepted up to noon of Tuesday for the paper dated the following Saturday.

Of this issue of the Street Railway Journal 8000 *copies are printed. Total circulation for* 1905, *to date,* 221,350 *copies, an average of* 8198 *copies per week.*

Request of the Committee on Rules

It will be remembered that at the last convention of the American Street Railway Association the Committee on Standard Rules requested that during the year all companies which had adopted the rules should report to the committee any observations as to their working, and especially any modifications which they had made in the rules. These rules will come up again for discussion at the Philadelphia convention, and it is very important that the committee shall be put into possession of all the information possible in regard to this subject. There is no branch of the work perhaps in which a greater interest is being felt not only by members of the association, but by the boards of railroad commissioners, and it is to be hoped that the request of the committee will receive prompt response.

The Lake George Convention

The success of the Lake George Convention of the New York State Street Railway Association justified the action of the executive committee in changing the date of the meeting from the fall to June. In spite of the short notice given of this radical departure from former precedents, the attendance was large and the greatest interest was taken in the meetings by the delegates present. The convention was essentially a "working" convention, and the sessions on the first day extended practically continuously through both morning and afternoon, and on the second day until adjournment at half-past two. This left but little time for excursions, or even for inspecting the exhibits, but brought out a very full discussion on the papers and question box.

The range of topics discussed was quite large, and the interest taken in them was so active that it is impossible in this issue to publish even an abstract of all of the proceedings. A report is therefore given of the discussion of the first day, notes on the convention, the paper by Mr. Wilson, of Buffalo, on "Types of Cars for City Service," and the remainder of the question box. A report of the proceedings of the meeting on Wednesday will be published in our issue of July 15.

We have taken occasion before to commend the admirable work accomplished by the New York State Street Railway Association, and the convention last week, as well as the work carried on by the association during the past year, are worthy in every respect of the past history of that body. In his devotion to the interests of the association, President Allen, like his predecessors, has made a great many personal sacrifices in the way of time and comfort, and the members of the association owe him a great debt of gratitude for his efforts in behalf of the body, both in connection with the work incident to the Lake George convention and for that accomplished during the year which has just passed. So long as the street railway interests of the Empire State can secure such presidential timber as President Allen and President Danforth, the interests of the association are in safe hands, and it is bound to enjoy an excellent reputation for good work accomplished.

Cars for City and Suburban Service

One of the questions which received serious consideration at the convention was that of the most desirable type of car for city and interurban service, and it was interesting to note the number of advocates of the short car for urban runs. For a long time the tendency has been toward longer cars for all classes of service, until now the use in cities of cars 46 ft. over all is not uncommon. Nevertheless, there seem to be many managers who believe a continuance of the use of the shorter car advisable.

In any discussion on this subject it is desirable first to define clearly the class of service under consideration, that is, whether it is strictly city, suburban, light interurban or heavy interurban, or whether it is a combination of one or more of these classes. We should then determine the effect of the proposed car on traffic, original cost and cost of operation.

City service can properly be divided into (1) that which is practically continuous and where a slight difference in headway does not materially affect the traffic, as on the trunk lines of New York, Chicago, Brooklyn, St. Louis and the largest cities, and (2) that in a smaller city where the cars run at greater distances apart and where the traffic depends to a considerable extent upon the headway of the cars. In the former case the cost of labor is the principal item in the expense of operation, and the proper length of car is practically limited only by that in which one conductor can properly collect all of the fares. In the smaller cities we believe that the other items entering into the proposition demand greater attention, and that they can fairly be divided into the effect of the proposed car on (1) traffic, (2) original cost, (3) maintenance of rolling stock, (4) maintenance of track and special work, (5) labor, and (6) power house expenses per passenger carried.

The discussion at Lake George indicated that the single-truck car is superior to the long double-truck car in counts 1, 2, 3 and 6. There was, it is true, some difference of opinion as to whether a longitudinally-seated car is as popular with the general public as a cross-seated car, but on the shorter headway which the short car would run and with an ample wheel base to prevent oscillation, we believe that there is no serious objection on the part of the short rider to a single truck car. The effect of the different types of cars on track and special work did not come up for discussion at the convention, and we should be very glad to see some testimony on this point, especially as the single-truck car has always been considered to be rather destructive of track. The labor cost is, of course, the chief drawback of the single-truck car, and it is a question for special study in each case whether the additional expense of propelling the long cars during the slack hours is going to be equal to or exceed the expense of the additional labor for the short cars during the rush hours. Theoretically, if it were practicable, the ideal solution in purely city service would be the operation of long, double-truck cars during the rush hours and of short cars during the slack hours. As this is impossible, it has been suggested that the solution most nearly approximating this condition is the employment of short cars at all hours and the use of trailers or multiple-unit trains during the rush hours. Multiple-unit trains would have the advantage that the speed would not be cut down during the rush hours, when the question of moving cars rapidly is more important than at any other time. There has certainly been a considerable change of opinion in regard to the practicability of the short car and the trailer during the last few years. Whether this will result in a return to general popularity of the single-truck car for purely urban service in cities of small size it is impossible to say, but we doubt very much whether for this class of work there is anything superior to it.

Closely associated with this question is that of the semi-convertible car vs. a double equipment of open and closed cars. In his advocacy of the cross-seat open car Mr. Root struck a popular chord, and we agree with him entirely that for roads which can afford a double equipment, especially in the Eastern States, where the open car is very strongly entrenched in popular favor as a summer car, nothing can equal it as a passenger winner. A canvass of the smaller cities, however, would show, without doubt, that the semi-convertible car is gaining in favor, and that this car may now fairly be said, more than any other one type, to be the standard, outside of New England and contiguous cities, and of the far West.

One speaker of experience in urban railway operation recommended a 20-ft. body car for city service, a 28-ft. double-truck car for suburban service, and a 34-ft. body car for light interurban service, with such variations from these dimensions as local conditions required. The latter length, we assume, would hardly be taken as a maximum for high-speed long-distance interurban lines. Nevertheless, there is no doubt that when about this length, or a little more, is exceeded the weight of a car per seat rapidly increases, and in the desire to reduce the number of car units the danger is incurred of increasing the amount of dead weight carried per passenger. We need more light on this subject, and the discussion at Lake George was one of the most instructive on this topic which has occurred at a convention for a long time.

The Trailer Question

The subject of trailers, which is also discussed in the Question Box of the State Association, shows a very considerable increase of interest in the subject, and upon the whole, good results from trying the experiment. The objections suggested by a few correspondents seem to be from a theoretical rather than a practical standpoint. A good many roads, particularly high-speed roads, hesitate to try trailers at all on account of the risk at curves. A subsidiary question is the motor equipment in case trailers are to be employed, and from the answers received it really looks as if the younger generation of street railway men had almost forgotten what a trailer was meant for. A trail car with motors is improperly so designated. The whole point of using trailers is to increase capacity without adding much to the weight and cost of equipment, and the moment one starts on multiple-unit control an entirely different situation is encountered. We have several times made a strong plea for short trains as tending toward economy and safety, but the trailer is a very different matter. We particularly wish that the matter of safety might have been more fully discussed. The roads that use trailers freely report favorably with respect to safety, while other roads seem to have been deterred by fear of danger. It is, of course, possible that roads with very sharp curves might find trouble with short and light trail cars, but we hardly see why a long, easy-riding, double-truck car should not, when properly coupled, take the curves with entire safety. Of course, if the intermediate platforms are freely used and insufficiently protected, there might well be danger of accident. Denver, which reports exceptionally good results from trailers, used a side entrance car, which tends to remove the risk at platforms. The saving of power from the use of a proper trailer system is certainly very great, and we are inclined to think on the whole the trailer is rather advantageous, assuming that there are no local conditions that set strongly against it. But we firmly believe that the trailer should be built with that use in view instead of being an old car tagged on anyhow.

Politics in Municipal Ownership

An interesting side light has been thrown this week on the practicability of municipal ownership for street railways, for which Chicago is so enthusiastic, in no less a city than Chicago itself. Mayor Dunne is convinced that Chicago can and should operate its street railway system, but at the same time is demonstrating the evils which would result from such a policy by his treatment of the fire department in that city. If there is any branch of a municipal government which should be kept out of politics, it is the fire department. Chicagoans, like the residents of New York and many other cities in this country,

have put up with politics in the police and water departments for many years, but have always insisted that the efficiency of their fire departments should not be impaired. Nevertheless, the recent experience in Chicago has shown that even in a small department of this kind, politics can be arrayed against discipline and good service, and with the chances in favor of politics.

It seems that for some time past the chief of the fire department and the firemen have been in dispute as to the hours of labor. Under present conditions the chief believes that shorter hours cannot be put in operation without vitally weakening the department, until the city's revenues shall be large enough to permit a large increase in the force. The men became dissatisfied with the ruling and formed an organization, which promptly brought their claims before the Mayor and insists upon the chief's dismissal. In the meantime, some of the men have been taking time off without leave, and the association is paying the fines for this dereliction of duty out of its own funds. This policy is followed by the association in the case of fines assessed for violations of other rules. Such action, the chief claims, is subversive of the discipline of the department.

Chief Campion, who is at the head of the fire department, has established a wide reputation as an efficient fire fighter, and the fire insurance interests as well as the representative business men have become alarmed at the situation, as they realize that no self-respecting man would consent to head the department in the case of the chief's dismissal under these circumstances. They have therefore appealed to the Mayor in several communications to support Chief Campion against the conspiracy of his subordinates. They have testified at length to his ability and integrity, and demand that he shall be supported in these two points, which are the only ones at issue in the controversy. They have claimed, and rightly, that the policy of the Firemen's Association in paying the fines assessed against individual members because of misconduct and breaches of the rules is absolutely opposed to the maintenance of that proper discipline within the department which is necessary for the protection of the community.

The question is squarely up to the Mayor, yet he hesitates. He says that his mind is in a blank about the merits of the controversy. He has taken the memorial of the Firemen's Association "into consideration" and is looking into "both sides of the question," but has given the general impression that he sides with the firemen's committee, although under the existing law he may not be able to remove the chief.

The root of the trouble, of course, is politics. The insubordinate employees have political affiliations, and their association is strong in certain districts. Its support or non-support can make or unmake aldermen, and several of the latter have already weakened under the pressure. The question is whether the Mayor can withstand the demands made upon him. His indecision has already had a tremendous effect in undermining the discipline of the department.

It is not difficult to see the effect which would follow similar tactics with a municipally operated street railway in a country where the suffrage is so broad as is our own. The employees would exercise a tremendous influence in all political matters on account of their numbers, and they would be the masters; discharge could probably be accomplished only after reference of every case to a board appointed by the Mayor and hence governed by political reasons, and the manager would be at the beck and call of every ward politician who could exert influence at elections.

The Safety of High Speed

We are glad to note that the most unhappy and lamentable accident to the Twentieth Century Limited is not to result in the abandonment of the schedule. The contingency of a maliciously misplaced switch is not to be averted by a reduction of 10 per cent in speed, nor would the results be rendered thereby perceptibly less disastrous. If speed were to be limited to a figure that would ensure safety under such circumstances the public might as well walk. The accident doubtless has lessons, but the intrinsic danger of a small increase of speed is not one of them. It is possible that a different system of signalling might have averted the disaster, but even a well-placed distance signal might have been tampered with. Of late years railway speeds have, upon the average, risen considerably, although the maximum speeds have not been greatly increased, and it is quite possible that the safety precautions have not been improved at an equal pace. A fast and heavy railway train carries a very long, dangerous space ahead of it, and the whole signalling system should be arranged accordingly. The dangerous space is that distance within which the train can be substantially brought to rest, and it obviously depends both on the weight and the speed of the train. Therefore, it must have increased greatly within recent years, for the weight of the rolling stock has increased, longer trains are run at higher speed, and the efficiency of the brakes has not increased proportionately. The longer dangerous space means enhanced danger, and the only corrective which can be applied is in the improved block system with distance signals placed with the increased dangerous space in mind.

The problem is exactly that which the electric roads have been facing in the last few years. As the weight per wheel has increased and the speed has gone up, the dangerous space has risen until the imperative need of extra safety precautions has been acutely felt, and is now being met. Cars of eight or ten tons weight, running at 10 or 12 miles per hour are easily controlled, but doubling both weight and speed brings risks which are only averted by safety devices of commensurate power. The big trunk lines are face to face with a precisely similar situation. The dangerous space of the fast trains has outgrown the safety appliances in vogue a few years ago, and there must be a prompt readjustment of means to ends. During the Zossen trials the braking problem constantly presented itself. The dangerous space lengthened amazingly, and even with the peculiar facility gained for an electric car by using the motors in braking action the need of extraordinary precautions was felt. Every railway manager should know the dangerous space with which he is dealing and should use this knowledge as the basis of remedial measures. No foresight can avert occasional accidents, but the record of the English railways, compared with our own, suggests very forcibly that the danger can be very greatly reduced. High speed in itself need not increase danger perceptibly, but high speed is an element of danger unless the precautions are increased with the speed. Certainly, foreign roads manage to get their trains over the ground at a fair rate without an annual casualty roll like that of the Russo-Japanese war, and it behooves us on this side of the water to find out the reason why. Surely, there is some manner of reason for the increased danger that is manifest here, and it is a thing which ought to be exhaustively investigated by the Government. Generally speaking, American railway methods are effective and their failure to ensure safety is so at variance with their ordinary efficiency as to be a subject for wonder.

PORTABLE SUB-STATION FOR CINCINNATI & COLUMBUS TRACTION COMPANY

BY JOHN R. HEWETT

Some two years ago the railway engineering department of the General Electric Company, at Schenectady, designed several portable sub-station equipments for operating from high-tension transmission systems. Since that date several such equipments have been manufactured, and have proved themselves useful adjuncts to the lines on which they are employed. As was at first anticipated, they have been of great service in dealing with an occasional abnormal rush of passenger traffic on lines where the usual load is light, but at the same time may be subject to sudden peaks out of all proportion to that existing during the greater part of the year. The General Electric Company has, up to the present time, designed and constructed portable sub-station equipments ranging in capacities from 200 kw to 400 kw, and these have already demonstrated the fact that they are capable of lending greatly increased flexibility to almost any existing electric railway. The equipment under consideration at present forms a 400-kw plant.

FIG. 1.—EXTERIOR VIEW OF 400-KW PORTABLE SUB-STATION, TRANSMISSION POTENTIAL 16,500 OR 33,000 VOLTS

Fig. 1 shows an external view of the Cincinnati & Columbus Company's portable sub-station, taken before it left the works at Schenectady. In this instance the machinery and apparatus are installed in a freight car of standard design. Figs. 2 to 4 are internal views, showing the arrangement of machinery, etc. Great attention has been paid to the location of the heavier units, to avoid undue strain being brought on any part of the car or machinery during the time it is in motion. The rotary converter is placed at one end of the car and the transformer at the other, in each case the center of gravity being immediately over the truck.

An equipment consisting of a rotary converter and transformer has been found by experience to be preferable to employing a synchronous motor generator set. The former not only has the advantage as regards weight, but it is also less costly, has a better overload capacity and the connections are simpler. Added to this, were a motor generator set installed, it would involve the use of an exciter set and a high-voltage starting compensator and switches.

The rotary converter installed in the Cincinnati & Columbus sub-station is a six-poled, three-phase machine with a normal output of 400 kw when running at 500 r.p.m. The potential at the d. c. brushes is 600 volts. It is fitted with a speed limiting device connected up in such a manner as to open the d. c. circuit breaker in case the speed rises above the normal, due to a failure in the a. c. power circuit, when the converter would run as a d. c. motor with a differential field.

In the first portable sub-station designed at Schenectady, three single-phase transformers were employed. But this was only due to the fact that such apparatus could be obtained at the works ready for immediate use. In the present case, one tri-phase transformer has been installed, and this arrangement possesses the two-fold advantage of being light in weight and occupying a minimum floor space. It is designed for a capacity of 440 kw, is a 25 cycle unit, and the primary is wound for both 33,000 and 16,500 volts, while the secondary delivers current at a pressure of 370 volts.

The blower set for supplying the air-blast consists of an ordinary rotary blower, direct-coupled to an induction motor; its

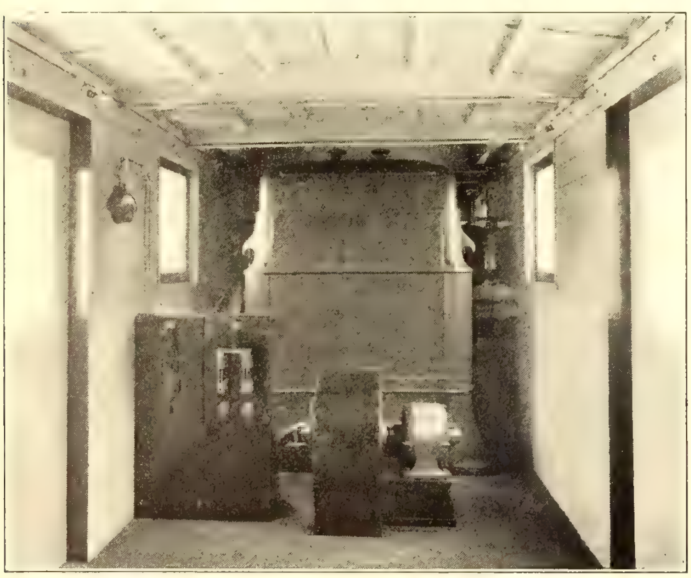


FIG. 2.—INTERIOR VIEW OF CAR, SHOWING TRANSFORMER, BLOWER SET, OIL-SWITCH LEVER AND STARTING PANEL

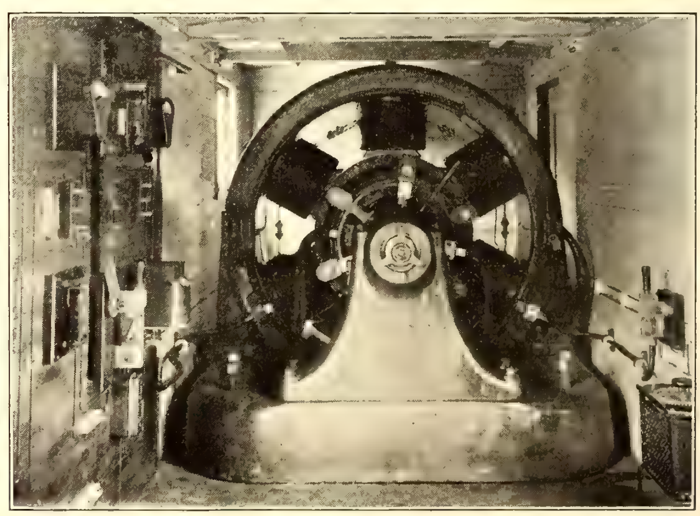


FIG. 3.—INTERIOR VIEW OF CAR, SHOWING ROTARY CONVERTER AND SWITCHBOARD

location in the sub-station will be seen on reference to Fig. 5. The details of equipment are somewhat simpler than in permanent sub-stations, certain modifications being made in the switchboard apparatus, etc., all the refinements used in permanent sub-stations not being considered necessary for portable emergency work. The switches, instruments, etc., are mounted on individual bases, which are again secured separately to a neat wooden switchboard fixed to the walls of the car. This arrangement avoids the use of large slate or marble panels, which are costly, and might easily be broken, due to the motion of the car if traveling at a high rate of speed.

The following will give a more detailed list of the apparatus installed in this portable sub-station:

1 rotary converter, provided with a centrifugal speed-limiting device, field break-up switch and necessary field rheostat.

1 tri-phase air-blast transformer.

1 complete blower set, consisting of rotary blower, direct connected to an induction motor.

The following switchboard apparatus, etc., is also provided and installed:

ALTERNATING-CURRENT EQUIPMENT

3 S. P. S. T. automatic oil switches, with operating mechanism. including electromagnetic tripping device, connected to a lever on front of panel.

1 panel for oil switch handle.

1 three-phase rotary converter starting panel, with D. P. D. T. starting switch.

1 front connected, station type ammeter.

1 set of three single-phase lightning arresters.

2 current transformers.

1 overload relay.

DIRECT-CURRENT EQUIPMENT

1 series shunt switch, mounted on machine.

1 field break-up switch, mounted on machine.

1 quick-break positive main switch.

1 equalizer switch.

1 field rheostat.

1 recording wattmeter.

1 T. F. T. ammeter and shunt.

1 G. E. permanent magnet voltmeter.

1 magnetic blow-out circuit breaker, on base.

1 d. c. lightning arrester.

As just stated, modifications are made in the electrical equipment. Knife switches, as commonly used to disconnect lightning arresters in permanent sub-stations, are omitted. In the place of Form K switches installed in brick cells with barriers, etc., the three single-pole, automatic, Form K oil switches are mounted on a frame as shown in Fig. 4. The handle for operating these is mounted on a separate panel, situated in front of the transformer (see Fig. 2), the connecting rod being carried by the side of the transformer as shown in Fig. 4. The latter illustration is of special interest, as, being taken when the transformer was removed, it shows the situation of all the high-tension apparatus behind the transformer. The lightning

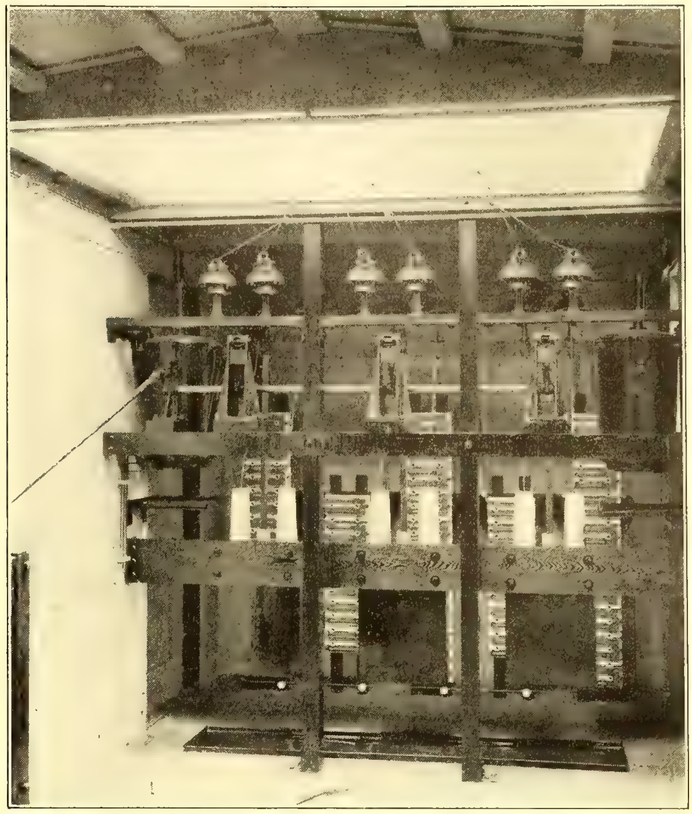
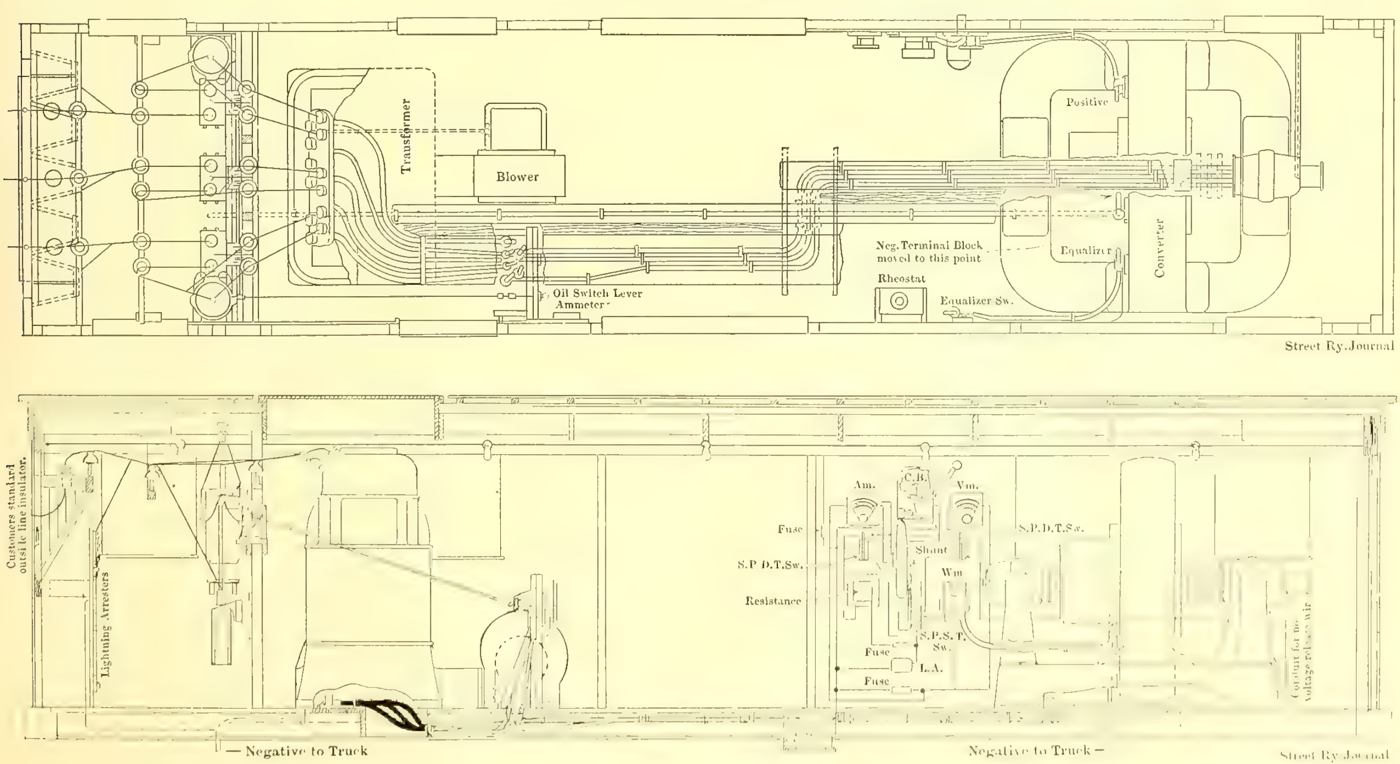


FIG. 4.—INTERIOR VIEW OF CAR WITH TRANSFORMER REMOVED, SHOWING HIGH-TENSION OIL SWITCHES, LIGHTNING ARRESTERS, CURRENT TRANSFORMER AND LINE INSULATORS



FIGS. 5 AND 6.—PLAN AND ELEVATION, SHOWING ARRANGEMENT OF MACHINERY IN PORTABLE SUB-STATION

arresters, which are of the General Electric standard pattern for 33,000 volt circuits, the current transformers, the high-tension oil switches, and the high-tension leads and insulators, are all clearly seen. It will be noted that no high-tension apparatus is brought in front of the transformer, a factor which insures the safety of the sub-station attendant.

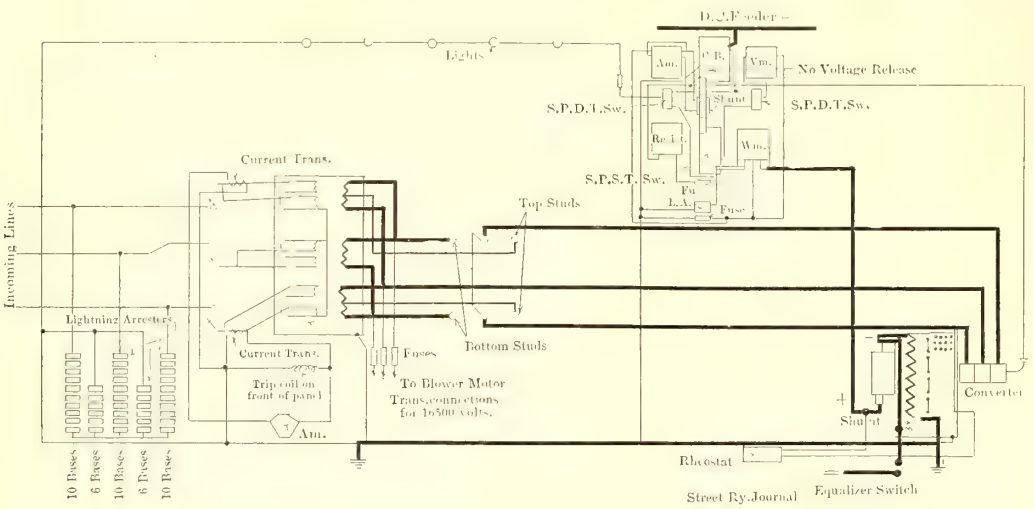


FIG. 7.—DIAGRAM OF CONNECTIONS FOR 16,500 VOLTS

The usual form of low-tension a. c. starting switch is retained, and no d. c. starting rheostat switch, or synchronizing apparatus is included in the equipment. Both power factor indicator and a. c. voltmeter are also dispensed with. No negative switch is provided, the negative terminals of the machine being connected directly to the metal truck, which is, of course, in metallic connection with the track. The rotary converter is compound wound, with the series coil on the negative side—that is to say, between the armature and ground connection. An equalizer switch is provided on the negative side of the machine for use when the car is in operation as a reserve to a permanent sub-station close at hand. The equalizer switch running to a flexible jumper can readily be connected to the equalizer bus bar in the neighboring sub-station; and again, the jumper can be connected to the ground should it become desirable to run the converter as a shunt-wound machine.

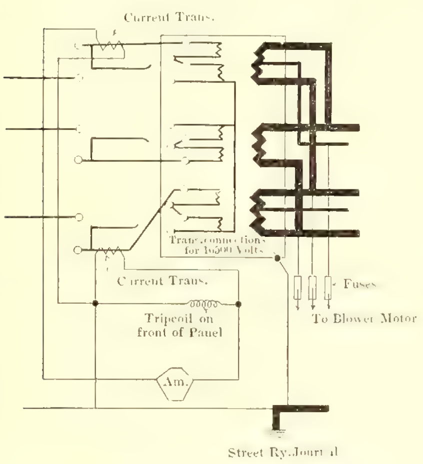


FIG. 8.—DIAGRAM OF CONNECTIONS FOR 33,000 VOLTS

The sub-station can be lighted from either the trolley or the rotary converter; and the voltmeter is provided with a double-throw switch to permit readings being taken of either the trolley or machine voltage at will. A flexible lead is taken through the wall of the car directly from the machine circuit-breaker to a terminal block on the outside, so that connections may readily be made to the trolley wire, d. c. feeder, or positive bus bar in the permanent sub-station, as occasion demands. The a. c. leads are carried out through a special weather-proof entrance, which is plainly seen in Fig. 1, and from this point connections are made to the overhead high-tension transmission lines.

Figs. 5 and 6 are respectively a plan and elevation showing the general arrangement of machinery and apparatus, and give a clear conception of the connections. In Fig. 6 the way of introducing the high-tension leads to the sub-station is clearly shown, and the opening in the roof, through which the transformer is introduced, will be noted. The end of the car near which the rotary converter is located is made detachable, to facilitate installation. The rotary converter is held in position by means of wooden cleats, which fit snugly to the interior form of the base, and provision is also made for leveling the rotary converter, should it be found necessary for the sub-station to be operated on a grade. As will be seen in Fig. 6, all the wiring from the transformer to the rotary converter is carried under the floor.

Figs. 7 and 8 show the scheme of connections diagramatically. In the former the transformer connections are for 16,500 volts, and in the latter for 33,000 volts.

The approximate dimensions of the car are:

Length	41 ft.
Width	9 "
Height	8 " 6 ins.

The car is fitted with hand brakes, but no motors are installed, as their occasional use would hardly justify the extra expense. When the sub-station is moved, it is drawn by a motor car. During transit over the steam railroads, standard M. C. B. wheels are used, but when the car reaches its destination, these are replaced by wheels of narrower tread and shallower flanges, suitable for running over city lines, switches and points, as well as rounding curves, etc. Cars for operating on lines where little clearance is provided between the top of cars and bridges, can be supplied with hand-brake rigging mounted below the roof line.

MISTAKES IN MOTOR CONNECTIONS AND THEIR EFFECTS

BY CALE GOUGH

The leads permanently attached to the motor and the motor leads of the car cables are usually marked with brass or fiber tags in such a manner that the proper connections may be be made without difficulty. Often, however, the tags become lost, and in such an event the cables must either be rung out from the controller when the motor is connected, or the less certain cut-and-try method must be resorted to. The great number of wrong connections possible, especially with the leads of No. 1 motors, sometimes makes this latter method consume more time than would be required to test out the cables. A little reasoning from cause to effect, however, will usually make it possible to connect the leads properly on the second trial.

The accompanying figures show all of the misconnections possible, together with the effects produced. Consecutive diagrams, as Figs. 1 and 2, 3 and 4, etc., show the connections for both the forward and rear positions of the reverse handle; that is, if Fig. 1 shows the connections with the reverse forward, the connections with the reverse to the rear are shown in Fig. 2, and vice versa. The arrows indicate the relative directions of the current in the fields and armature. With both arrows pointing in the same direction as in Fig. 1, a forward direction

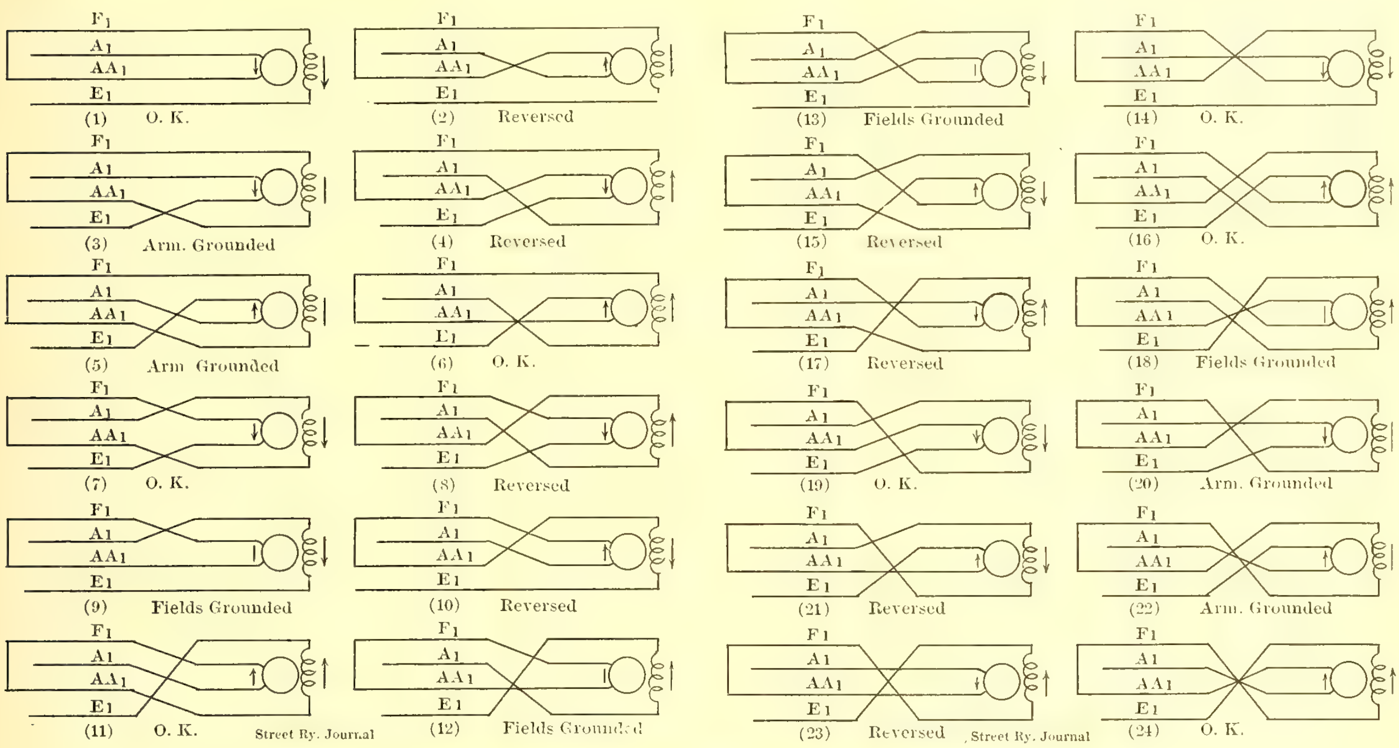
of rotation of the motors is assumed. Arrows pointing in the opposite directions indicate that the motor is reversed.

In all there are twenty-four different possible connections of No. 1 motor leads. The fact that one of the field leads of No. 2 motor is usually grounded direct on the shell of the motor limits the number of possible connections of its leads to six. Fig. 1 shows the proper connections of No. 1 motor; Fig. 2 shows the armature leads reversed, which mistake simply results in a reversal of the direction of rotation of the motor.

An interchange of the leads AA1 and E1, Fig. 3, is made evident by the fact that with the reverse lever in the forward position the motor refuses to pull on the series points, and when the motors are thrown into multiple the fuse is blown or the breaker opens. These effects are due to the fact that the armature is grounded, the fields being short circuited. The the reverse is thrown to the rear, while the remaining two cause No. 1 motor to oppose No. 2 motor.

In general the several possible connections may be divided into three distinct groups: (1) Those giving forward and reverse direction of rotation of the motor with different positions of the reverse handle; (2) those by which the armature is grounded with one of the other positions of the reverse handle, and (3) those by which the fields are grounded with one or the other positions of the reverse handle. Those of the first class cannot be distinguished from each other by the action of the motor. However, should the motor operate in a direction opposite to that corresponding to the position of the reverse handle the fault may be corrected by simply interchanging the armature leads of the motor.

The connections of class two and class three are distin-



DIAGRAMS SHOWING POSSIBLE CONNECTIONS OF THE NO. 1 MOTOR LEADS

fact that when the reverse is thrown to the rear the motor tends to operate in a reverse direction distinguishes this misconnection from those shown in Figs. 5 and 20. There is, however, no way of distinguishing, by the action of the motor, this crossing of the leads AA1 and E1 from the very complicated crossing of connections shown in Figs. 22. In either case the armature is grounded with the reverse forward and throwing the reverse to the rear reverses the motor. In the same way the connections shown in Figs. 4 and 21 cannot be distinguished from each other. The connections indicated in Figs. 5, 6, 19 and 20 may be recognized by the fact that the armature is grounded for one position of the reverse handle, while the motor operates in the proper direction when the reverse is thrown. Figs. 7, 16 and 24 show connections permitting the motor to operate properly. It may be noted that in Figs. 7 and 16 the fields are placed in the circuit on the trolley side of the armature. The connections shown in Figs. 7 are often used by those who believe for various reasons that the fields should be placed in circuit on the trolley side of the armature.

Four connections, Figs. 9, 12, 13 and 18, give grounded fields and short-circuited armatures. Such connections would cause the motor to act as a generator, being dragged by No. 2 motor. Two of these connections, as in the case of those causing grounded armatures, give forward direction of the car when guished from each other by the fact that in one case the motor exerts no torque when the controller handle is in the series position and the reverse is thrown in one or the other direction, while in the other case the short-circuited armature causes the motor to act as a generator retarding the movement of the car. The different connections in these two classes may be further identified by noting the position of the reverse handle when the motors operate, and by this means the mistake may be recognized as being due to one or the other of two possible connections.

The only possible connections of the leads of No. 2 motor when the fields are grounded direct on the shell are those shown in Figs. 1, 2, 9, 10, 13 and 14. All of these may be definitely identified at once by observing the action of the motor and the position of the reverse handle.

It cannot, of course, be presumed that the car house man becomes so familiar with the several misconnections and their effects as to recognize at once the proper changes to be made. Rather than spend so much time in studying possible mistakes it would be more economical and more satisfactory in general to keep the leads properly marked and thus avoid mistakes.

The officials of the Indianapolis, Columbus & Southern Traction Line have been notified that a regular pouch mail service will be started on that line by the United States Government.

VIENNA-BADEN SINGLE-PHASE RAILWAY

The Austrian Siemens-Shuckert Works, of Vienna, is preparing to convert the Vienna-Baden division of the Vienna Tramways now operated partly by steam and partly by direct current. Most of the line is double track with standard gage, and has a total length of about 28 km (17 miles), the steepest grade being 2.75 per cent, and the shortest curves 16½ meters (54 feet). It is to be noted that this line enters the centers of both cities over the tracks of the local street railway lines. These city divisions are respectively 4.3 km (2.6 miles) and 2 km (1¼ miles) in length, and over them the cars will use direct current at 550 volts. Only on the actual interurban division, which is about 21 km long (12.6 miles), 500-volt single-phase current will be used. The power house of this division is about 2 km (1.2 miles) from Baden and contains two 200-kva, 10,000-volt single-phase generators; one 550-volt, 165-kw, direct current generator; and two revolving transformer sets, each consisting of one 150-kva, 10,000-volt, synchronous, alternating-current generator, a direct current 100-kw, 550-volt machine for an 11-ton fly-wheel, and lastly, an accumulator battery. The high tension of 10,000 volts is divided into six divisions along the line for the corresponding step-down transformer stations.

The motor cars are furnished with two single trucks and carry four-series motors rated at 50 hp each for one hour's run. Series and parallel connections with resistances are provided, both for the direct-current as well as the alternating-current service. For the alternating-current work there is also a transformer with six voltage taps, three of which are for stepping down and three for raising the operating voltage of the motors, thereby regulating their speeds. The motors are planned for a maximum speed of 60 km (36 miles) per hour. The initial equipment consists of thirteen motor cars weighing 18½ tons each, and eighteen trailers of 10 tons each. The schedule has been so planned that with the shortest headway of 15 minutes expresses can be run as well as locals. The express trains are expected to operate at 35 km (21 miles) an hour. The largest number of cars which is contemplated to operate for the summer traffic is at the present time placed at 21 to 45 express cars and 17 and 16 locals for week days and Sundays, respectively. It is believed that the entire division will be ready for service about the middle of 1906.

TRAIN CREWS' REPORTS OF CAR DEFECTS

The Schenectady Railway Company has recently instituted a comprehensive system of reports whereby the train crews make daily record concerning the condition of the cars in their charge. It is pointed out that inasmuch as troubles and defects in cars and equipments are usually first noticed in the operating department, there should be a systematic method whereby the car crews can each day report to the mechanical department any defects or troubles in connection with their cars.

For this purpose blanks are provided, a sample of which is reproduced in this connection. The blanks are 13¾ ins. long x 5½ ins. wide, and there are four sets of the same blank used, one printed on white paper, one on pink, one on blue and one on yellow. These are supplied in pads to the car houses from which cars leave. On turning his car in, the motorman, if he has discovered any defect or has had any trouble with his car, marks an X in column headed "Motorman's Report," opposite the particular defect noticed. The list of "troubles" has been carefully selected to include all the common defects in car body, motors, trucks, controllers, air brakes, etc. The white blank goes to the superintendent's office and is at the disposal of the claim department. The pink blank goes to the general manager's office. The blue and yellow blanks go to the master mechanic's office, one being filed under the car number and one under the motorman's number.

It will be evident that the system accomplishes a number of things. Primarily it keeps all departments informed as to the condition of cars. It also serves as a check on employees, both in the operating department and in the mechanical department. As soon as a car is turned in it is inspected by the barn foreman's force, and a record is made in the column headed "Barn Foreman's Report." This report checks against the motorman's report, and if the barn foreman finds troubles not reported by the motorman, or if the motorman reports defects not noticed by the foreman, the discrepency is at once evident in the office, and the knowledge of this fact tends to keep up the watchfulness and interest of all employees. Furthermore, the two sets of blanks filed in the master mechanic's office give an accumulating comparative record of the behavior of each car and its equipment, and also affords a tab on the efficiency of individual motormen. For instance, if one man seems to be having an unusual number of troubles with his car, investigation can be started to determine if, possibly, the trouble does

SCHENECTADY RAILWAY COMPANY.

Motorman's Report of Defects in Car No.______

Date________ 19__ ______ A. M. ______ P. M. Route________

Place of Trouble ________________

Motorman ________________ No.____

CAR BODY TROUBLES	Motorman's Report	Barn Foreman's Report
Bell		
Bell Cord		
Brake Chain		
Broken Fender		
Broken Glass		
Broken Panel		
Broken Steps		
Car Dirty		
Car Floor		
Car Seats		
Curtains		
Dash		
Draw Bar		
End Door		
Gong		
Grab Handle		
Handstraps		
Heaters		
Light or Light Switches		
Register		
Register Rod or Handle		
Side Door		
Signs		
Ventilator		
MOTOR TROUBLES		
Armature Shaft Bent		
Armature Trouble		
Broken Gear Bolt		
Brush Holder		
Commutator Worn Bad		
Field Burned Out		
Field Wire Burned off		
Motor Bearings		
Motor Bucked		
Motor Flashed		
Motor Leads		
TRUCK TROUBLES		
Brakes Chatter		
Broken Brake Rigging		
Broken Spring		
Can not Brake Car		
Emergency Brake		
Flat Wheel		
Hot Box		
Need New Shoes		
Split Switch at		
Snow Scrapers		
Sprung Axle		
Truck Noisy		
CONTROL TROUBLES		
Circuit Breaker		
Circuit Control Magnet		
Controller		
Fuse Blows		
Hood Switch		
Jumps in Multiple		
Jumps in Series		
Miscellaneous		
Resistance Grids		
Reverser		
Slow in Multiple		
Slow in Series		
Trolley Base		
Trolley Pole		
Trolley Wheel		
Trolley Wire		
AIR BRAKE TROUBLES		
Air Whistle Out of Order		
Brakes do not release quickly at times		
Brakes do not stop car quickly enough		
Compressor Fuse Blown		
Compressor Out of Order		
Governor Does Not Work		
Motorman's Valve Leaks		
Motorman's Valve Stiff		
No Motorman's Report		
Reservoir Hose		

Signed________________ In Charge

Place check mark (X) opposite defect reported. If the defect cannot be readily located give in addition to check mark particulars on the other side of this sheet which will assist in locating trouble.

SCHENECTADY RAILWAY COMPANY'S BLANK COVERING REPORT ON CAR DEFECTS

not lie as much with the man as with the car. The idea is not to continually pick flaws in the work of the men, but to co-operate with them in increasing the general efficiency of the force. The men understand this and are in entire accord with the objects of the system. The blanks and system were developed by J. G. Baukat, master mechanic of this railway.

PROCEEDINGS OF THE LAKE GEORGE CONVENTION

The twenty-third annual meeting of the Street Railway Association of the State of New York was held at Fort William Henry Hotel, Lake George, N. Y., on June 27 and 28, 1905.

The meeting was called to order by President C. Loomis Allen, of Utica, at 11 o'clock on Tuesday morning. On motion of J. H. Pardee, duly seconded and carried, the official registration made by the secretary was accepted in lieu of the roll call. On motion of E. H. Peck, duly seconded and carried, the minutes prepared by the secretary and printed recording the proceedings of the twenty-second annual meeting were approved.

The president then read his annual address as follows:

PRESIDENT'S ADDRESS

At the last annual meeting of this association the executive committee was, by unanimous vote, empowered to change the time of the next annual meeting, and was also authorized to select a suitable place for the holding of the same. In acordance with this authority the executive committee selected the Fort William Henry Hotel, Lake George, and Tuesday and Wednesday, June 27 and 28, were the dates selected as the time for the holding of the twenty-third annual meeting of this association.

The change in the dates seemed to be necessary to meet all existing conditions. The American Street Railway Association has desired for many years to hold its annual meeting in September, and it was believed by your executive committee unwise to hold the New York State convention the same month. Furthermore, to obtain a suitable location where the delegates, guests and supplymen would find suitable and roomy quarters underneath the same roof, it was necessary to hold the convention at a time when some of the large summer resorts were open. There is much that might be said in favor of changing the date of the meeting from a fall meeting to a spring meeting; the most forceful argument being that there would be more time for the preparation of papers to be read at the annual meeting, and better preparation for the discussion of the same prior to July 1, than after that date.

Our fiscal year, which is about to close, has been one of commercial prosperity, as well as one of advancement in the science of transportation. The best energy and brains of our country are engaged in solving difficult transportation problems, and this is evidenced by the inauguration of quick and convenient rapid transit service in New York City, on Oct. 27, 1904, upon which date the subway system of the Interborough Rapid Transit Company was opened to passenger traffic. The rapid transit facilities offered by the subway in the territory which it serves are unparalleled in the transportation world.

Our brethren of the steam railway field, who for many years thought electricity impractical and not feasible as a motive power, are not only considering the same favorably, with a view to recovering the local traffic, which was decreasing where better served by electric traction, but are installing the same at the large terminals, for the purpose of handling not only local traffic, but the heavy limited trains as well, at these points. At the last annual dinner of the Transportation Club in New York City, so eminent an authority as the Hon. Chauncey M. Depew stated that within ten years the usefulness of the steam locomotive would be over.

Experiments that are being conducted on the New York Central's experimental track, immediately west of Schenectady, have demonstrated that the electric locomotive is not only capable of performing the service now being handled by the steam locomotive, but that the same service can be performed at considerably less cost. It is hardly necessary for me to state that it is impossible for one to foretell the advancement and improvements which will be made in transportation facilities in the next decade, due to the adoption of electricity as a motive power, but the street railways who have experimented and fostered the development of electric traction can justly claim a portion of the credit from the success achieved in electric traction due to the development which is sure to follow.

The legislature, after a session lasting 125 days, adjourned without passing any measure adverse to street railway interests. The only measure becoming a law that might be considered burdensome to street railways is the act which increases the Board of Railroad Commissioners from three to five members. The only criticisms that might be made to this measure are the increased cost to the railroads of maintaining this commission, together with the fact that this tribunal might be, by reason of increased numbers, unwieldy and difficult to obtain determination of questions submitted to them.

There are two things that I desire to bring to the attention of this association and to urge careful consideration, and I hope affirmative action upon the part of the association. The first is the revision of Article 4 of Chapter 39 of the general laws, known as the railroad law. The railroad law as enacted did not contemplate conditions as exist now. The demands of the public for increased transportation facilities, and the construction made necessary to give better facilities in transportation have created conditions not contemplated by the railroad law as enacted to-day. There are many legal provisions that are required by railroads in order that better facilities can be afforded the public. There are many provisions that the public require to satisfy public demands that are not to-day incorporated in the railroad law, and I believe that this association should be foresighted enough and in favor of advancement to urge upon our legislature the advisability of revising this act.

The other matter which I wish to bring to the attention of the association is the question of municipal ownership. For many years municipal ownership of public utilities has been agitated by certain classes. Discussions and agitation have steadily increased until to-day it is a subject of much discussion by writers in the daily press, the editors of our conservative magazines, and by the professors in our universities and institutions of learning. It is becoming so important to many minds, that it is believed that it will be one of the important issues in our next national election. In the early part of the winter it was my pleasure to attend a banquet where a fair-minded lawyer, of considerable repute, in responding to the toast of municipal ownership, without in any way making an expression of his opinion, occupied the time allotted for his toast in reading extracts from the published reports of Glasgow, Leeds, Plymouth and Huddersfield. This agitation and discussion are rapidly educating the public to the idea that municipal ownership is the only salvation of cheaper fares and better transportation facilities, and also to the idea that the municipality, owning and operating its public utilities, will, from the moneys derived from the net revenues of operating its public utilities, reduce the burden of taxation to a very considerable extent.

It seems to me that the public utilities, and street railway interests in particular, are derelict in their duty in failing to keep pace with the trend of public sentiment in this matter. We all know that there can be no successful street railway manager, unless that manager first considers the demand and needs of the public, and we know that the successful policy of a transportation corporation is one that, first of all, is ever particular to consider and care for the needs of the public. It is a fact, with possibly few exceptions, that the men engaged in street railway operations in the United States know less of real facts concerning the question of municipal ownership than many of the citizens that patronize street railways believe they know. We, of all others, should be the first to know, in minutest detail, the facts, figures, conditions and results of municipally operated street railways. I have read with great interest all the articles upon municipal ownership that it has been possible to obtain, but have been forced to the conclusion that these articles were prejudiced either in favor of or against municipal ownership. It is not a prejudiced statement of facts that street railway men desire. It is a true statement of conditions and facts that is needed before forming our opinions, as to whether municipal ownership is the best thing under our conditions and under our institutions. There are in this State some ninety street surface railways in operation under a common legislative act. We are reporting and are amenable to the same authorities, and our interests and conditions to a certain extent are similar. It seems to me that no better expenditure of money could be made by this association than to, at this convention, authorize the executive committee of this association to employ experts, who will make a study of municipal ownership of street railways and furnish reports to the members of the association, in such detail as we would expect to obtain from experts when examining a property with a view to purchasing its securities. Your executive committee has considered this question at two meetings and has embodied in its report a recommendation which I hope will be discussed and favorably considered before the adjournment of this meeting.

By referring to the program it will be seen that the sessions of this convention will be devoted to the reading of papers upon interesting subjects followed by discussion upon the same. The Question Box for a second time will be a feature of the convention. Copies of this Question Box have been liberally distributed, and we must all appreciate the excellency of the production. It reflects great credit upon C. B. Fairchild, Jr., associate editor STREET RAILWAY JOURNAL, who prepared the questions and edited the data containing the answers.

The manufacturers' committee has rendered good service to the association, and have obtained an exhibit in street railway supplies that is well worth the attention of every delegate. Sufficient time

has been allotted for the examination of the exhibits, and I believe the organization, known as the manufacturers' committee, will be a feature, hereafter, of our conventions.

The entertainment provided, as outlined in the programme, is for the ladies. It was deemed best that entertainment for delegates and supplymen should be confined to the annual dinner which will be held on Wednesday evening.

I wish to urge upon all delegates and supplymen the necessity of attending the sessions as outlined in their programme. The best results will be accomplished, I am sure, if we take up the business of the convention and proceed with it, leaving the entertainment feature of the convention to the ladies.

In closing, I desire to thank my associate officers and members of the executive committee for the support accorded me during my incumbency as president. Their loyalty to the organization and to the association has been unquestioned.

The report of the executive committee outlining the work of the committee during the past eight months was then read and approved, as were also the minutes of the executive committee.

The secretary and treasurer read his report, which showed a balance on hand of $1,953.25. The report, on regular motion, was approved.

MUNICIPAL OWNERSHIP.

The President—The first paper which your executive committee has seen fit to present for consideration of this meeting is on the subject, "Contrasts Between Company and Municipal Ownership and Management of Public Utilities," by Henry W. Blake, editor of the STREET RAILWAY JOURNAL, New York.

Mr. Blake then presented his paper, which was published in the STREET RAILWAY JOURNAL for July 1.

The President—I am sure we must all feel ourselves under great obligation to Mr. Blake for the preparation of his able paper. I have felt for a long time that when the question of municipal ownership was mentioned to the average street railroad man he always played safe—he shut his mouth, looked wise and said "yes." I feel that the paper that has just been read by Mr. Blake will be productive of much good. It has, to my mind, conveyed more real facts to the members of this association on the subject under consideration than any other article I have ever read or heard of. I hope you will not all "play safe" in discussing this paper, but that there will be a general expression of views upon the subject.

E. L. Gould, "Street Railway Review," Chicago—I have not prepared any thing, but will say a few things which have occurred to me as I listened to the reading of the paper. Mr. Blake seems to have laid open the question of municipal ownership and the arguments for and against it, and he has also very properly considered the difference in the conditions which prevail in different countries. In some foreign cities the natural conditions as relate to politics and the government of the cities seem to be favorable for municipal ownership, while in this country we have the political machines to watch out for, and as the success of any business undertaking depends directly on those men who are in control and plan for the success of that undertaking, we must look to the character of the men who would be in control of municipally operated street railways in this country, if the policy of municipal ownership should be established here. If we consider that when any city railway system is operated by the municipality, the men who have the operation of that system in control are given a vast amount of power in the municipality, we can see how important this question becomes from the standpoint of municipal politics. Take, for instance, such a city as Philadelphia, where there are perhaps 10,000 city railway employees, car men and other men, and each man has a brother or two, and perhaps a brother-in-law or two, and it comes around to the time for election, you can hardly estimate the power that the people in control of the operation of the city railway would have.

Then there is the question of practical results from the operation of a municipal railway—the profitableness of the proposition. You can hardly expect to elect a man to take charge of the system—perhaps a business man who is not familiar with the technical side of the operation of street railways—and have such a man take up the official duties of railway operations, and make plans for years ahead, such as must be done in any well-managed system, and expect from him the results you could get from a man who has started out in railroad work, which he has made his life's work, and which he intends to follow out all his days, and who expects to receive not only the direct financial returns from the operation of the railway, but we might say the glory of starting a railway enterprise, promoting a railway and bringing it into successful operation and expanding its field of operation year by year.

The consideration of the subject as it applies to European cities and the cities of this country, it seems to me, is a widely different proposition. At this time we have a great deal of newspaper talk about it, and sensational writers elaborate on the fact that municipal ownership gives to the passenger better service and a cheaper fare. I think if we watch the technical articles on the subject and consider the data given here by Mr. Blake, we will see that such is not the case. As an interesting point, it may be mentioned that some of the English city systems that have been held up as models have laid aside but a fraction, two-tenths of one per cent, for depreciation. It seems to me that a careful study of this question must be made, and the railway men must have the facts, the authoritative facts, on which to argue their side of the question.

Mr. Rogers, of Binghamton—If municipal ownership was a question to be decided by the clear-headed and financial men of the country, and the people having the business of the country at heart, I think this most excellent paper prepared by Mr. Blake would settle the question. Is not the question of municipal ownership most largely agitated by certain yellow journals and a certain class of people who have not the interest of the country at heart? Again, how can they acquire our properties? If they want to buy mine they can have it at a fair valuation. That is all I ask. I do not think we have anything to fear from municipal ownership. Of course, we all know how some things are done in Chicago. I think if they will only adopt it there, we will have a fair example of the matter, which will settle the question in this country. My opinion in regard to municipal ownership is that we have nothing to fear from it. We have fanatics who are discussing the matter, and we have more or less agitation in the newspapers, but I do not think there is any real demand on the part of the business people of the country for municipal ownership.

C. S. Powell—I am rather opposed to the last speaker in his opinion regarding municipal ownership. I think it is a question which the street railway man has treated rather too lightly. The facts which appeal to the public in these things are not the cost of operation, the cost of maintenance, the cost of production of power, nor the cost of carrying passengers so many miles, but it is the kind of service which is rendered by the corporation.

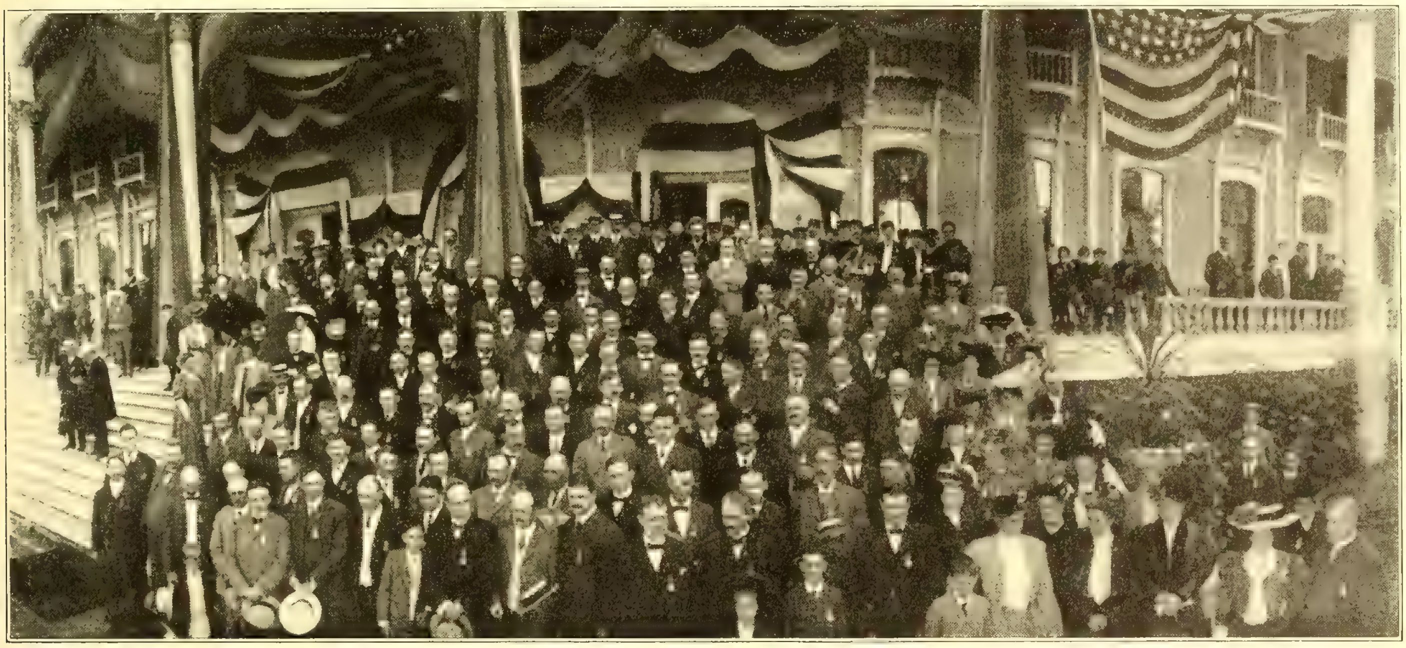
The question of municipal ownership resolves down to the question of differences in conditions. Take, for instance, the zone system of fares in Glasgow. I heard a prominent railway manager say recently that if we could establish a system of zone fares in this country we would make money very easily.

I think the companies in this country should go into this matter. They should get the data; they should find out about the service, as that is what appeals to the common people. I think if it can be shown that the service is no better than in this country, and perhaps not as good, that point will appeal more to the people here than any other argument we can make.

The President—The zone proposition was tried in the city of Cleveland at the request of Mayor Tom L. Johnson. There were three experimental zones adopted, the first being a 3-cent fare zone, running about 2½ miles east, 2½ miles south, and 2½ miles west, from the public square. Certain cars were

designated as the 3-cent cars, and no transfer privileges were given on those cars. On the same lines were 5-cent fare cars, which ran east, south and west from the square for a distance of about 9 miles, and the conductors on these cars issued transfers on the payment of the cash fare of 5 cents. I think these experiments were conducted for seven days, and at the end of that time the cars were withdrawn. As to the results of operation of these cars I recall these figures: The car miles run was increased about 14,000 or 15,000 car miles. There were added to the schedule 87 cars. The receipts during the seven days' operation were decreased over the previous seven days' operation a considerable amount.

I feel this way on the question of municipal ownership: I do not believe we have anything to fear. I believe we have all to gain, if we have a knowledge, and a true knowledge, of the facts. It may not be so with other public utilities, but I believe, from conversations that I have had with people who have made a study of municipal ownership, that street railways have everything to gain by obtaining a true statement of the facts and conditions as they exist in municipally operated cities.



GROUP OF DELEGATES AND GUESTS AT THE LAKE GEORGE CONVENTION OF THE NEW YORK STATE STREET RAILWAY ASSOCIATION

PUBLICITY AND ADVERTISING

A paper was then read on "Publicity" by J. Harvey White, of the Boston Elevated Railway Company. This paper was published in the issue of the Street Railway Journal for July 1.

The President—I am sorry indeed that Mr. White is not present to go a little bit further into this subject than his prepared paper does. Mr. White is the mouthpiece of the Boston Elevated Railway. If the railway has any statement of fact or any announcement to make, it is made through Mr. White. Their bureau of publicity follows matters that are not covered in this paper in very minute details. As an instance, a motorman of the Boston Elevated Railway may come from the western part of Massachusetts. In the course of time he takes his vacation, and it is the duty of the publicity bureau to see that when motorman John Jones takes his vacation that there is inserted in the little paper published nearest the locality in which he lives, a statement to the effect that motorman John Jones, who is running on the ——— Division of the Boston Elevated Railway, and has been in the service of the company ——— years, is at present taking his vacation at his home. Little things like that, when followed up, have been productive of very good feeling on the part of motorman Jones and his family and others.

For the purpose of obtaining discussion on this paper I would divide it into two heads. Publicity can be dealt with from the standpoint of the announcements that the corporation desires to make to the public, and also from the standpoint of advertising that the corporation desires to make to obtain patrons. We will first take up the question of dealing with the press from the standpoint of making announcements.

Oren Root, Jr., of New York—I agree with the writer of the paper very thoroughly in his high estimation of the newspaper profession and of the men who are engaged in it. I think as a class they stand well, compared with other classes of men, and I think they are susceptible to similar influences that other men are susceptible to. In a city such as New York, I think there are two classes of influences which a public service corporation may have upon the press. The first is the relation existing between the executive head or the financial interests back of the property, and the financial ownership of the paper or the controlling manager. The second influence to be exerted upon the press is the treatment of the newspaper men, the reporters, with whom the manager or his staff come in contact. I do not think you can overestimate in the long run the beneficial influence which polite and courteous treatment on the part of the officials of the railroad has upon the reporter himself, however small and unimportant he may seem, or however poorly he may be dressed. The cumulative effect of polite treatment of reporters is bound to be very great in the long run. I am reminded of an incident which occurred last year when there was some criticism being made of the New York City Railway Company on account of the number of open cars that were being operated. A reporter came to see me one night as I was leaving the house rather hurriedly, and propounded several propositions to me bearing upon the subject. I did not have time to discuss the subject very fully with him, but I gave him the facts and told him to go ahead and write an interview and I would stand for it. I was very much gratified the next morning to pick up the paper and find an interview occupying a quarter of a column, and which was far superior to anything I could have written. As another illustration, a short time ago, when there was some agitation on the part of the management of the company in the exposing of transfer frauds, we desired to get our position before the pub-

lic in order to eliminate any undue sympathy on the part of the public toward any people engaged in the transfer frauds whom we were intending to arrest and prosecute. We arrested some 150 men who were engaged in the fraud. I called up one of the reporters whom I knew and told him what I would like to have him do. I told him the whole story, including the inside facts of the case, and indicated what we would like to have published and what we would like to have left out. I said I did not want to be quoted at all in the matter. The whole conversation did not take over five or ten minutes, with the result that the next morning when this paper, one of the most, if not the most, important paper in New York, was issued there appeared an article of a column or a column and a half stating in a very favorable light our position, as far as this transfer proposition was concerned.

My experience has been the same as the writer of this paper, as regards the desire on the part of the press to report truthfully the occurrences which come to their attention, and I believe that a very large percentage of the misstatements of fact which we see in the newspapers come either from a lack of proper information, or from a desire to make a readable story, and without any desire to injure the company concerned. Some time ago there appeared in the evening paper a statement of a serious collision which was supposed to have occurred late at night in the lower part of the city between a vehicle and one of our surface cars. I noticed the account in the paper, and upon reaching my office the next morning could find no report of any such occurrence. I immediately started an investigation with the result that it was proven conclusively to my mind that no such occurrence ever took place. I got together a sufficient amount of data on the subject, and had the matter laid before the city editor of the paper which published the story, with the result that the reporter who wrote the story of the alleged accident was discharged from the paper. It seemed that the information had been turned into the office through one of the numerous runners who give information to the newspapers, with the desire of being paid for this information. They discharged the reporter on the ground that he did not properly verify the facts, which he could have done had he desired to do so. I think, as a general proposition, if you treat the newspaper men with the same consideration and apply the same rules of business amenities to them as to any other body of gentlemen, treating them politely and courteously, giving them what you want to tell them, not necessarily telling them the whole story unless you feel it is desirable, but treating them fairly, frankly and honestly, the results will be very satisfactory, and with the exception of a very few and unimportant cases you will find that they will not abuse your confidence.

W. E. Harrington, of Camden—My experience has covered, to a great extent, both views of this question. For several years one of the companies I was with was very strongly opposed to furnishing any information to the press, and for years carried out that policy very tenaciously. The result was that the company was misrepresented in very many instances, and was often placed in a very bad light. The company gradually changed that policy and began to furnish information to the press, and even went so far, in many cases, as to ask the newspapers to send a reporter to the office of the company for information, which the company freely furnished. The good results were so noticeable and so marked that it has been the practice of the companies with which I am associated and the companies generally in our vicinity to secure the dissemination of information in this way. The company with which I am now connected very frequently sends to the different newspapers in the different municipalities through which we operate notices of changes in our schedules and matters of general information; and we find without exception that the public at large is better posted upon matters pertaining to the railway company than it was before, when it was the policy of the companies not to furnish any information to the press. The furnishing of this information has redounded to our benefit. Furthermore, I have found that as a result of this policy the editors and reporters will, in many instances, when they receive information from other channels, call us up to see if it can be confirmed, and to find out if we wish to have it published or not.

W. W. Cole, of Elmira—Tersely speaking, I do not think there is any general rule that can be applied to this subject. As a matter of fact, the reporter, in going out on his assignment, is, of course, anxious to get the news. He has two sources from which to draw it from, either fact or his fancy. He prefers to get the facts, if he can, as it is the easier method for him. If he does not get the facts he draws upon his fancy, and every time he does that, trouble arises. I think in giving out the facts the company should appoint one man to whom all information should be given and who should determine what shall be given out for publicity. Where two or more men give out the news, one man generally talks too much, and the other man does not talk enough. It should be decided just what is to be given out, and one man should give to the press all the information that the company desires published. Under this arrangement the reporters become accustomed to going to one man for the news, and the official who is responsible for giving out information to the newspapers becomes acquainted with all the representatives of the papers, and is generally on a friendly basis with them. In this way the best results are secured, and the information that is given out is more likely to be correctly stated. Such a course does not lead to trouble, as in the case where a company tries to conceal news and allows the reporter to work on his imagination. I think that is the only general rule that can be applied.

C. B. Fairchild, Jr., associate editor of the STREET RAILWAY JOURNAL, then read the section of the Question Box relating to advertising.

J. E. Stephenson, of Buffalo—A great many ways of advertising have been mentioned in the Question Box, but it will be at once appreciated that the methods of advertising employed must depend largely upon the amount of money that the company can afford to spend for that purpose. The methods of advertising which we have found of the greatest advantage in Buffalo have been through the medium of the illustrated folders. We have published folders at different times, and they have averaged about one cent each in cost. The tendency for an up-to-date advertising man is to get out the nicest class of advertising he can. That is shown by the class of advertising being issued by the steam railroads of the country. They frequently pay for publications in small editions as high as 25 cents each. It depends largely on the revenue which can be attracted through that kind of a pamphlet. A trolley company could not afford to spend that much on a publication, but in view of the average fares to trolley resorts it would seem that a publication costing about one cent each would be a good medium for advertising. It does not necessarily follow that a person paying a 10-cent fare has cost the company one cent to reach him, through the medium of these folders, because one person who may ride as the result of the folders is the means of inducing other persons to ride. Much cheaper forms of advertising are also commendable. Time tables are necessary, and other information which can be put in cheaper pamphlets will carry a great deal of weight in the development of the business.

Newspaper publicity is preferred by a great many, while by others it is considered an expensive means of advertising. That, it seems to me, depends largely on the kind of newspaper advertising which is done. If a contract is made with a newspaper for a very small space, the cost of that space may reach a considerable sum by the end of the season, without

bringing any satisfactory results. We have found that spasmodic newspaper advertising, taking space of three to six or eight inches, at intervals, the announcements not appearing in two newspapers the same day, is a good means of advertising events and keeping up the traffic on the interurban roads. With advertising of this nature, which costs a little higher than the flat rate for running a given space for a period of time, it is the practice of the newspapers to give reading notices, and the standing of the railway company with the newspaper will govern these notices to a great extent. It depends a good deal on the liberality of the business manager and the policy of the newspaper. At times you can get only a very small space, and at other times the paper will insert a reading notice of half a column in connection with a 6-in. advertisement. Advertising of this nature is almost always accompanied with good results.

The practice in Buffalo has been to advertise events and special occasions by posting display cards in the car windows: a half-sheet poster will do for this purpose, as it is readable from the outside. With these posters in the cars that cover the city lines, you can reach the public with your announcements very quickly and very thoroughly, because a person does not need to be on a car to see the notice. We have come to the conclusion from the offers which we have received from advertising agents all over the country, that that space must appeal to the practical advertiser as a very valuable medium. We constantly change our matter. We had a lithograph poster during the winter time, which we had made up in large quantities, but the prevailing opinion was that the public tired of seeing it and we have gone back to the printed posters, which admit of more frequent changes. On the back of the poster facing the outside of the car we have another poster which faces the inside of the car, and that reaches the people traveling in the car. Notices of change of schedule and change of routes reach the people that way, and such notices are more valuable in this position, because they reach the people who are interested in the information.

On motion the meeting then adjourned until 3 o'clock.

TUESDAY AFTERNOON SESSION

President Allen called the meeting to order at 3:20 o'clock, and the discussion on methods of advertising was continued.

D. F. Carver, of Rochester—With the opening of the summer business we have gone into the publicity part of the service with great activity. We carry some advertising on the outside of our cars. We have a board, 9 ins. x 25 ins., made so that it will hang on the dash of the car without injuring the dash, and we use a printed card tacked onto the board. The cards are printed in type large enough so that the sign can be read by a person on the sidewalk. Using type of that size does not allow much reading matter to be put on the sign, but we can put enough on the sign to attract the attention of people and get them talking about what is going on. In this way we created a great deal of business for the "Lilac Route," and in the spring when the lilacs were in bloom we had on the sign the words "Lilacs in Bloom." The signs are changed sometimes three times a week. Our idea is to get people talking about the road. Strangers may not understand it all, but they can find out from others. We use similar signs for the suburban lines. We think we get a great deal of business on these lines from this advertising. We try to feature some special thing.

E. J. Wilcoxen, of Rochester—On the suburban line running to Sodus Point we advertise excursions extensively. We started what we call a "novelty advertising scheme" for calling attention to the foliage along our route. For instance, when apple blossoms were in bloom, we put in the railway ticket offices a branch of apple blossoms every morning, and also put branches around in different parts of the city. We then advertised on the boards on our cars "Apple Blossom Excursions." We found in doing this that it called the attention of the school principals to our park and led them to make up parties to visit the section through which the cars passed. We also tried the scheme of putting in the windows of some of the sporting goods stores fish caught at one of our resorts. The fish were furnished by the oarsmen whom we hired at the bay. We noticed for two or three days after an exhibit of fish had been placed in the windows in this way that our receipts on this line were increased to quite an extent. For instance, on off days, such as Tuesday and Friday, the travel is increased by putting an exhibit so as to cover those days. We have also tried this scheme with several different things, such as peaches, farm produce, and other things, that at the particular time are particularly attractive on the lines of our road, and we have found this advertising adds somewhat to the receipts.

In regard to "company publications" the Rochester Railway is publishing a regular pamphlet which consists of about 36 pages. The book we have this year is called "Trolley Topics," and it is published once a week from about Decoration Day until Labor Day. It contains some advertising matter, and a small amount of space is given to each town along the line calling attention to certain industries which are there, and there are one or two pages devoted to theaters, attractions and write-ups of all the summer resorts. I think it costs us, after deducting receipts from the advertising in the book, about $500 a year.

Mr. Fairchild—Is it money well spent?

Mr. Wilcoxen—It certainly is.

Mr. Fairchild—There has been a good deal of interest in these little weeklies. Most of the company publications which are published in this country have emanated through the example set by the Detroit United Weekly. In the Question Box there are a number of letters referring to company publications, and I believe these are found to be valuable mediums for advertising the road.

W. E. Harrington—The matter of publishing a periodical is one which has been considered by our people on at least half a dozen occasions. It has always come back to the question of the man who would have charge of it. If a paper of that kind is not properly looked after, made spicy, and the matter in it continually changed, it would not be a success. The public would lose interest in it. It depends upon the character of the man you have to look after it.

As to the value of a periodical of that kind, there is no question of the great good it would do and the benefit to be derived from circulating it throughout the community that you serve. The greatest amount of good, however, I think could be derived from your time-tables and folders, specifically describing the lines and containing a map of the system showing the points of interest. If a periodical could be gotten up by some one, and the main portion of the publication could be used by the companies in the various small places, somewhat along the same idea as newspapers are printed and published throughout the country districts, having the body of the paper the same in a number of places, the local news being inserted by the local editor or publisher, I should think possibly a street railway publication along that line might be useful generally throughout the United States. I do not know whether that idea has been thought of or suggested, but it seems to me such a publication would be very valuable to many companies and would supply an actual need.

J. H. Pardee, of Canandaigua—We have never issued what might be called a regular publication. We issue time-tables, folded once or twice, so that they will fit into the vest pocket. We issue these in large quantities along the line, and we find that almost every person in the community, at least every man, has one of these little time-tables in his pocket. The people will not carry the large folder with them, but they will carry the little time-table. Then we issue a folder descriptive of the

line. We have distributed a large number of these very carefully in the towns, and these seem to be preserved. In my opinion an attractive folder, which people will look at the second time, is very valuable and the money is well spent. We have a peculiar situation. We have two or three different classes of people whom we have to attract to our line, which is strictly an interurban line. We have no summer resort on it, except a lake, on which there is a steamboat line. It is a very easy matter to advertise the line along the towns, and for getting the people out of the city we use newspaper advertising and display advertising during the summer time. Then, to attract the general traveler and the commercial traveler, we have felt that we should inform the public so generally about our line that no man or woman living within 100 or 150 miles of Rochester, when they arrive at Rochester or Geneva, would fail to know that there was an electric line to Rochester or to Geneva, and they would know enough about that line to take it instead of the steam line. We are confronted with very strong competition from the steam line. In order to accomplish the effect desired I have had these folders distributed in the folder cases in all the hotels and railway offices in Western New York, west of Syracuse and Binghamton. That is all we have done or been able to do. We cannot afford to spend a very large amount of money in advertising, and are compelled to take outside or alien advertising in our folder to help pay for it. Our general offices are in a small town, and we have adopted another plan for our advertising in that town and the adjoining territory. There is a local newspaper reporter there, and he writes articles for the country newspapers all over that section of the country. I get electrotypes of scenes along the lines, one column wide or two columns wide, and he sends these to the country newspapers in the towns near by and furnishes an article with them, and the newspapers are always glad to publish these articles as news. Somewhere in the article it says that the Rochester & Eastern Railway is running to certain points. That is a very valuable method of advertising, and is not very expensive. The newspaper man can easily use such advertising. If a company is large enough so that it can afford to engage a man to look after its publicity department, that is the best method, but with a company not able to maintain such a department, it can accomplish these results inexpensively in the way indicated.

W. E. Harrington—It occurs to me it may be well to bring to your attention a practice we followed for some time. When we make a change in our time-table, or have any particular notice regarding our car movements, we get up a circular announcing the change, and we make an arrangement with the local newsdealers in the different towns affected by the changes, by which, for a very nominal consideration, a few dollars, they will put the circular in all the newspapers which they distribute from house to house through the neighborhood the following morning, so that the circular or advertising matter would be in each residence within 24 hours after it was issued.

H. J. Clark, of Auburn—In Syracuse there has recently been started a publication, it might be termed a pamphlet, which I think is called "Trolley Topics." This is issued without any expense to the railroad company, by an individual who is not connected directly with the railroad company, and who relies on the advertising he can obtain to pay his expenses. We are enabled in this way to make note immediately of any change of our time-tables in this publication. Although we operate a strictly interurban line between Syracuse and Auburn, we use the lines of the local companies for advertising purposes. We have two cards in each car. We believe that has paid us many times over.

G. Tracy Rogers, of Binghamton—We have an interurban and a city line. Some two or three years ago we got up a souvenir book, 10 ins. x 18 ins., which was entitled "Views of Binghamton and Its Surroundings." We mailed that to every society within 100 miles of Binghamton. We issued the book to these societies in order to have them arrange for excursions to Binghamton. We have been very successful in that direction, and have made money as the result of our effort. Then on our cards we have a large painted sign, extending from the top of the car, down on the side of the car, advertising vaudeville shows and other matters of interest. Then we have a car the whole side of which is used for advertising purposes. This is run as a special car, and at times we have a band of music in the car to attract attention. In the office we have one man who writes the notices for the newspapers. Each paper has a notice every day of the different entertainments and general information for the public. Our method has been very successful in securing a large attendance at our parks. We have two or three, and have found that this form of advertising is very successful.

The President—If you will take the statistics of the income and operating expenses per car mile of roads which are members of the association, for the year ending June 30, 1904, compiled by H. M. Beardsley, of Elmira (this table will be published in the next issue), and examine account 31, which includes "Advertising and Attractions," you will see a great difference in the cost of advertising and attractions among the different roads. By following through these different roads you will see there are some roads which do not have to build up traffic, and, of course, do not spend anything for this purpose, for example, like the New York City Railway Company. It certainly must be a subject of great interest by reason of the diversity of these figures.

George J. Blakeslee, of the Albany & Hudson Railway—Perhaps it would be well for me to describe briefly our layout. In the first place, our road is built through a country in which the business along the line is hardly sufficient to support the road. We have a combination of 36 miles of third-rail road, two gas companies and two electric light companies. We found it was necessary to attract people from Hudson and Albany, Albany in particular, to support the road. In order to do so we established what we called "Electric Park," a resort which is pretty well known throughout the State. The best method of advertising, in my opinion, is what has been mentioned in regard to the newspapers. We treat the newspapers pretty well and advertise our time-tables in them, and some of them we supply with transportation. That does not amount to very much, as they do not come very frequently. We find that by selecting one paper for our announcements, as, for instance, the Times-Union in Albany, that the people get into the habit of looking in the "Times-Union" to see what is going on at Electric Park. By following that practice regularly, after a while everyone knows where to look for information about the park. Last year we had a number of photographs made, which we framed in an attractive manner, and we put them in the principal hotels. This is a good plan, because a picture in a place like a hotel comes to the attention of all traveling people. We got out a souvenir book containing ten or a dozen illustrations. These were sent to all the societies in our neighborhood, which are in the habit of holding picnics. We also had these on sale at our park, and sold enough of them to pay for the publication. Then we use the billboards very largely. I think that is one of the best means of advertising which we have employed. If anyone is in the habit of going to Albany they will see on all the billboards there the name "Electric Park." The billboard does not tell where the park is, or much about it, but everybody knows where it is. We have a vaudeville entertainment and run a good class of shows. We have a programme for our vaudeville, which is paid for by the advertisements, and this programme is pretty generally circulated. We find in the summer time it is a good plan to have a man to look after excursion business and advertising, and all

that sort of thing. It pays very well. Our expenses charged up against our earnings for advertising and publicity are not very large—less than $500 per year. We tried some experiments last year with our park, with regard to winter sports, and the experiment was so satisfactory that we are going to keep the park open all the year, which will mean a little more expense in the way of advertising. When there is any special entertainment or attraction we have cards printed and hung up in the cars and distributed among the stores. It is an inexpensive way of calling the attention of the people to the park. We found this year we did not need to advertise as extensively as heretofore, because Electric Park is so well known. A good many of the companies do not need to advertise as much as we do, because our bond interest is paid by the people whom we attract to Electric Park. You know what that means.

F. J. Ryan, of Schenectady—I ask the opinion of some of the delegates on the relative merits of the souvenir folder as against the pamphlet periodical, and the best means of distribution?

Mr. Stephenson—In Buffalo, we have done very little in the nature of advertising through the medium of pamphlets. I presume the gentleman refers to the pamphlet company publication distributed in the cars. We have not adopted that plan of advertising, but it seems to me from what I have seen in other cities that the idea is a very good one and serves to bring the company and its affairs more closely in touch with the traveling public. In other words, the company takes the public into its confidence by keeping the people fully informed on the current topics, and at the same time places its resorts and other features along the line before the public and keeps them there. I think the pamphlet idea of advertising is a good one, but I would not attempt to pass on the relative merits of that, as compared to the folder. My experience in advertising has led me to believe that the public will not pay attention to advertising matter unless presented in an attractive and readable form. Notwithstanding the fact that the electric railway business and the steam railroad business are two different things, the public is educated undoubtedly to the folder plan of advertising when it comes to getting information on a traffic matter, whether it be a steam road or a trolley road. People will pick up an attractive folder and read it carefully much quicker than they will pick up a leaflet, which may be at first glance like an advertisement for patent medicine or something else which is thrown into the doors every day.

Our experience with cheap advertising, such as handbills, has been that it is shown to be a rather expensive form of advertising in the end, because the handbills, while they may not cost much money for the printing of them, have to be distributed in quantities of not less than 20,000 to cover our population, and the distribution of the handbills costs $1.50 a thousand and in many instances we find them thrown away, and we cannot place much dependence upon the distributers. A distributer is given $1.50 a thousand for distributing the handbills, and it is an easy matter for his man to throw away five hundred in an ash barrel. We used to find that handbills would turn up in ash barrels and all manner of places where we did not expect to find them. For that reason we discarded the distributing of cheap literature from house to house.

We publish an attractive folder. Our folders of the different kinds average just about one cent apiece. We find the distribution of that folder from house to house has a good effect, because it is not thrown away or classed with cheap literature. The cover at once shows what class of literature it is and invites inspection. While we have a good deal of faith in the distribution of a weekly pamphlet in the street cars, I do not think a distribution from house to house is advantageous. I think the cost of distribution is greater than the results of the work justify. I do not believe it can be considered a good form of advertising for our business.

For a period of ten weeks I think a folder prepared in an attractive form ought to be produced at from $35 to $40 a week, depending on the number of half-tones and the class of paper. You can vary the expense very much, according to the quality of paper you use. If you use machine-finished book or coated paper, the expense will be somewhat higher; but the better the paper the better the work you can bring out. You can get out an edition for possibly $30 a week, or you could spend $60 a week for an 18-page folder.

Mr. Blakeslee—We use a folder in addition to our programme, and we have not been obliged to pay any thing for it. As a matter of fact, last year we sold the programme privilege for $100. We have a number of stations along our line, and in Albany and Hudson, and other places, where this advertising matter may be properly distributed, and I do not think there is any need of spending money for a programme or a folder, because there are people who will be glad to print it for the advertising they get out of it. That is my experience. Our folders and catalogues have not cost our company much money. After the first year's experience, we found people who were glad to undertake the work free of expense to our company.

E. F. Peck, of Schenectady—Recently I have received prices on a very elaborate booklet, 12 ins. x 12 ins., which is to open endwise and which will be handsomely illustrated. The price quoted me for the cuts and reading matter complete for an edition of 25,000 was $600. This was to be more elaborate, I think, than any of the booklets which have been described here. The pictures are to be high-class, and the book put together in fine shape with a handsome cover. I wonder whether that will be good advertising or not? It is to be used in connection with the illustrating of features along our road, the describing of historical points and the illustrating of picturesque scenery. The book is not to be distributed to everybody, but we will advertise in the papers that it will be sent on receipt of a 2-cent stamp.

Mr. Stephenson—It occurs to me in connection with the price which Mr. Peck mentions for the folder that the price quoted would be at the rate of 2.4 cents a copy. The question arises whether the result of such advertising would justify that expenditure.

I would like to hear further discussion as to the experience of the various companies which have taken alien advertising in the various publications to defray the expense of the publications. It seems to me to be the prevailing opinion of the railroads that they can get an advertising man to take the publication and deliver them to the company free of charge and pay the expense of its distribution; the advertising man being reimbursed through the amounts which he receives for the advertising in the publication. If that can be done, it seems to me to be a good method of advertising. The question is, how is the company to determine the number of copies printed and the number of copies distributed? If you leave it to an outsider he has something to gain by running an edition ten thousand or fifteen thousand short of the agreed number. As we know, many advertising agents have a tendency to represent their publication as issuing 25,000 or 50,000 copies, while as a matter of fact they may only issue 10,000 copies. We have made it a rule in Buffalo to advertise as little as possible in programmes and other similar publications. When we do go into such advertising, however, we make it a rule to insert a clause in the contract that the money will be paid when we find that the agreed number of copies have been printed and circulated. We had to take that precaution, because we found that many advertising agents will represent that they are giving out 50,000 copies, when by figuring out the cost of the production and the revenue derived from the advertising, we found that the man could not possibly issue 50,000 copies, based on the prices he charged for advertising. As a matter of fact, 10,000 copies seem to be the limit most agents will issue. If

that rule applies in advertising of that kind, does it not follow, when an advertising man takes a publication off your hands and agrees to distribute it, there is a question whether he is not going to take advantage of you and distribute a smaller number of copies than you would if you were doing the work yourself?

Mr. Rogers—In regard to the expense of advertising, I think there must be a difference as to the method of charging it to the company. I would ask where the roads charge their music. We furnish a band every day in the summer. I ask some of the members where they charge that expense. We are putting these things into advertising, and taking the profits of our parks and casino and putting the result of that in the season's profit. I ask where other roads are placing these charges?

Mr. Stephenson—According to the classification laid down by the Street Railroad Commissioners, that expense should be put into account 31, "Advertising and Attractions."

Mr. Rogers—If that is so, some of the roads cannot furnish music, as the music would cost them as much as their whole charge for advertising. I am paying from $2,000 to $3,000 for music each year. I see some of the roads expend only $2,000 altogether.

The President—Speaking for the Utica & Mohawk Valley Railway, we have two parks, and this is our method of handling these accounts: The net deficit resulting from the operation of the parks is charged to account 31.

Mr. Rogers—That is what we have been doing.

Mr. Pardee—The folder we issued this spring is devoted entirely to the railroad and the connecting lines. We have some local advertising and some alien advertising. The folder consists of 24 pages inside and four pages of cover, 28 pages in all. We put in a very heavy paper for the cover, so that it approximated the steam railroad folder, although it was not quite as good. We issued 25,000, which we thought would be enough, but we are going to get out another 25,000. The first 25,000 cost approximately $350. The alien advertising paid within $50 of the total cost. The folders were distributed in a house to house distribution in Rochester, and the work was very carefully done. As far as alien advertising is concerned, the ideal thing is to get out a folder without alien advertising in the same way as do the steam roads. But with a small company in the issuing of these folders, it is often a question of taking some alien advertising or not getting out the folder.

CARS FOR CITY AND INTERURBAN SERVICE

The President—If there is no further discussion on advertising we will take up the next topic, which will be a discussion on the merits of single-truck cars and double-truck cars for city service, and heavy and light cars for interurban service. This subject will be taken up first by T. W. Wilson, general manager of the International Railway Company, of Buffalo, in a paper entitled "Suitable Cars for City and Surburban Service."

Mr. Wilson read the paper, which is published elsewhere in this issue.

Oren Root, Jr., of the New York City Railway Company—I had hoped that Mr. Starrett, our chief engineer, would be here and that I could place the burden of opening this discussion on him, but he was unable to be present. I do not consider that any one can argue convincingly on this subject by dealing in generalities. The subject is essentially one which must be handled according to the conditions which arise in any particular locality. I have noticed for some time that the general trend of opinion of managers throughout the country has been along the lines suggested in this paper by Mr. Wilson. I have no doubt that their judgment is correct, certainly so far as we have heard in regard to the conditions which exist in a great majority of the cities in this country. But I must certainly take issue with them as regards their opinion when it refers to Manhattan Island. No amount of theory has any weight with practical experience in that case. There is no doubt in my mind as to the desirability of the double equipment as used in New York City at present. In other words, the standard closed car and the complete open car. There is nothing, in my mind, which will take the place of the open car unless it should be the development of a full convertible car—a complete closed and a complete open car. As far as my knowledge of the situation goes at this time, I do not know of any such car which I should consider feasible for up-to-date city service. If the convertible car was thoroughly practicable and you could take an open car and make a first-class closed car out of it with no attendant disadvantages, that would be an ideal situation. At the time that the Metropolitan Street Railway Company took over the Third Avenue system in New York, there were about one hundred cars on the Third Avenue system which were of the St. Louis type. They were excellent cars, as far as the cars themselves were concerned, and, as I remember, were 42 ft. over all, with cross-seats and the aisle in the center, large windows, and substantially what is known as the semi-convertible car. The car was not adapted, in the opinion of the officials of the Metropolitan Street Railway Company, to our winter service. The condition in the winter service was, that the car during a round trip, which would be made by our standard type of car in 220 minutes, could not be made with the cross-seat car, with the loads we are forced to carry in New York City, within about 15 minutes of the time the trip could be made with our standard car. This loss of time was almost entirely caused by the time that it took people to get out of the car when it was crowded. The normal conditions during certain hours of the day, probably three or four hours, in New York, are crowded cars. It is only necessary for you to figure up mentally the great loss in business and in operating expenses to the company by this decrease in the running time of the cars. The slowness of the operation of the cars under consideration was on account of the length of the stop. But that was not the principal objection. The Third Avenue line, on which these cars ran, carried during the summer months on the normal day probably 190,000 passengers, so that you can see it is a typical trunk line in the New York City service. We ran these cross-seat cars, which may be termed a semi-convertible car, in conjunction with the standard Metropolitan open cars. I have stood on the street corners and watched them for hours. Upon a hot afternoon—particularly on Sunday afternoons—when this line was carrying upward of 200,000 passengers during the 24 hours, I have seen the standard open cars so crowded there was scarcely room for another passenger, and people standing along the streets waiting to board the cars. A cross-seat, semi-convertible car would come along immediately behind a standard open car and the seats would not be filled. There is no amount of theorizing that can possibly offset, in the mind of a practical man, the result of such a test as that. In other words, it was absolutely convincing to my mind (and it does not seem to me that any man could fail to be convinced in a similar manner), that the standard open car was the kind of car the people riding at that time wanted. Whether it is possible to educate the people to the use of the semi-convertible car is a question. I do not believe you can, as compared with the standard open car.

Regarding the advisability of carrying this double equipment, since we have put on the open cars, we are carrying about 240,000 cash passengers a day more with the open car equipment than we did just prior, when we were running the complete closed car. You do not have to take your pencil to figure out the great advantage to the company, financially, of having that double equipment. So I say you cannot argue convincingly as to the advisability of any particular type of car and make any general deductions applicable to all conditions.

It is for this reason I would take issue with the statement in the paper which says: "The cross-seat car is one of these modern conveniences. It is prescribed by law to-day in Chicago and other cities, and, in our opinion, will be within a few years the standard street railway car of America." I do not question the correctness of the statement as applied to street railway operation outside of New York City; but I do not believe anyone who analyzes the New York situation—without necessarily being connected with the operation of the railway there —could help but believe that as far as New York is concerned that statement is incorrect. I believe not only that that statement is incorrect, but I also believe that anyone who is familiar with the subject will agree that the situation as it exists to-day is the correct one, as far as Manhattan Island is concerned.

The President—The next paper will be on types of interurban cars, by J. N. Shannahan, general superintendent of the electric division of the Fonda, Johnstown & Gloversville Railroad.

Mr. Shannahan read the paper, which was printed in the last issue.

W. W. Cole, of Elmira—During the month of February last, E. P. Dandridge and R. R. Drake, of Cornell University, made a test of our single-truck and double-truck cars. I have their report in my hand. The data which they give bearing on these tests are rather voluminous, but their summary is interesting. They state:

Summing up the results for the two days we find that the watt hours for the complete run with the single-truck car amounted to 76,870. The length of the run was nine hours. The cost of power per kilowatt-hour was 1.25 cents. Hence, cost of power for the day was $76.870 \times 1.25 = 97$ cents. The cost of platform labor was 35 cents an hour, or $3.15 for the nine-hour run. Total cost for the run = 97 + $3.15 = $4.12. The seating capacity of the car was 25, and the distance traveled was 84 miles; hence the cost of operation of the single-truck car per car seat per car-mile was

$$\frac{\$4.12}{25 \times 84} = .196 \text{ cent.}$$

The watt hours for the complete run with a double-truck car amounted to 129,380. The length of the run was 5.3 hours. The cost of the power for the run was $1{,}293.80 \times 1.25 = \$1.622$. The cost of platform labor was 35 cents an hour, or $35 \times 5.3 = \$1.86$ for the 5.3-hour run. Total cost for the run was $1.62 + \$1.86 = \$3.48$. The seating capacity of the car was 40, and the distance traveled 52 miles; hence the cost of operation of the double-truck car per seat per car-mile was $\frac{\$3.48}{40 \times 52} = .167$ cent per car seat per car-mile.

The per cent gained by using double-truck car, figured on the basis of car seat per car-mile is $\frac{1.97-1.67}{1.97} = 15$ per cent.

TABULATION OF FINAL RESULTS

	Platform Expenses for Run	Cost of Power Consumed	Seating Capacity	Mileage	Cost per Car Seat per Car Mile
Car No. 26..	$3.15	$ .97	25	84	.196
Car No. 21..	$1.86	$1.62	40	52	.167

Percentage gained per car seat per car-mile in favor of double-truck car equals .029 cent, or 15 per cent.

Upon receiving this report I wrote the gentlemen that they had not taken into consideration the passenger factor, or ton factor in that report, and it was suggested to them that the final results should be figured out in terms of cost per seat occupied, per car mile.

The following are the determinations made on this basis:

Cost of operation of single-truck car	$4.12
Cost of operation of double-truck car	3.48
Passengers carried during run with single-truck car	245
Passengers carried during run with double-truck car	306
Miles traveled by single-truck car	84
Miles traveled by double-truck car	52

Hence, cost per car seat occupied per car mile equals, with car No. 26, $412 \div (245 \times 84)$ or .02 cent for the single-truck car. With car No. 21, the cost is $348 \div (306 \times 52) = .022$ cent.

From this it follows that, if the capacity of the smaller car is ample for the maximum load conditions, then it is the part of economy to use comparatively many single-trucks cars in preference to a few double-truck cars.

H. M. Buegler, superintendent of the electric department of the Elmira Water, Light & Railway Company, went over these tests and checked up the figures, and I have his letter as follows:

With a view of determining the difference in cost of operating single-truck and double-truck cars, operating under exactly the same conditions, we carried on a test last February, confining it entirely to local conditions. The results obtained, at first glance, are somewhat misleading, as the problem we set out to solve was to determine the cost of operation per car seat, per car-mile, ignoring the fact as to whether the car seat was occupied or not, and the ton-mile factor. The conclusion reached, without taking into consideration the passenger factor, is about 15 per cent in favor of the double-truck car, but this difference in cost is brought about entirely by the fact that there is a fixed platform cost that does not fluctuate with increased travel per car-mile, as in the case of current consumed. With the 40-seat double-truck car the platform expense per car seat per car-mile is only .0009, while with a single truck, 25-seat car, the platform expense per car seat per car-mile is .0015, or about 40 per cent in excess of the double truck. On the other hand, with the double-truck car, the power consumption per car seat per car-mile costs .0004, while with the single-truck car with 25 seats, the cost of current per car seat per car-mile is 48 per cent less than with the 40-seat double truck. If we were to operate our equipment idle, without stops or passengers, the above results show conclusively that there would be some economy in operating double-truck cars, but this would ignore the passenger factor entirely. When we bring this into the problem and determine the cost per seat occupied, per car-mile, the results are decidedly in favor of the single-truck car. The following are the determinations made on this basis, which shows a percentage in favor of the single truck, 25-seat car of 10 per cent, operating under actual conditions, and taking into consideration the seating capacity, passengers carried, mileage, current consumed and fixed platform cost.

The total cost of operation of the single-truck car 84 miles, carrying 245 passengers, is $4.12. The cost of operation of the double-truck car 52 miles, carrying 306 passengers, is $3.48. The cost per car seat occupied per car-mile with the single-truck car, is .02 cent, and with the double-truck car .022 cent. From this, it follows that if the capacity of the smaller car is ample for maximum load conditions, then it is the part of economy to use comparatively many single-truck cars, in preference to a few double-truck cars for the purely urban service in cities of the third class. I am of the opinion that there is an economy of at least 15 per cent in the use of single-truck cars, as compared with the double-truck type, such as are in use in Elmira. The fact that the current consumption per ton mile in the double-truck car showed an excess consumption of 50 per cent over the single-truck car, convinces me that with the traffic we have, we can double the number of cars in service during the rush hours and show a decided decrease in operating cost, as compared with a double-truck equipment, including all such important factors as car seat capacity, current consumption, passengers carried, platform cost, and the ton-mile.

I have carefully gone over the results of the test and I find them correct, except in the conclusion, where every factor which would tend to decrease or increase power consumption should have been taken into consideration.

J. E. Duffy, of Syracuse—For a great many years we have operated in Syracuse a single-truck, 22-ft. body car, but during the past five years all of the new cars we have been ordering have been double-truck cars. The first double-truck cars we ordered were 30-ft. over all, seating 44 passengers. We found that that type of car was a little large for our service in Syracuse. It might and would do upon our main line, with no curves, but we found considerable trouble in operating that car on other lines. Another trouble experienced with that car, even on our main line, was the fact that it was hard work for the conductors to collect all the fares in a car with a seating capacity of 44 passengers and a standing capacity of 40 or 50 more passengers. In our city, for a distance of about 7 or 8 blocks through the center of the city, it is almost impossible for our conductors to go into the cars to collect fares, owing to the large amount of special work and the large number of passengers who are boarding and leaving the cars at the more

important transfer points along these 7 or 8 blocks. We found by inspection that we were losing a large number of fares, due to the use of the extremely long car. The last nineteen cars which we ordered were cars 28 ft. over corner posts, seating 40 passengers, and up to this time we have adopted this car as our standard car. I believe the management of our company has ordered eighteen more of these cars to be delivered some time this fall. As I say, we have found this an exceedingly good car for our city service and for what little interurban service we have, which is on one line running 8 miles from the city and on another line running 5 miles from the city. I have no data in relation to the amount of power consumed in the double-truck cars over the single-truck cars. I would not disagree with Mr. Cole as to the ratio that he expresses, but with the large number of cars in our city, and in view of other considerations, which are strictly local, I would state that the type of car we are now using has given us excellent service. Mr. Root spoke a little while ago of some cars of the semi-convertible type, which were used on the Third Avenue line in New York City. I am sorry to say that we have several of those cars in Syracuse. I am not surprised that Mr. Root wanted to get rid of them. We do not run these cars much in the summer time, as the platforms are not very large and they are enclosed with a vestibule in our city, which they were not in New York City. Perhaps our vestibule on the double-truck cars which we use is not as large as that in some other cities. In fact, on our 28-ft. body car the vestibule is not nearly so large as on the 30-ft. body car, but we have decided that a 4-ft. 6-in. platform is a pretty large platform for our city. We are more than satisfied with that type of double-truck car in our city and for what little interurban service we run.

T. W. Wilson, of Buffalo—I am of the opinion that the New York cars cannot be made much wider than 8 ft. There is a great deal of difference between an 8-ft. semi-convertible and a 9-ft. semi-convertible with longitudinal seats at the end and room enough for two people to get on and off at once, and also to move up in the aisle.

Mr. Duffy—That car is 8 ft. 2½ ins. over corners.

Mr. Wilson—Add the difference between that and 9 ft. to your aisle and you have a car in which you can handle people very easily.

Mr. Duffy—Our track centers limit us to a car less than 8 ft. 5 ins. wide. Our standard type is 8 ft. 3 ins. wide.

The President—What has been your experience, Mr. Duffy, with the semi-convertible type of car which you have had in use in Syracuse?

Mr. Duffy—The great trouble is when you want to avail yourself of the convertible features of the car, the windows do not go up or come down easily. Most of this trouble was experienced with the type of semi-convertible car in which the windows drop into the wall-pockets, although we experienced some trouble with those that went into the roof. This was due, perhaps, to the condition of the weather.

D. F. Carver, of Rochester—Personally, I am very much in favor, for this northern climate, of the semi-convertible car with windows going into the roof. Mr. Duffy spoke of the windows sticking. In the semi-convertible cars the sash are all wood, and if a heavy rain comes on, unless the windows are put up before the rain gets a chance to run down the post, some of the windows usually stick. With a semi-convertible car, with the windows in the roof, the water does not touch the sash slide, and I might also add that in the latest type of car the slide is being made of tin instead of wood. We have fifty of them in Rochester, and expect to get twenty more in a few weeks. We get larger receipts per car-mile from the open car, but these cars have the disadvantage that on long runs it is very hard to change them when a rain storm comes up. I know that in some places where open cars are run it takes two or three hours to change the equipment from open cars to closed cars when a storm comes up. With the semi-convertible car you can change from an open car to a closed car in a few minutes and keep the seats dry. If you are handling heavy crowds on Sunday and Saturday afternoons, and take people long distances in an open car or a semi-convertible car that cannot be changed easily, and a heavy rain comes up, you get a large number of the passengers wet; whereas, if you take them out in a car which can be converted into a closed car rapidly, you can keep a large percentage of the passengers and get them home in good order. For purely economical reasons, I think the single-truck car has a great advantage over any double-truck car, but there are other considerations than economy in getting business. Foremost among these considerations are those of safety. I think a double-truck car is much safer than a single-truck car. It is easier to keep on the track, and if a double-truck car should happen to become derailed, my experience has been that the difficulty and the injury is not so great as it is with a single-truck car.

Mr. Wilson—I will also add that one of the other advantages in having the window slide up into the roof pocket is that it gives you about 2½ ins. more to your seat, and if you do not have a double side to your car you can put your seat right up against the outside sheathing.

Mr. Duffy—That was one of the main reasons why we ordered the car with the windows going into the roof—it increased our aisle space.

W. E. Harrington, of Camden—For purely city service, I am firmly of the belief that a single-truck car is best adapted for city conditions. If you have a service where you go from a city into the country, and fast running is incidental to the service in the country, there is almost an absolute necessity for a double-truck car. If you go out further, 10 or 20 miles, then you need the interurban type of car of the larger kind. We used in Camden for years a 20-ft. body car, for the box cars, with 7-ft. 6-in. wheel-base truck, and we finally put on an 8-ft. wheel-base truck. We were fearful, before we put on the 8-ft. wheel-base truck, that we would have trouble from derailments in going around some 30-ft. radius curves, of which we had a few. To our surprise, we found no trouble whatsoever from this, and the use of the long wheel-base truck eliminated practically all the oscillation and other troubles incidental to the operation of single-truck cars for city service. The power consumption was so materially less, the average current consumption being 25 to 28 amps. per car for the 20-ft. car, against an average current consumption of 55 to 60 amps. per car on the 28-ft. double-truck car, that this alone is a factor in the economy of its operation. Other advantages are the quicker acceleration, the less amount of repairs and the fact that you can vary your number of cars to suit the different classes of business from day to day or from week to week. The largest car that we purchased in Camden was a double-truck semi-convertible car 33 ft. 9 ins. over the end posts of the car, equipped with four No. 56 Westinghouse motors, and the average current consumption was 100 to 105 amps. per car, with momentary inrushes of current 175 to 250, and sometimes 300 amps. In all this discussion I have not heard anything about increased fixed charge item brought about by the necessity of more power-station capacity. It is one of the important factors in the selection of cars. When we put on larger cars, we bought twelve 33-ft. 9-in. body cars, it brought about the necessity for putting in another 800-kw unit in our station. It hits us, when you put on these large equipments, in more ways than we think of. While I object to a single-truck or double-truck open car with cross seats on one point, and that is, the greater liability of accidents, there is no question but that you increase the number of passengers carried by the use of the open car, and the single-truck open car is certainly a winner. In the notes read by Mr. Cole as to the advantage of the single-

truck and double-truck car he made no mention, that I could hear, as to the increased expenses that would be chargeable to the double-truck car by reason of this increase of equipment required in the power station or to the greater depreciation which would ensue from the larger number of parts and motors and the trucks, which are incidental to the double-truck cars. Therefore, I believe that the single-truck car, with an 8-ft. wheel-base truck, and body 20 ft. over all, with longitudinal seats for a box-body car, and with cross-seats and side steps for open cars, seems to prove to be the best type of car for purely city service. For semi-interurban or suburban service, running out 4 or 5 miles into the country, I would say that a 28-ft. body double-truck car would be the best, and for regular interurban service, running long distances, a 34-ft. body car, with double trucks, having 6-ft. 6-in. wheel base and inside hung motors, would give the best results.

G. Tracy Rogers, of Binghamton—There is a serious element in the use of these very heavy cars which confronts us all, and which has not been referred to in this discussion. I refer to the effect of this heavy equipment upon our tracks and special work. These heavy cars are pounding our tracks, and sooner or later a serious question will confront us as to the replacement of the tracks.

The President—There is no doubt all of us who have had power stations which were able to care for single-truck cars on a given service have found, as our ideas have grown toward the double-truck car as the car which would become standard, that the power house has fallen short of doing its duty. We have accepted this state of affairs, and have excused ourselves with the thought that the increased receipts and increased good will in a community, due to changing from a single-truck to a double-truck car, would more than compensate for the difference in the cost of current. I see we have with us a number of master mechanics, and while we are discussing this question of the most suitable type of car for city service, I am reminded that one of the elements certainly includes the cost of maintenance, I should like to hear from some of the mechanical men as to what has been their experience in maintaining single-truck and double-truck cars.

Fred DuBois, of Syracuse—I think the double-truck equipment is less expensive to maintain than the single-truck equipment. It rides the track more easily and the bearings and equipment throughout stand a great deal more service than with a single-truck car. Much of the trouble in the latter car is due to the spinning of the wheels. You do not have the spinning of the wheels on a four-motor equipment that you would have on a two-motor equipment. Therefore, I think there is less wear and tear on the parts on the four-motor equipment than on the two-motor equipment, and that the total expense of the truck and motor repairs is reduced. I have, however, no data which I can offer on this subject.

J. G. Baukat, of Schenectady—Perhaps our company is in a class by itself, but our experience has been that the single-truck is the cheapest to maintain. I will point out one thing—that you have a very expensive brake rigging to take care of on the double-truck car which you have not on the single-truck car. I think that in itself will prove that the two different types of truck will show that the double truck is the most expensive to maintain. Our heaviest expense on the double truck is the brake rigging, whereas on the single truck we have not that to take care of. For city service I would, by all means, say use a single truck with an 8-ft. wheel base. We made some experiments with regard to the wheel base and we found that the 8-ft. wheel-base truck was not only the best truck, but gave the best flange wear.

Mr. Duffy—I will add one thing I overlooked mentioning in my previous remarks: On one of our lines we operate fourteen single-truck cars. Last February we added seven double-truck cars to our equipment and placed them on that line, running them alternately with seven single-truck cars. That line is nearly 11 miles for the round trip, and after we put on the seven double-truck cars that line showed an increase in receipts for three months of over 35 per cent, whereas our total average increase in receipts was less than 10 per cent. That showed to us plainly and conclusively than the double-truck car is what the people want.

Mr. Wilson—I think the gentleman who has just spoken has struck the keynote of the whole situation. We have been talking of economy, economy; but we ought to have in mind a surplus, and in order to get a surplus we must have increased receipts. The single-truck car is an admirable car for very small towns, but where you go into a larger population there is no doubt in my mind that your earnings will be greatly increased by giving the people a car which not only carries them satisfactorily, but is pleasant to ride in. As opposed to the economies which have been spoken of in favor of the single-truck car, there is one great economy in favor of the double-truck car, and that is the trainmen's wages. I think Mr. Cole's very scientific discussion seemed to show that taking all these factors into consideration, the economy was rather in favor of the double-truck car. Did I not so understand it?

W. W. Cole—Yes, where you have sufficient capacity. I think the whole thing in the summary comes down to this: That a 21-ft. single-truck car will consume on an average about 42 amps. in the ordinary city service. The 30-ft. double-truck car will consume from about 71 to 80 amps., and it comes down to a question of the difference in the cost of current between the two cars. There is no doubt about the popularity of the 8-wheel car. The people will wait on some of our lines, where the cars alternate, and take the 8-wheel car in preference to the single-truck car. On lines where you get a sufficient patronage or seating demand, so that you can afford to run cars five minutes apart, the 8-wheel car is the one adapted to that line, as far as economy is concerned. On lines ordinarily running cars every twenty minutes, you can better afford to run the 20-ft. car every ten minutes than the 30-ft. car every twenty minutes.

Mr. Carver—I think I was the one who started the statement about the economy of the single-truck car, but I always prefer to have the double-truck car. There is no question about the earning capacity of the double-truck car and the preference of the riding public for the car. I am familiar with such cases as Mr. Duffy referred to, where the earnings of a line have been greatly increased by the use of double-truck cars, and I have also been familiar with some cases where the people will not ride in single-truck cars at all. They will let them go by, time after time, and take the double-truck cars. I do not think it pays to run single-truck cars alternately with the double-truck cars.

Mr. Duffy—One more point in relation to the use of double-truck cars in a city the size of Syracuse: During the rush hours we usually put thirty or forty cars on the road for a few hours. We cannot keep men waiting around all day to make two or three trips at night, and we know 75 per cent of the register shortages come from the new men. If we have double-truck cars, which are large enough to carry the people, we do not require so many extra cars during the rush hours.

The President—There is no doubt that a very poor place at which to economize in street railroad operation is in the train service. Train service is the place where we sell our wares, and to economize even in favor of less expensively operated cars, as is shown by Mr. Cole's figures from the standpoint of the consumption of power, would be a very poor place, I am sure, in the mind of every one of us, to begin to economize.

We will now take up the discussion in relation to the best type of car suitable for interurban service. I will ask H. J.

Clark, of the Auburn & Syracuse Electric Railroad Company, to lead in that discussion.

Mr. Clark—We have but one type of car on our road. We operate between the city of Syracuse, with 230,000 population, and the city of Auburn, with 30,000 population, running over a very hilly country. Consequently, we have no tangents over 3 miles in length. It is a steady climb, without many curves. The car which we selected weighs thirty-four tons, of which fourteen tons is in the car body itself, the balance of the weight being the trucks and motors. It measures 50 ft. over all, 40 ft. over corner posts, and is equipped with four Westinghouse No. 76 motors and Westinghouse air brakes, and is heated with electricity. The car has a monitor roof and the windows lift, but do not slide into the roof as in the semi-convertible cars. Our car is narrow, 8 ft. 3 ins. over all, and that is due entirely to the fact that we operate in the city of Syracuse, where that is the limit to the width of the cars, owing to the distance between the tracks. The car floor and platform stand 4 ft. above the rail. That gives us one advantage, and that is the opportunity to suspend the motors from the outside. All inspection as the car passes the car house on each trip is done from the outside, and it is not necessary for any employee to disturb the passengers in raising the trap doors. We first had cane seats throughout the car. The last cars we purchased have been identical in size with the previous ones, but we placed cane seats only in the smoker and plush seats in the passenger compartment, as we found the plush seats to be much easier riding, especially on our crooked roads. While it is only 27 miles from Syracuse to Auburn, it takes us an hour and a half to make the trip, owing to the fact that we spend twenty minutes in Syracuse and fifteen minutes in Auburn, where we follow the city schedule. We are just about ordering cars for the Rochester-Syracuse double-track road, and they will follow practically the same dimensions, with a little heavier equipment. We have just purchased one steel-framed car, and it arrived last week. As to the safety of passengers and people crossing the track, I might say that we have not had a collision as serious as that Mr. Shannahan spoke of, although we hit a traction engine weighing ten tons, and the car was going 20 miles an hour. The car was not derailed, and we carried the traction engine along on the pilot 61 ft., the traction engine skidding on top of the rails. The floor system was not broken at any point. Apparently, 4 ft. above the rail the posts supporting the vestibule were not weakened. We also had a collision with a wagon loaded with stone, with a total weight of three tons, and we carried that wagon on the buffer of the car for 30 ft. with no damage to the floor system of the car, or even to the vestibule itself, and consequently no damage to the passengers. We have left out of consideration up to the present time the question of toilet accommodations. There has been very little demand for them. While our shortest ride occupies an hour and a half, there has not been any demand for such accommodations. On our through service, from Syracuse to Rochester, of course we will make provision of that character for the accommodation of the passengers. Our smoking compartment is in the end, and for this reason we are not able to turn the car; in fact, the ladies have to enter the smoking compartment going one way. The seating capacity is 56, and even with a slightly longer running time we find that we take practically all of the business which formerly went to the steam road. There is one question I would like to ask, and that is in reference to arms on the ends of the seats on the aisle side. We have considered them seriously, but have not yet adopted them. I have only heard of one car which has arms on the end of the seats, and that is the car spoken of by Mr. Shannahan. We have, of course, a narrow aisle, owing to the 8-ft. 3-in. dimensions, which is necessary on our cars, because they run in the city of Syracuse, and the question of an arm on the end of the seat is a serious proposition. If any one knows of a folding arm, or has seen any description of it, I would like to be informed regarding it.

The President—There is no subject, in my opinion, that is of so much interest to railway men concerned in the operation of interurban systems, as this question of the different types of cars on interurban railways. A year ago I was visiting a car manufacturer, and in passing through his shops I saw some cars 48 ft. over corner posts, 9ft. over all in width, and weighing 95,000 lbs., when equipped with brakes, motors and trucks. I inquired as to the road on which they were to be operated. I have since followed the history of those cars. Although the company was having twelve cars constructed in the shop at the time, the gross receipts of that interurban road have never equaled $100,000. The operating expenses, the last time I saw the figures, were 88 per cent of the gross receipts. In my judgment, at least, they had overdone the car proposition. I have had the pleasure of discussing at different times with the managers of the different interurban roads in New York as to their experiences with the different types of interurban cars as to whether the largest and heaviest type of car or whether a medium-weight car was the better. It is most difficult to lay down any iron-clad rule on this subject. Local conditions, to a certain extent, control.

Mr. Peck—We have three interurban divisions, and they are all of equal length, about 15 miles, and we have three distinct types of cars. On our Albany division we are running cars which are from 51 ft. to 52 ft. long. These cars weigh in the neighborhood of 60,000 lbs. On our Troy division we are running cars about 40 ft. in length, and the weight of these cars is about 48,000 lbs. On our Ballston division we have the large type of cars, 52 ft. in length, weighing, with full equipment, unloaded, 76,000 lbs. These three divisions have distinctive features. On the Albany division we have no very heavy grades. On the Troy division we have a line which follows an old country highway, and is full of curves, with a very heavy grade on one end. On our Ballston division, which is our latest division, we have an almost straight road with very few curves. On our Albany division we feel that the cars we have there, the cars measuring about 52 ft., seem to answer that service very well. On our Troy division the lighter cars are best. On that division we recently made a test of one of our cars and kept records, and found that we made fifty stops in fifteen miles on a schedule of one hour and 10 minutes. It goes without saying that a lighter car is the car for that division. On the Ballston division the large car is rather a white elephant. On a 15-mile run with a car weighing 76,000 lbs., the car is entirely too heavy and the equipment too heavy, and as a result of that conclusion the last cars we ordered are 43 ft. A 43-ft. car seems to be the car in use in Schenectady, and that is the type which will ultimately be used on all divisions. The difficulty of running different types of cars on different divisions is the fact that we are at times crippled on one division or another, which makes it necessary to take cars from one division and put them on the other division. This winter, when we have been short of cars, we have been seriously crippled because we could not use the Ballston type cars on our Albany division. That seemed to be an important factor which led us to decide on a standard type of car. The car we recently ordered, 43 ft. over all, seems to us to be the proper type for car for our particular work.

J. N. Shannahan—I ask Mr. Peck a question which enters into the discussion of the proper type and details of an interurban car, as to the most economical method of heating a car of this length. Mr. Clark spoke of heating his cars electrically. I would like Mr. Peck to state his conclusions on that line.

Mr. Peck—We formerly heated all our cars electrically, but recently we decided to make some experiments in regard to the heating of the cars. We have had two of our cars on each division heated with hot water, and as a result of these experi-

ments it is our intention to change our heating system to hot water heating. We get a more uniform heat for our climate, and it is much cheaper.

We have had some experience with semi-convertible cars on our interurban divisions, and I must say, as far as we are concerned, that they have not been a success. We have destroyed the semi-convertible feature of the cars by placing stops so that the windows cannot be opened, except for a certain distance. It has been very difficult, indeed, for us to heat these cars.

I also wish to say, in answer to the question asked by one of the gentlemen, that we have found arms placed on the aisle side of the seat a very favorable feature. I have talked with our conductors, and they tell me that a car with seat arms in the aisle is a much easier car to handle.

Mr. Shannahan—I would ask Mr. Peck to be more specific, if he will. That is to say, will he give us the cost of heating a car 52 ft. long for an 18-hour day, each way, that is, electrically and by hot water?

Mr. Peck—I am very sorry to state I have not these figures at hand. I know it was very much in favor of the hot water heating.

Mr. Baukat, of Schenectady—As nearly as I can remember in regard to the heating, it takes all the way from 100 to 120 lbs. of coal for 24 hours, and if I recollect the figures aright, in the semi-convertible car it would cost somewhere around $4 to $5 a day for the heating. We conducted some very accurate tests, and the General Electric Company was with us in these tests. I am sorry I cannot give you the correct figures, but that is about the average cost, from $4 to $5 a day. It took about 120 lbs. of coal for 24 hours, at a cost of about $4 This is quite an item, because the cost of coal would determine the cost of heating the cars by the hot-water heater system, although there is extra labor involved in taking care of the hot water heater. In undertaking the experiments with the hot water system, we procured special heaters, designed with a magazine large enough to take care of the heating for 24 hours, in connection with which very little attention is required, so that one of the car cleaners can take care of all the cars we have equipped up to date, and the heating is certainly much better than the electric heating. In regard to the new car referred to by Mr. Peck, we decided to buy twelve more interurban cars. We made several designs and then considered a convertible car. The idea was we did not like to have so much money tied up in cars which could only be used for a portion of the year. It was our idea that a car which could be converted into an open car in the summer time and into a closed car in the winter time, would be an ideal car, but we found that this form of construction destroyed the strength of the car. The question of maintenance and repairs will come into consideration at some time or another, and if you once get into it you never get out of it. We concluded that the thing to do was to secure a well-built car, which we considered would be the best investment we could make. We found that if the floor framing of the car is built strongly that it is the very best investment we can make on a car, so we started to design a car in the following way: We took a piece of boiler plate the total length of the car, that is 43 ft. in length, 24 ins. in height, and 3/8 in. thick. On the bottom of the boiler iron a channel was riveted on one side and an angle on the other side. The angle as well as the channel was filled with wood, and in the center we have two 6-in. I-beams running the entire length. We have no off-set vestibule, and the rest of the car is the same as any other type of car. The only new feature we have in this type of car is the boiler iron on each side of the car. I am well satisfied with this type of construction. The total weight of the car is, I think, 24,000 lbs. I think we will have a very rigid car.

Mr. Harrington—We started in to run between Camden and Moorestown a special club car service, the distance being about 12 miles. We ran a 33-ft. 4-in. body car, semi-convertible, Brill make, equipped with four No. 56 Westinghouse motors, and made that run regularly every day in thirty-five minutes. We figured that was practically 33 miles in an hour and a half, or a little more. It was fast service and was very satisfactory service, so much so that the service has been increased this year and is run under conditions that nearly parallel the average interurban service as it is usually in operation in this country. The car complete, I do not think, weighs much over 33,000 lbs. Why we go into these large, heavy equipments, with cars 40 ft. or 50 ft. in length, with the added structural difficulties and added weights, I fail to understand. I do not think we should do it. I do not believe that such equipment is necessary or advisable, in view of the question of first cost and the question of repairs. Any car builder will tell you if you construct a car over 33 ft. 4 in., or thereabouts, in length of body, you get into another class of construction that requires additional bracing and trusses which increase the weight of the car, and the percentage of increase is very marked. I believe a car of the size just mentioned, properly designed, and properly painted, will give all the appearance of weight necessary, and will actually give the necessary weight. In addition, it will take much less power to operate, and hence the operation expense will be less, the investment cost less and the results obtainable would be such as to change the investment feature of cars for an interurban road to a much more desirable basis.

Mr. Baukat—In regard to lightly constructed cars, we had some light cars built at one time, and in about three years the cars were fit for the scrap heap. That was the only evidence we had on which to base our conclusions in favor of the heavy construction. Contrasted with these light cars, we had some much more strongly built, and these cars are about as good today as they were when we first bought them. That is what impelled us to build a very heavy and rigid car.

The President—I was sorry to hear Mr. Peck speak so unfavorably of the semi-convertible car. My experience has been the exact opposite of what his has been, and I feel I would not be doing justice to myself or to the builder of our cars unless I should say a good word for the semi-convertible car.

We placed in operation four years ago next September on an interurban line 38 miles in length, taking four hours and fifteen minutes for the round trip of 76 miles, a 34-ft. 4-in. body car, from post to post, 8 ft. 4 1/2 ins. over all in width, equipped with four Westinghouse No. 56 motors. The car, when weighed on the railroad scale, without its passengers, weighed 47,250 lbs., having a seating capacity of 48 persons. We have had these cars in constant operation, using the semi-convertible feature very freely, between the first of April and the first of November. We have added to that equipment by supplementing on two different occasions orders for additional equipment of the same kind, and we feel that the car is the right car for the service. A careful counting of the number of stops made on the run of 38 miles has shown that the car has stopped, and that not on an extraordinary run, 116 times for the purpose of letting off or taking on passengers. It would not be the car that I should select for a limited service. I do not hesitate to say that. If I were operating a limited service I would select a heavier type of car, but this is a territory in which limited service could not be given, if you understood the problem to be solved from a transportation standpoint.

Mr. Pardee—On the Utica & Mohawk road they have a proposition on which a shorter type of car, a lighter type of car, works admirably. There are other interurban roads where a larger car is necessary, as, for instance, on the Fonda, Johntown & Gloversville Railroad, and I think that the conditions on each road must necessarily determine the type of car. If you have very frequent stops and a large amount of traffic, so

that you have to maintain frequent service and make very frequent stops, it seems to me a lighter type of car is necessary and very advantageous, but where you have long runs and have many through passengers, then it is necessary, in my opinion, to make your car just as comfortable and make it ride just as easy as possible, as outlined in Mr. Shannahan's paper, or you do not get the business. Our line is 44 miles in length, without including 3 miles operated over the city lines in Rochester. Our route is from Rochester to Geneva. We found we were not getting a considerable amount of business from Geneva to Rochester. The business men told me the reason they did not ride with us was because we made a good many stops, and they would rather pay a little more money for fare and get into a big, comfortable seat, and have a nice ride to town. Because of this we put on a limited service, running through in 1 hour and 45 minutes, making only four stops, and we are getting all that business.

We have two classes of interurban cars, one that we call our large type of car, 52 ft. in length, having a motorman's cab on the front end and a large vestibule on the rear end. We have a toilet room in the rear of the main compartment, and a smoking compartment of eight seats in the front end, four seats on each side. We carry considerable express matter on our line, and on four of these cars we have moved back the front bulkhead the length of one side seat, so that it gives us a large, roomy cab, and we carry all our express matter in that cab on an hourly schedule. This has enabled us to build up something of an express business. As we do not turn our cars at the terminals, we can run the single-end car, and for that reason we would not adopt the kind of a smoking compartment that Mr. Shannahan has adopted, because the women passengers do not like to pass through the smoking compartment. We can open up the doors and there are spaces on the front end, so that we can unload from that front end, if necessary. We have what we call our smaller type of car, which is 46 ft. in length. This is practically the same general style of car as the other, except that most of them are arranged for a double-end car, and some of these are equipped with type M control, and we run two and three-car trains and take care of our excursion business in that way. These cars have no toilet rooms. We expect this coming winter it will be necessary to use some of these cars for winter service, and we plan to put toilet rooms in these cars. We find it is necessary to make provision for toilet accommodations. The public seems to require such provision, and there is usually some complaint to the conductor from a passenger, where the smaller cars go through from Rochester to Geneva, on account of the lack of toilet facilities.

Mr. Peck—The semi-convertible car I object to is a larger car than President Allen describes, and is used on that part of the road where we make 50 miles an hour, and the semi-convertible feature is absolutely useless for that type of service.

The President—Mr. Wilson, in his paper, says: "Having equipped the car with this gate, and having installed a mirror, by which means the motorman can see everything that occurs at the rear step, the starting of the car can then devolve upon the motorman, who, after glancing at his front step and seeing in his mirror that the rear step is clear, can then close his rear gates, give two taps with the gong as a signal to the conductor that all is clear and then start his car upon two bells from the conductor. This will leave the latter free to devote his time to the collection of fares and the stopping of the car upon signal from the passengers."

There are two questions which occur to me in this connection. I ask what are the advantages of installing a gate operated by the motorman? That is the first question. The second question is, having installed the gate and the mirror, don't you think the time required for the making of the stop, letting the passengers off and on, would be greatly increased as compared with letting your motorman control the front end of the car and the conductor look after the rear end of the car?

Mr. Wilson—In answer to the last question, I can say that I think the time with this form of gate would be increased over a car we at present operate with both front and rear platform open. In Buffalo, at the present time, we only allow the passengers to enter and leave from the rear end. I think it would be advantageous to let them in by the front platform as well as the rear platform, and you can make the platform 6 ft. deep instead of 4 ft. deep, as at present. The front platform would be an additional way of entering and leaving the car, so that by the introduction of this car in the Buffalo service I do not believe the headway would be cut down. The chief advantage of this gate is in cutting down the class of accidents which are due to people falling in getting on or off the car. I have seen the gate operated in Minneapolis and St. Paul, and it seems to me to work like a charm. I had that in mind when I recommended it. Another advantage in the use of the gate is that it allows the conductor to devote his whole time to the collection of fares. At the present time he has to rush back to the rear platform and watch it, or he has to ask some one on the rear platform if everything is clear, and take the word of the passenger for it. In a 30-ft. car, such as we operate now, it makes it practically impossible for the conductor to get all his fares. I think those two things gained will more than compensate for a little loss in the headway.

Mr. Harrington—I am informed by the managements of both the Kansas City and Minneapolis roads that the use of the gates has decreased the running time, saving all the time previously taken by the conductor in making certain that the platform is clear when he is inside the car. It has also materially reduced the accident accounts. On our road we had 200 persons injured last year in falling off the cars for one reason or another, and 75 or 80 per cent of these accidents could have been avoided if the gates had been used. I think the gate is a good idea, and I am interested in seeing it generally adopted.

Mr. Peck—How does the motorman clear his platform? Is not considerable time lost in getting the passengers to go inside?

Mr. Wilson—I would allow the passengers to ride on the front platform, outside, just as they do in Chicago at present. I had Chicago in mind in proposing this gate. I was led to favor this gate by the fact that in Buffalo to-day the motormen lean over the front dash, look behind and watch the rear step, and when they see the rear step is clear they bang on the dashboard with their controller handles or something of that kind. That being the natural way that the motormen have adopted, it seems to me we should facilitate it by some such mechanism as has been suggested.

The President—The reason I ask the questions is this: In Minneapolis last fall I first saw this gate operated by the motorman, and it impressed me very much, indeed. I thought that these people must be making money in the reduction of their accident expense; in other words, that they could not have any accident account. I did think that perhaps it would take a little longer time to operate the cars with the gate. When I arrived home I took occasion to find out what the accident account of the Twin City Rapid Transit Company was, compared with the city of Cleveland and with the city of Buffalo, and very much to my surprise I found that the Twin City Transit Company charged off in their accounts a little more in relation to their gross receipts than did Cleveland. They were charging off 4 per cent of their gross receipts. As to what the other side of the balance sheet was I cannot say, and it is a thing entirely obvious to any one who sees a great deal of passengers getting on and getting off cars.

These are the facts, and I think these figures I am quoting are exactly what the amounts are.

Mr. Harrington—In reference to the motormen's mirror,

we tried a mirror of this kind and finally had to take it off for two reasons. One reason was that in rainy weather the mirror was obscured and was not reliable, and the second reason was that it projected outside the car and was broken by passing vehicles.

The meeting then adjourned until Wednesday morning.

NEW OFFICERS

At the last session of the association, held on June 28, the following were elected officers for the ensuing year: President, R. E. Danforth, president Rochester Railway Company; first vice-president, B. B. Nostrand, Jr., president and general manager Peekskill Lighting & Railroad Company; second vice-president, J. H. Pardee, president and general manager Rochester & Eastern Rapid Railway Company; secretary, C. B. Fairchild, Jr., associate editor STREET RAILWAY JOURNAL; treasurer, W. W. Cole, vice-president and general manager Elmira Water, Light & Railroad Company; executive committee, the officers and E. F. Peck, general manager Schenectady Railway Company; T. W. Wilson, general manager International Railway Company; Oren Root, Jr., general manager New York City Railway Company; and J. N. Shannahan, general superintendent Fonda, Johnstown & Gloversville Railroad Company.

A report of the proceedings on June 28 will be published in next week's issue.

ENTERTAINMENTS

The Lake George Convention was strictly a working convention, so that practically all of the entertainments and trips which were provided were participated in only by the ladies in attendance. The slight showers on the morning of Tuesday and Tuesday evening interfered somewhat with the programs at those times, but the weather during the rest of the convention left nothing to be desired and contributed greatly to the enjoyment of those present.

The first regular excursion was that on Tuesday afternoon, when, upon invitation, a special car of the Hudson Valley Railway Company was taken at the hotel and a trip was made to Warrensburg, 6 miles northwest of the Fort William Henry Hotel. The road extends through a beautiful country lying in the foothills of the Adirondack Mountains, and with the band on board the car the excursion was a very attractive one. It was originally proposed after returning from Warrensburg to take the party to Glens Falls, 9 miles, and Saratoga, 18 miles distant, but the time was found to be rather brief for making this trip, and after the Warrensburg trip the party returned to the hotel.

In the evening an exhibition of fireworks was provided by the Pain Fireworks Company and lasted from 9 p. m. to 10 p. m. The display was given directly in front of the broad piazza of the Fort William Henry Hotel and was witnessed by all of the attendants at the convention. There were forty-two features in the program. Following the display of fireworks there was dancing in the ballroom of the hotel.

On Wednesday morning, at 11 o'clock, upon invitation of the association, a trip was made on the steamer Sagamore to the Sagamore Hotel, located near Bolton, N. Y., about halfway up the lake. Upon arriving at this hotel an attractive lunch was provided, and the return trip was made by the steamer Horicon, reaching the hotel about 4 o'clock in the afternoon.

In addition to these official trips, there were a large number of special trips and excursions made on the lake by private launches, which were greatly enjoyed. Among those who acted as hosts on these occasions were William M. Field, of the Barbour-Stockwell Company; Jerry M. Hayes, of the Frank Ridlon Company, and W. M. Johnson, of the Schoen Steel Works.

THE BANQUET

The annual banquet was held in the main dining room of the Fort William Henry Hotel, on Wednesday evening, June 28, and was a thoroughly enjoyable affair. C. Loomis Allen, the retiring president, introduced W. Caryl Ely, of Buffalo, as toastmaster, and Mr. Ely contributed much to the success of the evening by his characteristically felicitous handling of the duties of this office. Considerable merriment was aroused by a clever impersonation of Booker T. Washington, and this feature of the program was particularly appreciated by those at the speakers' table, including the toastmaster, and it resulted in numerous calls for A. B. Colvin, the chairman of the entertainment committee. The other speakers were as follows: J. M. Wakeman, of New York, who replied to the toast "From the Writer's Standpoint," in place of James H. McGraw, of New York, to whom the toast had been assigned, but who was unable to be present; Rev. Robert M. Reilly, of Glens Falls, who won the hearts and applause of the audience by his happy response to the toast "When the Wheels Go Round"; Joseph A. Lawson, of Albany, who spoke to "Sic Transit"; Judge Tierney, of Troy, who spoke for ex-Judge L. E. Griffeth, of Troy, on our "Sweethearts and Wives"; and E. M. Angell, of Glens Falls, who replied to the toast "The Farmer and the Financier." Music was furnished by the ladies' orchestra of the hotel, and the special program included several feats of juggling by Willie De Lisle, the boy juggler of Glens Falls. The banquet adjourned at 12 o'clock in order to give delegates and attendants time to catch a special train which left Lake George at 1 a. m.

THE WHEEL QUESTION

BY C. G. BACON, JR.

It is probably true that there is no one mechanical question which is deserving of more thought and investigation on the part of the railway official of to-day than that of wheels, and equally true that no time is wasted which is spent in the study of that important subject. George L. Fowler's article in the STREET RAILWAY JOURNAL of June 17 brings out several very interesting points, which are well worthy of the closest attention; for instance, briefly he refers (1) to the guaranteed life of cast iron wheels; (2) to the variables which go to affect that life, and (3) to the value of the guarantee, per se. In this connection it is suggestive to refer to the data recently obtained in inves-

OPEN CARS

Make of Wheel	Number of Wheels	Average Life, Miles	Per Cent of Failures	Average Life, Including Failures, Miles	Miles Guaranteed
"A"	202	28,434	14¾	26,789	30,000
"B"	363	39,007	16⅛	37,666	40,000
"C"	64	21,833	15¼	19,917	30,000

CLOSED CARS

Make of Wheel	Number of Wheels	Average Life, Miles	Per Cent of Failures	Average Life, Including Failures, Miles	Miles Guaranteed
"A"	317	27,018	17⅗	23,987	30,000
"B"	146	37,406	18¼	35,843	40,000
" "	43	20,013	16½	19,105	30,000
"D"	136	29,654	16½	28,423	30,000

tigating the subject of wheels on a railway operating some 400 cars, in both city and interurban service, these figures covering a period of some four or five years' experience with 33-in. cast-iron wheels.

Under the heading of "failures" in these tables are included all cracked hubs, broken spokes, broken flanges, cracked wheels, etc., and all the flat wheels which it was impossible to true up for further service, and the most astonishing feature of the situation is that in only one instance (that of the "C" wheels), had any claim been made by the railway company upon the manufacturers for restitution under the guarantees. The settlement made even in that instance was not sufficient to cover the discrepancy as developed by these investigations.

Again, and in another instance, 1200 cast-iron wheels were furnished under a guaranteed life of 42,500 miles. None of these has been in service long enough as yet to have reached this mileage, but 345 of these wheels (or 28¾ per cent) have already been removed from service on account of failures, and this total of 345 wheels shows now an average mileage of only 16,190 per wheel.

The only conclusions which can be drawn from these, and numerous other showings of similar purport, are simply:

(1) Despite the earnest and successful efforts of several manufacturers to produce the very best cast-iron wheel, such wheels cannot possibly be made to fulfil economically or safely the requirements of the high-power, high-speed and heavy-weight interurban, or even urban, service of the present day.

(2) It is not the mileage of those wheels which give their full life in service which is the determining factor, but, rather, the large percentage of failures which enters in to affect very materially the average life, which must be considered by the mechanical and operating officials, and

(3) A "guarantee" is a most uncertain quantity under ordinary conditions, largely because, as was stated by the head of the mechanical department of one large road after he had had a part of his force following up "guaranteed" material for upwards of a year, "it costs more for clerk hire in 'keeping tabs' on guarantees than the total amount of the restitution under those guarantees."

Consideration of the foregoing tables will bring to light another point which is worthy of note, viz.: that, all other conditions being the same, the life of wheels of the same make is greater under open cars than it is under closed cars. Extensive investigation on this point has shown that during the three winter months, when the rails are covered with ice, snow and sleet, the wear of the wheel per 1000 miles is about twice as much as it is during the other nine months of the year. This is due, of course, to the fact that on account of the slipping, particularly in starting, a wheel is revolving five or six times the distance of its own diameter in traveling the distance of its circumference. This ratio would apply to wheels engaged in an active city service, and would be variable in other kinds of service in proportion to the number of stops, grades and curves, but a fair average would not be very different from as 2 to 1.

But it is more particularly toward the "variables that so affect the life of the wheel," to which Mr. Fowler refers, that attention should be directed, for therein lies the greater part of the wheel question of to-day. If the Schoen steel wheel, to which he refers, is going to cause a reduction in the percentage of failures, so as to bring it down to say 3 per cent to 5 per cent, as against say the 14 per cent to 18 per cent as at present in the case of the cast-iron wheel, then the all-steel wheel proposition becomes an attractive one from the very start, in spite of a trebled first cost, because the saving in the labor item and in the ability to keep cars out of the shops and in active service, not mentioning the increase in the factor of safety, would cause our railway managers to favorably consider this type of wheel in very short order.

Going a step further, however, and considering what the life of the all-steel wheel is going to be, and also as to what extent it lies within the power of the railway official to control these variables, one is brought face to face with the old saying that "an ounce of prevention is worth a pound of cure." It is generally accepted as a fact that the "miles per 1-16 in. of wear" are just as great in the case of a cast-iron wheel as they are with an all-steel wheel, during the life of the best part of the chill in the cast-iron wheel. The chill, of course, it will be remembered, is projected at right angles to the chill block, and only to a certain depth and even in that depth in a gradually decreasing density. In other words, let it be assumed for the sake of illustration, that the chill extends into the wheel to a depth of say ¾ in., and that the "miles per 1-16 in. of wear" are 4000 with the new wheel; then, after, say, ¼ in. of the chill had

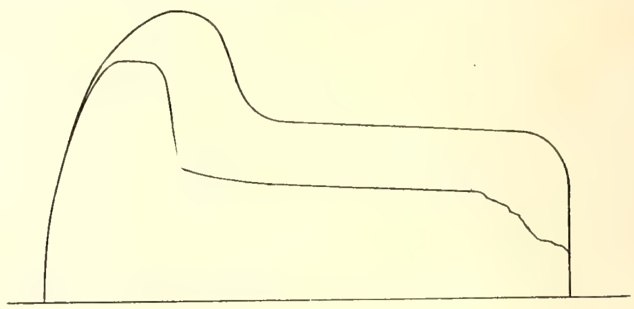


FIG. 1.

been worn away, the "miles per 1-16 in. of wear" would be reduced to, say, 3000, and after a second ¼ in. of the chill had been worn away the "miles per 1-16 in. of wear would be still further reduced to say 2000. Theoretically, then, such a wheel would have a life of 36,000 miles for a total of 12-16 in. of wear or an average of 3000 miles per 1-16 in. of wear. But the all-steel wheel would have the same mileage per 1-16 in. of wear as the cast-iron wheel during the first ¼ in. of its chill, or 4000 miles, and this wheel would maintain this same rate of wear throughout say 1¾ ins. of wearing tread. That is, it would have a total of 28-16 ins. at 400 miles per 1-16 in., which equals a life of 112,000 miles. Such a life would thus be somewhat more than three times as great as the life of the cast-iron wheel, and the absolute economy of the all-steel wheel would be demonstrated.

An important element which enters into any such discussion as this, however, is the problem of handling the all-steel wheel so as to minimize the loss of wearing body involved in

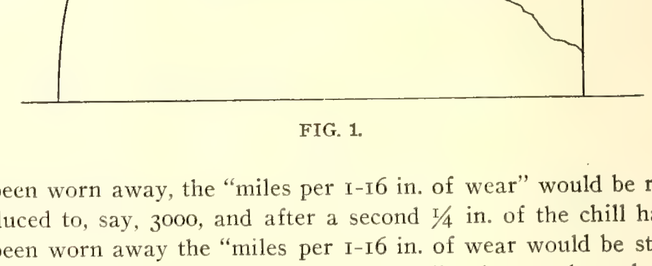


FIG. 2.

turnings, and the labor item, loss of service, etc., attached thereto, and here is where the "ounce of prevention" may profitably be used.

Would any railway official consider that a particular make of wheel, or its manufacturers, were responsible for the condition of affairs as set forth in Fig. 1 and Fig. 2? Yet these are conditions which are frequently, if not almost constantly, met, though they are remediable to a very great extent.

And why is it not possible so to care for all-steel and steel-tired wheels in service that 98 per cent or 99 per cent of them will wear through their entire lives without turnings, and preserving throughout their original contours, in the same manner as did the wheel shown in Fig. 3?

As a matter of fact, it certainly is possible, with proper care and attention, to handle these improved types of wheels so that they can be kept "trued up" throughout their lives, and

the railway managers who have already come to a realization of this important item are those who are securing the most satisfactory and economical results.

Hand in hand with the developments which are being made in the manufacture of wheels must go improvements in the care of wheels in service, not along the lines of curing the variables, but of preventing them, or keeping them down to a minimum, in order that due value may be obtained from the rapid advances which are being made in wheel manufacture, and all of which should certainly accrue very largely to the benefit of the railway companies.

Lack of space, and the impossibility of setting forth any fixed rule which should control all cases (since the local conditions of each railway company would be very largely the determining factor, and would all have to be taken into account when considering the indicated prevention) render it impossible to deal here with the exact and specific ways and means, but it is easily susceptible of proof in practical service that these ideal conditions can be attained in the vast majority of cases. This is rather a bold assertion, and 1 per cent or 2 per cent of exceptions must be allowed to prove the rule, but it is a statement of fact which can be so clearly and definitely demonstrated as such that no hesitancy need be had in its making, or in its acceptance.

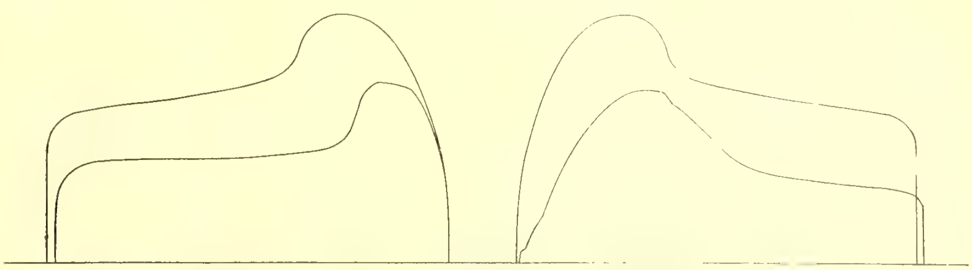


FIG. 3.

The present situation and the great importance of this wheel question certainly should induce every street railway in this country, large and small, to investigate, test, and sift the matter most thoroughly. It will never do to sit back and await results on some other road, for local conditions form the controlling and determining factor. Each and every road should determine this matter very largely for itself, and under its own conditions of service—and this remark has special significance in connection with the care of wheels, to even a greater extent than in connection with the selection of any particular make of wheel.

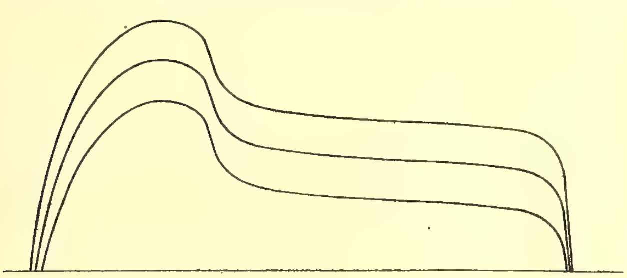


FIG. 4.

And, in conclusion, nothing could be more fitting than to quote from the editorial which appeared in the STREET RAILWAY JOURNAL of December 10, 1904, as follows:

The practice of testing equipment and supplies is one which has of late grown considerably in favor among railways. No small amount of time and money can be thrown away in experiments by hasty or ill-considered methods. It is generally a mistake to lay the burden of making tests of a special nature upon the operating department of a large road. Such a course is liable to hamper the regular business, and when men laden with the responsibilities of keeping a great system in motion are required to undertake an exhaustive and scientific study of special equipment, there is every likelihood that justice will not be done to the tests, interested as the men who are making the tests may be to secure good results. The expert should be called upon, like the physician, to correct railway ills, and it is rarely that his services are over-paid.

The Grand Rapids, Grand Haven & Muskegon Railway has put on a fruit express to connect with the steamers of the Crosby Transportation Company for Milwaukee.

CORRESPONDENCE

HEATING TOOLS

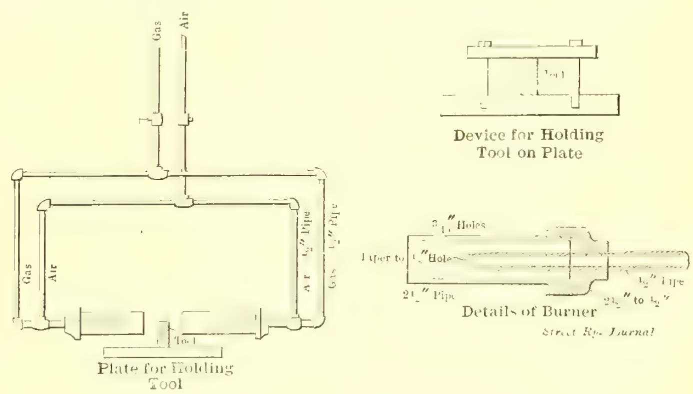
NORTHWESTERN ELEVATED RAILWAY COMPANY

Chicago, July 5, 1905.

EDITORS STREET RAILWAY JOURNAL:

In a shop where fuel or illuminating gas is accessible, and where high-speed steel is used for turning steel tires, it is possible that the accompanying sketch will be of value to some one. As this particular high grade of steel should be worked when at a fusing heat, it becomes necessary to devise a plan for quickly heating the end of the tool to be dressed without heating 3 ins. or 4 ins. farther back than is actually required, which, if done in a blacksmith's fire, will invite sulphur from the coal to unite with the molecules of the steel, which is considered injurious.

After the tool has been dressed to the desired shape it may be clamped to the plate as shown in the sketch and brought up to a fusing heat by the use of a combination of gas and compressed air, which should be regulated to produce a blue flame. The proper temperature of the steel may be determined by the appearance of small blisters. When it has been attained the gas should be shut off immediately, and the air valve opened wide enough to allow a full volume of air to strike the end of the tool. The mixing chamber will at this time be hot enough to extract from the air the moisture that possibly exists.



DEVICE FOR HEATING TOOLS

I may mention that the distance between the mixing chambers should be not less than 6 ins.

J. E. OSMER, Master Mechanic.

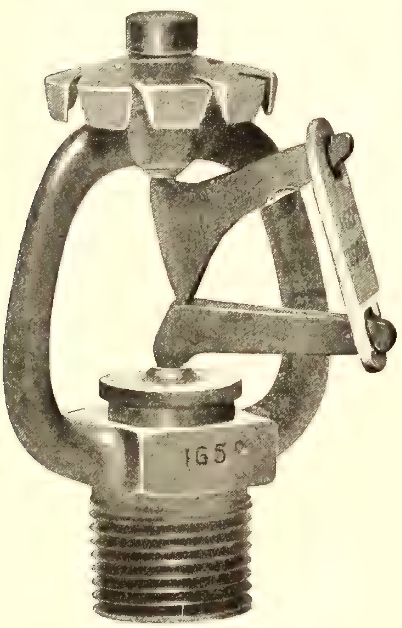
PROPOSED ELECTRIC RAILWAY AT PANAMA

Bids will be received by R. Chiari, municipal treasurer at Panama, on July 24, for the construction of an electric tramway in the City of Panama. The line is to start from the Plaza de Armas, and will follow a course along Carreras, Nacional, Picaurte, Bolivar, Constitucion and Ithmo up to the new station of the Panama Railroad Company, the public market and the cemeteries. The cars are to run from 5:30 a. m. to midnight, and three years after the main line shall have been completed the contractor is to pay 2½ per cent of the gross receipts of the tramway to the city, and after five years 5 per cent.

FIRE-PROTECTIVE APPARATUS FOR CAR HOUSES

The efficacy of automatic sprinklers for car-house protection has been demonstrated so often that it is hardly necessary to expatiate upon the wisdom of installing such apparatus. However, as so many different systems are on the market, it may not be amiss to describe the details of the "Evans" automatic sprinkler devices developed by the International Sprinkler Company, of Philadelphia, because they have been officially approved by all the fire underwriters of the United States and Canada, and have found such wide acceptance among users of this class of apparatus.

This sprinkler system consists of a series of lines of pipe hung from the ceiling of any building, running parellel and every 8 ft. to 10 ft. apart, with sprinklers attached along these lengths of pipe at distances of 8 ft. to 10 ft. Thus to every 64 sq. ft. to 100 sq. ft. there is an automatic sprinkler. This pipe system must have a sure source of water supply. There are two sprinkler systems, the wet and the dry—the former being used in buildings in which there is no danger of freezing the water in the pipes, and the other in buildings where freezing is possible. The water supply is intercepted at the point where freezing may occur, by the dry pipe valve. Between this valve and the sprinkler heads the pipes are filled with compressed air. A relatively low air pressure of 30 lbs. pressure per sq. in. operating on the dry valve keeps it closed against any available water pressure. Upon the occurrence of fire, causing the opening of one or more sprinklers, and the reduction of the air pressure to approximately 10 lbs., the dry valve opens automatically and floods the system with water. The automatic alarm is used in both systems whereby electrical or mechanical gongs, one or both, are sounded upon the opening of one or more sprinklers from fire or accidental break in the piping.



DETAILS OF SPRINKLER HEAD

The sprinkler head made for this system has been designed to satisfy the highest standards in art, manufacture, and performance. It is preferably installed in the upright position, as shown in the accompanying cut, but operates as well reversed, or "pendant." It consists of a bronze frame, threaded for attachment to the pipe system, containing a water outlet, and opposite thereto a reflector, normally rotating in action, but giving equally good distribution when stationary. The water outlet is kept perfectly closed by a bronze cap, retained by two levers, whose ends are in turn secured by a fusible link, consisting of two bronze plates transversely corrugated and soldered together.

As soon as the air about any sprinkler head, by reason of combustion, reaches a given temperature—usually 165 deg. F. —the solder link in the head melts. Thereupon the valve cap which closes the outlet end of the water-supply pipe is released. Water then pours through the opening against the distributor, and is spread over the ceiling and floor of the building.

The "International" head distributes water perfectly, above, below, and for a desired distance around—in large drops and not in a fine spray, which runs into steam too rapidly to combat a fire successfully.

The fusible link, due to its thin design and exposed location, is very sensitive to heat and certain in operation. The entire device incorporates in itself a spring, ensuring the promptest action at rated temperatures.

EAVE SPRINKLER

Experience with this design in large quantities for many years has proven it free from accidental injury no matter where installed. The "International" head is made in four different fusing temperatures, namely: 165 deg., 212 deg., 280 deg., and 360 deg.

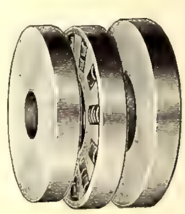
This head is made of "standard" size, same as cut; and also in "Jumbo" size, which is four times as large as "standard," for rare application at points requiring a large discharge of water.

The "International" eave sprinkler illustrated is made of bronze and is used to protect the exteriors of buildings, and wall and window openings.

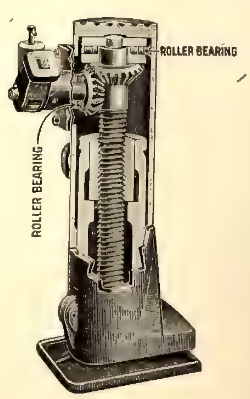
Other devices made by this company in connection with its sprinkler systems are: A dry pipe valve, which under any conditions of water pressure opens promptly should accident or fire cause any sprinkler heads above it to open; an alarm valve, consisting of a complete check valve, retarding chamber, electrical alarm and water motor for the mechanical alarm; and a combined elevated tank and gravity reservoir, which consists of a stand pipe divided sectionally by a floor, the upper portion being an elevated tank, and the lower a gravity reservoir for pump supply.

A NEW ROLLER-BEARING SCREW JACK

A line of some twenty-five or more different sizes of a new roller-bearing screw jack has just been placed on the market by the Duff Manufacturing Company, of Pittsburg, Pa., which announces also that it has other sizes and designs in the course of construction. This jack has been put to abnormal tests to prove its superiority over any other style of jack for heavy work. The manufacturer of this jack states that these tests demonstrated that this new type will involve a large saving in operating expenses, time and labor, and developed the fact that loads could be lifted with about 15 per cent less effort than with any other anti-friction screw jack.



ROLLER BEARING



SECTION OF NEW SCREW JACK

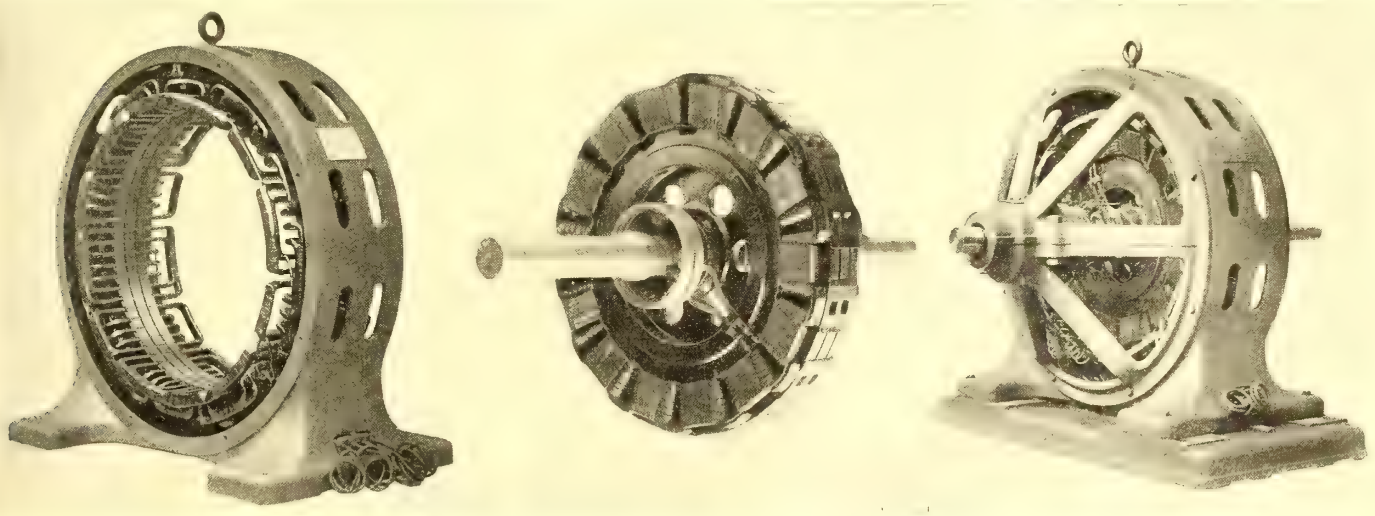
It will be seen from the accompanying sectional cut that the jack contains two roller bearings—one large or main bearing at the head of the jack, and another bearing to take the thrust on the level pinion. This additional bearing is a valuable feature, and is said to be found only in the "Duff" jacks. The main feature of any anti-friction jack, however, is the bearing itself. The roller bearing used is of a construction particularly valuable when applied to lifting jacks. It consists of two hardened ground tool steel plates with a cage between them carrying the hardened ground tools. This form of bearing will stand heavier loads and will wear better than ball-bear-

ings, or any other form of roller bearings. The rolls will not crush or flatten, or wear grooves in the hardened plates after continuous service, as is often found in other types of anti-friction bearings. When the bearings are removed from the jack frame, they remain intact and do not separate and become hard to handle. The ratchet on this jack may be reversed easier and quicker than the old style ratchet.

This roller-bearing jack covers a wide and an important field in the handling of railway equipment, in bridge work and in the way of wrecking purposes. It is manufactured in all sizes, with capacities from 15 to 70 tons, and the company is also making cone-bearing and roller-bearing journal jacks with capacities of 10, 15 and 25 tons.

WESTINGHOUSE BELTED TYPE, ROTATING FIELD ALTERNATORS

A line of belted type, self-contained, rotating field, alternating-current generators, such as shown in the illustrations, has recently been placed on the market by the Westinghouse Electric & Manufacturing Company. The machines are built for single, two and three-phase circuits, in sizes from 30 to 200 kw. The single-phase generators are manufactured for 220, 440, 1100 and 2200-volt circuits at 7200 alternations, and besides these the polyphase machines are wound for 6600 volts and both 3000 and 7200 alternations. In this type of generator the armature is stationary, a construction which facilitates the insulation of its windings and provides that the field current instead of the armature current pass through the brushes and collector rings. Alternators of this type are therefore especially adapted to high voltages or large current output.



FIGS. 1, 2 AND 3.—ROTATING FIELD ALTERNATOR

The frame of the stationary armature is cast in one piece with slots machined on the inside for holding the punchings which receive the windings; these are composed of wire, strap or bars, depending on the size and voltage of the generator. Open slots are employed in machines up to 75 kw, with coils held in place by hard fiber wedges. In the larger machines partially closed slots are used. Horizontally split brackets, which carry the bearings, are bolted to this cast iron frame. The bearings are generous in their dimensions and are self-oiling, having oil rings and an oil gage on each, thus giving superior running qualities. All generators have bed plates with large foundation areas and suitable belt tighteners. These generators may also be arranged for direct connection to an engine or water-wheel.

The fields of the smaller generators are of cast steel, with pole caps of the same material. The poles of larger sizes are laminated and keyed or dovetailed to a cast iron spider. The field coils are composed of square wire so wound as to expose the maximum surface. In the generators having laminated poles heavy brass wedges, which hold the field coils in place, retard any shifting of the field between the poles, and thus practically eliminate pumping between the generator and any rotary converters or synchronous motors which may be connected in the system and insure satisfactory parallel operation of two or more generators. A large shaft insures cool running of the bearings, and the absence of any distortion which might result from the pull of the belt.

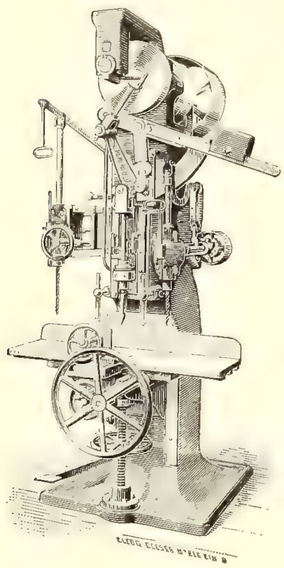
Every means has been utilized for the rapid dissipation of heat from all parts of the machines. Open spaces in the laminated field register with those in the armature, and during operation air is drawn in through the field spider and forced out through the stationary core and windings, thus insuring low operating temperature. Excellent regulation is obtained by properly proportioning the armature and field windings in preference to saturating the magnetic field.

The single-phase generators have compensating field windings supplied with rectified alternating current. A commutator on the shaft adjacent to the collector rings has its brushes connected to the secondary of a series transformer in the armature circuit and its segments to the self-exciting field coils. The compensating winding is so designed that the generator can be adjusted for practically constant voltage from no load to full load or for an increase in voltage.

The Grand Rapids (Mich.) Railway Company recently inaugurated a novel contest among its patrons. In the "Street Railway Weekly," which is to be found in every car on the company's lines, it announced a query to its patrons: "Where will five cents invested in a street car ride net the passenger the greatest return?" To the patron sending the best response prior to July 1, the company gave 300 tickets, and for the second best response 200 tickets. Answers were confined to fifty words and sent to the editor of the "Street Railway Weekly." The announcement called attention to some of the best known attractions on the street railway lines, then said: "There are endless nooks and corners of the Grand River Valley about which only one resident in 1000 knows. We anticipate that this embryo contest may unearth some of these attractions for more general popularity. Have you some favorite spot for an afternoon with your novel? Tell us of it. Do the car lines carry you into forgetfulness of the busy world of commerce? What is the route? Be a good Samaritan; let others into the secret. * * *"

LARGE CAR MORTISING AND BORING MACHINE

A very heavy and substantial car mortiser and borer has been brought out by the J. A. Fay & Egan Company, of Cincinnati, designed to cut in any kind of wood, mortises from ¼ in. to 3 ins. wide and up to 6 ins. deep, and adapted for the heaviest description of car and bridge work. The column is a single casting, which, being hollow, is amply strong to stand up to the heaviest strain to which a machine of this kind may be put. The entire machine is self-contained, and its broad floor base insures freedom from vibration. The driving pulley and crank shaft are supported between the bearings instead of being overhung, as is the case with some machines, adding materially to its capacity and power. The outside bearing supports the crank shaft in front. The front and center bearings are placed on top, being a part of the main column, and receive the shock of the ram. This is one of the new features of this machine, and is claimed to be superior to all other methods for this purpose. The new strap device on the upper end of the pitman, connecting it with the crank shaft, is especially provided for the take-up of the wear and to permit changing the bronze bushing without dismantling the upper part of the machine, saving much time and labor over other methods.



CAR MORTISER AND BORING MACHINE

The chisel mandrel, large in diameter, and made of the best cast steel, is connected to a solid ram working in planed ways, making it impossible for the mandrel to spring when mortising at full stroke the hardest kind of wood. It has a perfectly graduated stroke, commencing at a still point above the extreme upper throw and working gradually down into the mortise, with little or no perceptible jar and under perfect control of the operator. The chisel reverser, which is perfectly automatic, is controlled by a treadle movement operating upon the chisel mandrel and reversing the chisel every time it is brought to the still point by releasing the treadle, locking the chisel bar and holding it in the correct position. The radial slide is attached to the connections and operated by the treadle, and prevents the slightest jar on the foot, even when mortising without first boring a hole to admit the chisel, a feat which it is claimed has heretofore never been accomplished on a machine of this kind.

The bed will receive timber 19 ins. wide x 16 ins. thick, and the chisel will cut a mortise 6 ins. deep, or, by changing the face of the timber, it can be made to mortise clear through the thickness of 12 ins. The table is supported on a central screw, by which means the effect of the thrust or blow of the chisel is conveyed to the foundation and relieving the table bracket. The table is 48 ins. long and has a longitudinal movement by means of rack and pinion of 27 ins. There are two boring attachments, arranged in a novel and compact manner, one on a line with the chisel, to bore the hole to start the mortise, and which will bore to a depth of 8 ins.; also an adjustable auxiliary boring attachment, for boring bolt holes, which has a 15-in. stroke and may be moved by a hand wheel and screw to bore to any point within the width of the bed, which is 19 ins. Both boring attachments are driven directly from the countershaft of the machine, and each is provided with a stop for gaging the depth in boring. A spring counterbalance is provided for returning the boring mandrel after the stroke. The tight and loose pulleys are 16-in. x 4½-in. face and should make 275 r. p. m. The company furnishes its non-dripping, self-oiling, bronze-bearings, loose pulley.

CONVERTIBLE CARS FOR THE LONG ISLAND ELECTRIC RAILWAY COMPANY

The Long Island Electric Railway, Jamaica, N. Y., has recently placed on its lines five convertible cars, built by the J. G. Brill Company. The cars will traverse a most beautiful section, being operated on lines connecting Brooklyn, Queens, Jamaica and Far Rockaway, and also reaching Interstate Park, where the national shooting matches are held, Queens Park, Belmont Park and the Jamaica race track. In the summer, particularly, large crowds are handled and the convertible type is expected to be highly satisfactory, as the cars, when closed or open, are practically the same as the standard types, and conversion or semi-conversion may be effected quickly and easily, thus always being prepared for any sudden change of weather. The cars are mounted on "Eureka" maximum-traction trucks, which carry long car bodies practically as low as a single truck and are easier on the rails. Brackets connect the back of the seats with the posts, thus forming convenient handles which encourage passengers to face in the right direction when leaving the car. Thirty-six passengers may be comfortably seated on the spring cane seats. The interiors are of cherry in natural color, and the ceilings are of decorated birch. The vestibule sashes are composed of single lights and are arranged to drop into pockets.

The cars are 25 ft. 9 ins. over the end panels and 35 ft. 2 ins. over the crown pieces. The platforms are 4 ft. 8½ ins. The width over the sills and the panels is 7 ft. 6¼ ins., and over the posts at the belt 8 ft. 1 in. The sweep of the posts is 3½ ins. The distance between the centers of the posts is 2 ft. 7 ins. The side sills are 4¾ ins. x 7 ins., and the end sills are the same. The sill plates are 7 ins. x ⅝ in. The thickness of the corner posts is 3¾ ins. and of the side posts 3⅜ ins. The trucks have a wheel base of 4 ft. and move 33-in. and 20-in. wheels. Among the specialties are angle-iron bumpers, radial drawbars, "Dedenda" gongs, "Dumpit" sand boxes and ratchet brake handles.

CONVERTIBLE CAR OPERATED BY THE LONG ISLAND ELECTRIC RAILWAY COMPANY

A special car on the Indiana Union Traction Company line made a record-breaking run from Noblesville to Indianapolis on June 27, covering the 22 miles in twenty-seven minutes. This included 5 miles in the city, where the speed was slackened.

NON-ARCING LIGHTNING ARRESTERS

The recent transfer of the patent rights on the Shaw non-arcing lightning arresters and static dischargers by the Shaw Engineering & Manufacturing Company, Newark, N. J., to the Lord Electric Company, Boston, Mass., is a matter of more than usual interest. A great deal of importance attaches to the subject of lightning arresters at this time by reason of the great demand for an instrument which will afford better protection against abnormal potential strains caused by crossed wires, static discharges, or lightning. By far the worst of these conditions is lightning, a fact due, in some measure, at least, to the universal lack of knowledge regarding its power.

To successfully perform its important duty the internal resistance of an arrester must bear such relation to the circuit and apparatus which it protects as to offer a path of such low resistance that the executive current will pass through it to the ground, and this should be accomplished without allowing the useful current to follow it or in any way disturb the normal operation of the electric circuit.

It not infrequently happens that induced charges in the circuit produce abnormal potentials between line and line, as well as between line and ground, and it is therefore advisable to make provision to equalize these high potentials from line to line of the different phases, as well as from line to ground. The rapid increase in long distance, high-potential transmission lines has increased the difficulties and dangers from lightning, and the demand for a satisfactory device to protect the great amount of valuable apparatus used in connection with such lines. Although usually very high, the frequency of lightning disturbances undoubtedly varies greatly in different cases, and there is no positive knowledge by which to formulate a rule applicable to the demonstrations of the discharge.

It is well known that an ordinary current will follow the convolutions of a coil of wire, while lightning will leave such a metallic circuit and jump across an air gap. This is illustrated in the burning out of a dynamo by lightning where the discharge will leave the metallic circuit of the coils, puncturing the insulation and going directly to the core and thence to the ground, the explanation of this being in the distinction between ohmic and inductive resistance.

The Lord Electric Company has made this the subject of special study for some time past, and has re-designed the standard instruments so as to improve their efficiency and make the parts uniform and interchangeable. In the construction of the improved Shaw non-arcing lightning arrester two metal caps are used, each having circular serrated edges. These caps are supported by metal brackets and they in turn support a hollow insulating tube on which are placed alternately mica washers and carbonized rings. These rings are specially prepared high-resistance carbonized material. In both the low and high potential types this composition is formed into oval rings, affording a large surface of discharge area, and when placed in series with mica rings to supplement the air gap, the resistance surface of the mica acts as a discharge plate and materially assists in presenting a continuous surface of the abnormal or static discharge. At the same time this combination of resistances will not permit an arc to form or a dynamic current to precede or follow it. This high resistance feature and the peculiar shape of the rings afford one of the many advantages possessed by this form of arrester.

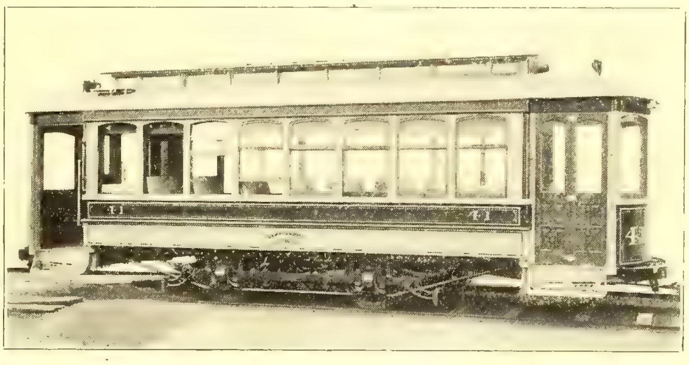
The supporting brackets are secured to the insulating base, which is raised from the bottom of the steel box in which it is enclosed, allowing the free circulation of air and preventing the formation of an arc between the box and instrument. As a further precaution the box is treated with special insulating enamel.

The box itself is made of heavy pressed steel, with a cover of the same material held in place with winged screws. The openings in the sides of the box for circuit wires are provided with special insulating bushings, the whole making a compact and durable instrument of neat appearance, the several parts being so proportioned and distributed as to make the combined instrument convenient to handle, place and connect. All of the parts are readily accessible for inspection and test at all times.

NEW EQUIPMENT FOR MENOMINEE & MARINETTE TRACTION COMPANY

The American Car Company has recently delivered to the Menominee & Marinette Light & Traction Company, Menominee, Mich., the type of semi-convertible car illustrated. The railway company operates systems in Menominee and Marinette and a line connecting the two cities, and also owns the attractive resort, Lakeside Park. Menominee is at the extreme southern point of Northern Michigan, and Marinette is just opposite in Wisconsin. Both are just off the coast of Green Bay.

The car illustrated is seated for twenty-eight passengers, and the seats are of spring rattan. The semi-convertible window system permits the admittance of as much air as desired, the windows being arranged to be held at any height or raised entirely into the roof pockets. Cherry, with neatly decorated birch ceilings and bronze trimmings, constitutes the interior



TYPE OF SEMI-CONVERTIBLE CAR USED BY THE MENOMINEE & MARINETTE TRACTION COMPANY

finish. The furnishings include Brill angle-iron bumpers, "Dedenda" gongs, radial drawbars, ratchet brake handles, etc., and American Car Company's sand boxes. The Brill No. 21-E type of single truck is used with a wheel base of 7 ft. 10 ins. and 33-in. wheels.

The length over the end panels is 20 ft. 8 ins., and over the crown pieces 30 ft. 1 in. The distance from panel over the crown piece is 4 ft. 8½ ins. The width over the sills, including the panels, is 7 ft. 9½ ins., and over the posts at belt 8 ft. 2 ins. The sweep of the posts is 2¾ ins. The distance between the centers of the posts is 2 ft. 5 ins. The side sills are 5 ft. x 3⅜ ins., and the end sills are 3½ x 6⅛ ins. The angle-iron sill plates are 6 ins. x 3½ ins. x ⅜ in. The thickness of the corner posts is 3¾ ins., and of the side posts, 3¼ ins. The seats are 36 ins. long, thus leaving a 22-in. aisle.

Three hundred men on June 22 changed the gage of the East St. Louis & Suburban Railroad, running between East St. Louis and Belleville, Ill., by 1½ ins., the entire alteration, in the route between the two cities and in the tracks running from the limits of Belleville, to its public square, being effected in little more than nine hours. The original gage was known as the "street car," and this was altered to the standard width. Cars were run all day between the limits of Belleville to East St. Louis, where transfers were made to the city line at the Belt line crossing. In Belleville the service was interrupted from 6.30 a. m. to 4 p. m., when the change was completed.

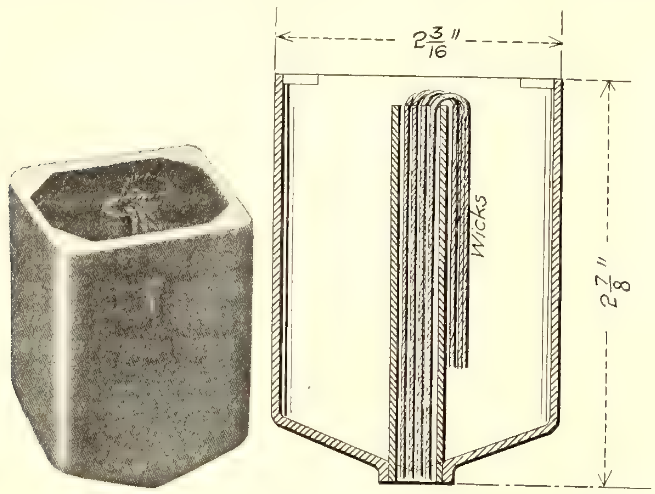
NEW YORK STATE QUESTION BOX

In the last issue of this paper was published a portion of the new answers contained in the Question Box prepared for the Lake George convention of the Street Railway Association of the State of New York. The remaining answers are given herewith:

MECHANICAL (Continued)

No. 22.—Give description with sketch of oil cup or journal-box, suitable for using oil as the lubricant.

The Schenectady Railway Company has adopted the use of oil for lubricating motor, axle and journal bearings. The motor and axle bearings are lubricated by an oil cup designed in our shops as per the accompanying illustrations. This cup is very simple,



OIL CUP USED BY SCHENECTADY RAILWAY

and the number of wicks entirely governs the feed. It was found that by using oil entirely 25 per cent of armature trouble has been eliminated, besides cutting expense of lubricant in half. The use of grease for lubricant in my opinion is a thing of the past.
J. G. BAUKAT, Master Mechanic, Schenectady Ry. Co.

We use a cup with a piston feed, the jar of the car causing the piston to move and feed the oil.
F. P. MAIZE, Master Mechanic, Rochester Ry. Co.

WHEELS

No. 23.—Give your ideas and experience with respect to the following:

(a) Life and cost (per 1000 wheel-miles) of cast-iron wheels?

Average mileage taken from 1458, 400-lb. cast-iron wheels, showed an average of 40,014 miles per wheel, and including one regrinding show a cost of 22 cents per 1000 miles.
J. A. HANF, Gen. Foreman Shops, International Ry. Co., Buffalo.

Cast wheels on this road have been giving an average of 12,582 miles at a cost of .00718 per mile. Steel-tired wheels thus far have not filled their entire life with us, and consequently can give but little idea of the mileage and cost at the present time.
W. R. W. GRIFFIN, Supt., Rochester & Eastern Rapid Ry.

Average life of cast-iron wheels about 30,000 miles. Cost per 1000 wheel-miles, 20 cents.
W. H. COLLINS, Master Mechanic, F. J. & G. Ry. Co.

Average life, 25,000 miles. Cost per 1000 miles, 19 cents.
F. P. MAIZE, Master Mechanic, Rochester Ry. Co.

(b) Life and cost (per 1000 wheel-miles) of steel-tired wheels?

None of our steel-tired wheels have been finally removed, but the majority of them have been turned up twice with an average of 38,000 miles for each turning. Not having the complete life of any of these wheels, we are unable to give the cost per 1000 wheel-miles.
J. A. HANF, Gen. Foreman Shops, International Ry. Co., Buffalo.

Average life of steel-tired wheels 150,000 miles. Cost per 1000 wheel-miles, 13½ cents. This cost is based on price of tires only, as we consider the wheel center should be classed as a permanent feature of the truck when considered in comparison with cast-iron wheels. The shop cost of turning the tire on one steel-tired wheel during its life time is practically the same as for boring and fitting five cast-iron wheels, which it would be necessary to use to make the same mileage. The value of scrap returned after 150,000 miles service is, however, in favor of the cast-iron wheels to the amount of about $4, which would reduce the cost of the cast-iron wheel per 1000 wheel-miles, to 17.4 cents.
W. H. COLLINS, Master Mechanic, F. J. & G. Ry. Co.

(c) Life and cost (per 1000 wheel-miles) of rolled-steel wheels?

We are unable to give the life or cost per 1000 wheel-miles on rolled-steel wheels, owing to the fact that we have had them in service but a short time. I would say, however, that from the present indications, their performance should be very satisfactory.
W. H. COLLINS, Master Mechanic, F. J. & G. Ry. Co.

No. 24.—What are the deciding factors in determining the wheel problem, and under what conditions will the steel wheel supplant cast iron?

For interurban use the most important factor is that of safety. Another argument in favor of steel wheels is the removal of the flat wheel nuisance.
J. A. HANF, Gen. Foreman Shops, International Ry. Co., Buffalo.

With us the principal deciding factor is the city tracks of Rochester. We are unable to get cast wheels with flanges that will not chip more or less.
W. R. W. GRIFFIN, Supt., Rochester & Eastern Rapid Ry.

To my mind the factor of safety will be the deciding one in determining the wheel problem, and I believe as a matter of economy, the steel-tired wheel will eventually supplant the cast-iron wheel, at least on suburban and interurban cars.
W. H. COLLINS, Master Mechanic, F. J. & G. Ry. Co.

No. 24a.—If steel wheels come into vogue, what additional equipment will be required at the repair shops, and what will be the effect on cost of wheel maintenance.

A wheel-turning lathe, and a systematic inspection of wear of flanges.
J. A. HANF, Gen. Foreman Shops, International Ry. Co., Buffalo.

The only additional equipment in the shops to maintain steel wheels with us will be a tire-turning lathe.
W. R. W. GRIFFIN, Supt., Rochester & Eastern Rapid Ry.

In shops not already equipped, it will be necessary to provide a wheel-turning lathe. The cost of wheel maintenance should not be increased.
W. H. COLLINS, Master Mechanic, F. J. & G. Ry. Co.

BRAKE SHOES

No. 25.—What has been your experience with different types of brake-shoes?

We have experienced some difficulty in making a car with insert shoes brake as readily as with the soft shoes.
W. J. HARVIE, Elec. Eng. Utica & Mohawk Valley Ry. Co.

Have used several different types of brake shoes. We have found that air brakes require a harder shoe than we were using, soft shoes having a tendency to skid the wheels. We have also used with success, shoes with patented wearing plates inserted.
J. A. HANF, Gen. Foreman Shops, International Ry. Co., Buffalo.

We have had considerable experience with different types of brake shoes, and can find nothing better suited for our requirements than a cast-iron shoe made in our own foundry.
W. H. COLLINS, Master Mechanic, F. J. & G. Ry. Co.

We find that a hard iron shoe with a soft insert gives the best mileage.
F. P. MAIZE, Master Mechanic, Rochester Ry. Co.

No. 26.—What effect has the type of shoe on the life of the wheel?

Effects of different types of shoes on wheels are manifold, the contour and composition of metal used with their varying coefficients of friction being vital to the wheels.

J. A. Hanf, Gen. Foreman Shops,
International Ry. Co., Buffalo.

The soft iron shoes we use have had but little effect upon the life of our cast wheels.

W. R. W. Griffin, Supt.,
Rochester & Eastern Rapid Ry.

In my opinion the character of the brake shoe has a considerable bearing on the life of wheel; this is especially true of steel-tired wheels. A brake shoe that is too hard or has inserts that are too hard, materially lessens the life of the wheel, and does not afford the braking qualities of a softer shoe.

W. H. Collins, Master Mechanic, F. J. & G. Ry. Co.

The difference in the wear on the wheel with a hard iron shoe with a soft insert, and a soft shoe is very slight.

F. P. Maize, Master Mechanic, Rochester Ry. Co.

No. 27.—How thin is it safe to wear a shoe?

By proper adjustment of brake shoes so that an even wear be maintained they can be, with safety, worn down to about ⅝-in. on city cars, and ¾-in. on high-speed cars.

J. A. Hanf, Gen. Foreman Shops,
International Ry. Co., Buffalo.

We wear our shoes to less than ½-in. in thickness.

W. R. Griffin, Supt.,
Rochester & Eastern Rapid Ry.

We make a practice of wearing brake shoes down to ⅜-in. Or in other words, a brake shoe originally weighing 36 lbs. is worn down to 10 or 12 lbs.

W. H. Collins, Master Mechanic, F. J. & G. Ry. Co.

We found some time ago that a great many brake shoes were being taken out before they were fully used up. We made a number of experiments, and finally came to the conclusion that it was entirely safe to wear a shoe down to about ⅝-in. thickness. We believe it is a waste of good material to take a shoe out which measures ⅞-in. or 1-in. in thickness.

Schenectady Ry. Co.

Five-eighths inch to one-half inch.

F. P. Maize, Master Mechanic, Rochester Ry. Co.

If shoes wear even on both ends it is safe to wear the shoe to ¼-in., but if one end wears faster than the other, it is necessary to watch the shoe carefully, as the flange of the wheel is apt to wear through and cut the shoe hanger. On single-truck cars I let the shoes wear to almost ¼-in.

Homer Tice, Master Mechanic,
Poughkeepsie City & Wappingers Falls Elec. Ry. Co.

No. 28.—What is the cost of your shoes per 1000 car-miles?

Cost of brake shoes per 1000 car-miles is about 7 cents.

J. A. Hanf, Gen. Foreman Shops,
International Ry. Co., Buffalo.

Seventeen and one-half cents per thousand wheel-miles.

W. R. W. Griffin, Supt., Rochester & Eastern Rapid Ry.

Cost of brake shoes per 1000 car-miles, 59 cents.

W. H. Collins, Master Mechanic, F. J. & G. Ry. Co.

Fifty-eight and three tenths cents.

F. P. Maize, Master Mechanic, Rochester Ry. Co.

No. 29.—Have you had any trouble with shoes breaking?

Yes:—Shoes frequently break in one of two places, either straight across the center of the shoe, or the eye through which the key goes breaks off and drops the shoe.

W. J. Harvie, Elec. Eng.
Utica & Mohawk Valley Ry. Co.

Practically none.

J. A. Hanf, Gen. Foreman Shops,
International Ry. Co., Buffalo.

None whatever.

W. R. W. Griffin, Supt.,
Rochester & Eastern Rapid Ry.

It is very seldom that we have a shoe break.

W. H. Collins, Master Mechanic, F. J. & G. Ry. Co.

We have had no trouble with shoes breaking.

F. P. Maize, Master Mechanic, Rochester Ry. Co.

No. 30.—What adjustment do you allow between the shoe and the wheel, (a) With air brakes? (b) With hand brakes?

We get the best braking results when we adjust the shoes so as to just clear the wheel when the brakes are off.

W. J. Harvie, Elec. Eng.
Utica & Mohawk Valley Ry. Co.

Our shoes are adjusted to from ¼-in. to ⅜-in. in both cases.

W. R. Griffin, Supt.,
Rochester & Eastern Rapid Ry.

From ⅛-in. to 3-16-in. we find sufficient for air, and 3-16-in. to ¼-in. for hand brakes.

J. A. Hanf, Gen. Foreman Shops,
International Ry. Co., Buffalo.

(a) One eighth in. (b) One quarter in.

W. H. Collins, Master Mechanic, F. J. & G. Ry. Co.

Hand brakes ⅛-in.; air brakes, 3-16-in.

F. P. Maize, Master Mechanic, Rochester Ry. Co.

I allow anywhere from 1-16-in. to ⅛-in. if the car has to run on short curves, and ⅛-in. is not too much. If the shoe is hung too close to the wheel it will bind on the curves, and the edge of the wheel will cause the shoe to clatter. Our road has some bad grades, and we have had trouble with the brake beams becoming sprung, causing the shoes to wear more at the top than at the bottom. I have not yet found any way of overcoming this uneven wearing.

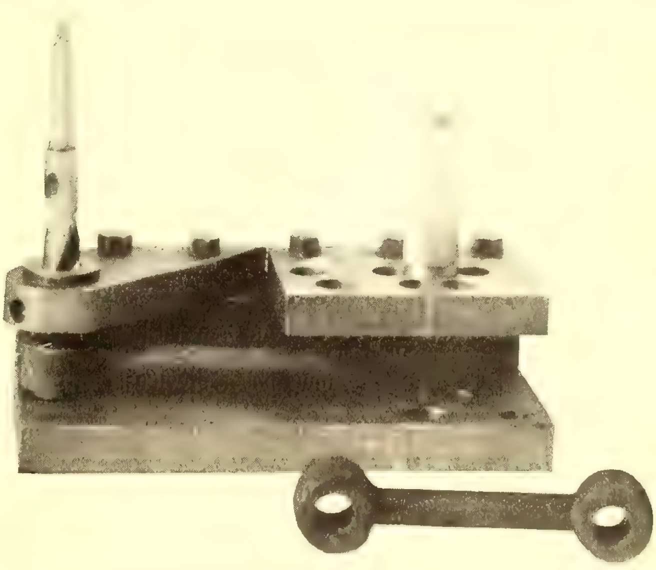
Homer Tice, Master Mechanic.
Poughkeepsie City & Wappingers Falls Elec. Ry. Co.

SHOP DEVICES

No. 31.—There is always a demand for information relative to labor-saving devices and schemes for the shops. If you are using any novel device or labor-saving scheme not recently described, please send description and photographs or drawings.

BORING BRAKE HANGERS

One of the most essential features of brake rigging is the proper position of the shoes on the wheel, and a much neglected detail pertaining to the subject is the boring of the brake hangers. Without uniformity in the hangers, poor braking and improper wear of the wheel and shoe is sure to result. In order to eliminate trouble of this nature, and at the same time materially reduce the labor costs, the "jig" shown in accompanying illustration was designed.



JIG FOR BORING BRAKE HANGERS, BUFFALO

The undrilled hanger is first drilled on one end, centered by the eye only. It is then placed in the "jig" and the pin inserted in hole

governing the length required. By means of a set screw in back (not shown in the illustration) the hanger takes the correct position without further adjustment. The hole is then drilled, the drill being guided by a steel bushing. The "jig" is suitable for any length of hangers from 6 to 10 ins., increasing in steps of ½-in. at a time.

J. A. HANF, Gen. Foreman Shops,
International Ry. Co., Buffalo.

GRAINING WOOD

A device that we have lately put into service, and which has already proven itself a money saver, is an outfit for transferring the natural grain of wood to our sash, etc.

While the apparatus is in no way a new thing, it is not (to our knowledge) extensively used by street railways; therefore, we submit an illustration of our outfit, thinking it may be of some interest.

DEVICE FOR GRAINING WOOD, BUFFALO

The hand roller, with its composition surface, is shown in the box. An impression is made from the natural wood to the composition, and from that to the surface to be grained. The other articles shown comprise a brass cylinder, bottom and bolts with which it is put together, forming a circular mould. The roller is placed in position inside the cylinder and the melted composition poured in, making a continuous surface, so that no cracks or seams show in the graining. This outfit is entirely home-made, the roller being wide enough to grain two stiles or rails at one time. It has proven itself in every way superior to the old and lengthy process of graining by hand.

J. A. HANF, Gen. Foreman Shops,
International Ry. Co., Buffalo.

THE POWER HOUSE

TREATING FEED-WATER

No. 32.—How can the engineer of a small power station, without consulting a chemist, determine the scale-forming ingredients of the feed-water he is using, with a view of injecting neutralizing chemicals?

The engineer, unless he is himself a chemist, should not attempt any extensive doctoring of feed-water, any more than he should prescribe for sick members of his family. The fee charged by an expert chemist for analyzing feed-water is merely nominal, and if the water requires treatment at all, it is worth doing in a scientific manner. There are many reputable firms making boiler compound who will analyze feed-water without charge, and furnish the proper neutralizing chemicals at reasonable price.

If there is corrosion of boilers due to presence of acid in the feed-water, the acid may be detected by use of litmus paper. Blue litmus paper will turn red if dipped in water containing acid. Soda may be used to neutralize acid; it should be used in such quantity as to render the water slightly alkaline. This condition will be shown by the turning blue of litmus paper previously turned red by the acid.

G. A. HARVEY, Elec. Eng.,
International Ry. Co., Buffalo.

Take a glass vessel and fill it with the water to be tested. Add a few drops of water of ammonia until the water is distinctly alkaline. Next add a little phosphate of soda. The action of this is to change the lime magnesia, etc., into phosphates, in which form they are deposited in the bottom of the glass. The amount of matter thus deposited gives a crude idea of the relative quantity of sediment and scale-making material in the water.

C. DAVIS, Eng. of Pow. Sta.,
New Paltz, Highland & Poughkeepsie Tract. Co.

No. 33.—Is it practicable to use soda ash for purifying boiler feed-water? What are the objections? Under what conditions should soda ash be used, and in what quantities?

No snap-judgment should be formed as to the use of soda ash in feed-water. If an expert chemist is consulted, he will designate the quantity to be used if its use is advisable. If the "small power station" is so located that an expert chemist is not within call, he can be reached, nevertheless, by mail, and samples of water and scale can be sent to him.

Where deposit is due to presence in feed-water of chloride and sulphate of magnesium, carbonic acid and oxygen, sulphate of lime or carbonates of lime, magnesium and iron, soda ash may be used. Soda ash is also helpful where corrosion is due to fatty acid contained in some cylinder oils.

Too much soda will cause foaming. Such quantity may be used as to render the water slightly alkaline. Determine this by litmus paper test.

G. A. HARVEY, Elec. Eng.,
International Ry. Co., Buffalo.

The writer does not consider it practicable to use soda ash regularly for purifying boiler feed water. However, soda ash may be used for cleaning out the boiler by dissolving 4 to 6 lbs. in clean water in a tub or tank, and pumping this into the boiler. The boiler should be worked two or three hours, and then should be cut out and allowed to cool, after which it should be blown out, and man-holes and hand-holes removed, and the boiler thoroughly washed out with a hose.

C. DAVIS, Eng. of Pow. Sta.,
New Paltz, Highland & Poughkeepsie Tract. Co.

Soda ash is used to soften the scale, to bore it out easily with a mechanical pin. One objection to the use of soda ash is the danger of using too much.

D. F. CARVER, Gen. Supt.,
Rochester Ry. Co.

No. 34.—Under what conditions can kerosene be used to advantage in boilers? What are the objections to the use of kerosene?

In water causing an incrustation due to presence of soluable salts, kerosene may be used. It decreases the tendency of small particles to crystalize and to adhere to the iron, and keeps them in the form of a soft slush which can easily be blown out.

In boilers which have already become scaled, kerosene may be used to advantage by allowing the boilers and scale to become thoroughly dry; then pour in kerosene, and very slowly fill boilers with water. The oil floating on the surface will saturate the scale as it rises.

One of the most serious disadvantages in the use of kerosene is the rapid formation of rust which results. This will be found in all parts of the system, even as far as the low pressure cylinders of the engines. On delicate valves the corrosion is apt to cause sticking, and the use of kerosene in boilers has accounted for the twisting off of Corliss valve stems.

The effect of kerosene on pipe joints is very bad. It will quickly open up joints which are slightly defective, and it causes the rotting of any packing which contains rubber.

Scale removed from boilers in which kerosene has been used will be found, if closely examined, to contain traces of iron adhering to it.

Kerosene also has a tendency to destroy lubricating qualities of cylinder oil.

G. A. HARVEY, Elec. Eng.,
International Ry. Co., Buffalo.

Kerosene may be used if it is fed into the boiler by means of a lubricator of some kind. It should be fed one drop at a time in the same way as feeding oil to an engine cylinder. The objection to using kerosene is that it greases the tubes and shell, and may cause the flues to burn, giving rise to all sorts of trouble.

C. DAVIS, Eng. of Power Sta.,
New Paltz, Highland & Poughkeepsie Tract. Co.

No. 35.—Will zinc placed in a steam boiler prevent scale or corrosion? Under what conditions of feed-water impurity should zinc be used?

I do not think that it will.

C. DAVIS, Eng. of Pow. Sta.,
New Paltz, Highland & Poughkeepsie Tract. Co.

Zinc placed in boilers might have a tendency to neutralize certain acids contained in the feed-water, but the direct application of a proper compound to the water before it enters the boiler will effect a more thorough and uniform neutralization.

G. A. HARVEY, Elec. Eng., International Ry. Co., Buffalo.

CARRYING THE PEAK

No. 36.—In a small or moderate-sized plant, what is the best method of increasing the boiler capacity during heavy peak loads? Give details and results obtained.

The capacity of a boiler might be compared to the strength of a chain. When it is once strained by overwork, it is thereafter always a doubtful quantity. The best method of operation is to always keep the boilers thoroughly clean, both inside and out, and they will then be in shape to take care of as heavy loads as should properly be placed upon them. The stirring of fires and increasing of draft to a reasonable limit is about as much forcing as should be resorted to. G. A. Harvey, Elec. Eng.,
International Ry. Co., Buffalo.

The best way to increase boiler capacity is to put in more boilers. C. Davis, Eng. of Pow. Sta.,
New Paltz, Highland & Poughkeepsie Tract. Co.

No. 37.—Is it practicable to inject live steam under boilers to raise the steam pressure at times of heavy demands? Please give details of proper arrangement and results secured.

The writer does not consider it is practicable to inject live steam under the boiler to raise steam pressure. A better way is to insert a steam jet in the smoke-stack. C. Davis, Eng. of Pow. Sta.,
New Paltz, Highland & Poughkeepsie Tract. Co.

No. 38.—What pointers or suggestions can you give for the benefit of the chief engineer of power station, who is called upon to run his station heavily overloaded during the summer months? What are some of the things you do under these conditions?

All power station machinery has a "normal rating" given it by the manufacturers, which can safely be exceeded for definite limited periods. If these limits are exceeded, either as to amount or duration of overload, the policy of operation is most unwise. Continued excessive overloading is sure to result, sooner or later, in break down of some part of the apparatus, which will result in serious hindrance of operation. There should always be some margin of spare machinery. If there be no margin, there is all the more reason for limiting the load to an absolutely safe point.
G. A. Harvey, Elec. Eng., International Ry. Co., Buffalo.

LIGHTING

No. 39.—Is it possible to run a lighting or power load from generating units that are supplying current for railway purposes? How can it be done? What is the best method of regulation in such cases to prevent fluctuations in the lighting or power circuit?

If lighting on power circuits is permitted by the underwriters, and the use of 500-volt current and lamps in series can be tolerated, the lighting can probably be done in a manner that will be sufficiently satisfactory for the purpose. Lighting circuits should be taken directly from the power-station bus-bars, and there should be nothing but lighting service on the leads that are provided for that purpose. With a station having modern units, not greatly overloaded, such lighting service ought to be quite satisfactory. If possible, the generators should be adjusted for flat compounding curve. If there are storage batteries in connection with the plant, the lighting will be better.

A still better method of lighting from railway power would be to install a motor-generator set, for the motor of which power should be taken directly from the station bus-bar independent of any railway feeders. The generator of this set could be built for 110 volts. If the field is worked at a high point on the saturation curve, the power-station fluctuations will be considerably cushioned at the lamps. G. A. Harvey, Elec. Eng.,
International Ry. Co., Buffalo.

We are doing it every day by the use of a synchronous motor-driven, 60-cycle alternator, and are having no trouble whatever with the regulation. W. R. W. Griffin, Supt.,
Rochester & Eastern Rapid Ry.

LIGHTNING

No. 40.—Please state in detail what trouble you have had with lightning at your power house. Then please state in full what steps you have taken to prevent damage from lightning.

We have found that suitable lightning arresters properly installed and cared for, will take care of any lightning discharge which is likely to occur. This applies principally to the high-tension lightning arresters installed in the sub-station; each station is also equipped with arresters on the D. C. side, but these arresters, it might be added, do not show signs of having operated, while the high-tension arresters have been seen to operate. This condition leads us to believe that the high-tension system is more sensitive to lightning discharges and is, therefore, a protection to a neighboring D. C. line, and to station equipment.
W. J. Harvie, Elec. Eng.,
Utica & Mohawk Valley Ry. Co.

Lightning troubles of the International Railway Company, aside from temporary interruptions of power due to short circuiting or grounding of high-tension transmission line, have been limited to burning out of current transformers, and occasionally the relays connected thereto. The manufacturers have since increased considerably the insulation in the make-up of current transformers. Attention has been given to lightning-arrester outfits. The ground plates have been carefully installed, being embedded in powdered coke at such depth that they are constantly in moist earth. Where each ground plate is buried, a 2-in. iron pipe is placed in the earth, so that the lower end reaches the bed of coke and the upper end projects above the surface. The coke can thus be kept wet if there is any doubt as to natural moisture of the surrounding soil. Choke coils have been installed in connection with the lightning arresters, and the gaps of the arresters have been cut down to the minimum safe amount. Arresters now take discharges more frequently than previously. G. A. Harvey, Elec. Eng.,
International Ry. Co., Buffalo.

Have had no serious trouble on our line from lightning. In addition to the regular arresters on the D. C. switchboards, we have a home-made arrester made up of 9 or 11 No. 27 single cotton-covered magnet wires, twisted together in the center and the outer ends laying across the bare terminals, one of which is attached to the feeder, the other to the ground, thus leaving only the cotton cover of the wire insulated between the trolley and the ground. We find that this works to our entire satisfaction, although several of these little wires need repairing after each thunder storm. W. R. W. Griffin, Supt.,
Rochester & Eastern Rapid Ry.

LINE DEPARTMENT

LIGHTNING

No. 42.—Please state in detail what trouble you have had from lightning on any part of the transmission or distribution system. Then please state in full what steps you have taken to prevent damage from lightning.

This question has a bearing on Question No. 40. Would say in this respect that we have had to replace D. C. line arresters on portions of our line which are exposed and are not paralleled by the transmission line, while on equally exposed portions of the line that are paralleled by our transmission line we have had very few replacements to make. We installed D. C. lightning arresters every half mile, and have found this sufficient in our climate.
W. J. Harvie, Elec. Eng.,
Utica & Mohawk Valley Ry. Co.

Refering to the line I am in charge of at present, I have had no trouble from lightning on the high-voltage transmission, as it is well guarded with well-known protective apparatus in the main generating station and each sub-station.

As for the D. C. feeders and trolley we are amply protected with arresters of the wood-box type, which are placed on the pole line at intervals of ½ mile.

Although this line has only passed one lightning season since in operation, we have had no burned-out cars nor any damage whatever as a result of lightning. W. F. Burket, Chief Lineman,
Rochester & Eastern Rapid R. R.

Use the latest improved lightning arrester. Do not think there is any device at present that is a perfect safeguard against lightning. H. L. Mack, Supt. of Line,
International Ry. Co., Buffalo.

The writer once saw a number of lightning arresters connected to the direct current feeder of a suburban electric railway. Each arrester was grounded by a connection with one of the track rails. Those who have had experience with three-wire electric lighting systems can imagine what would occur if a lightning arrester was connected between either side of the system and the grounded neutral. At the first storm all of the arresters, with one or two exceptions, were burned out. The management promptly condemned the arresters, and it was only after much argument that they were repaired and connected to the line and with proper

grounds. As well as the writer remembers, none of these arresters were burned out again.

Track rails do not constitute a proper ground for lightning arresters on account of their self-induction and their high resistance to earth, for in many places the track is only ballasted to the top of the ties in the center of the space between the rails, the rails themselves being separated by the ties from the ground. In long continued spells of dry weather the ties become more or less of an insulator and interpose considerable resistance between the rails and the ground.

The proper method of grounding lightning arresters is to connect them by a copper wire of No. 6 B. & S. gage to a copper plate of some four square feet in area buried in the ground. The ground wire should be insulated where it runs along poles or buildings. It should be soldered entirely across the ground plate, without the use of corrosive acids. The ground wire should never be run through an iron pipe for mechanical protection, as such would greatly increase the impedance of the circuit, sometimes to such an extent as to render the arrester useless. If mechanical protection is needed, it is better to provide for the same by the use of a larger size of wire. If the ground plate cannot be buried in permanently moist soil, half a bushel or so of coke or charcoal should be placed below and above the plate to assist in the retention of moisture. When the latter procedure is followed, the ground should be located some distance away from the butt of the pole, as such a ground would produce an excess of moisture at the butt of the pole, which is not to be desired on account of the increased decay that it would produce.

Ground wires should run as straight as possible without bends or pigtails, to interpose self-induction, direct from the arrester to the ground plate. Nearly all of the arresters on the market at the present time will, if provided with proper grounds, give satisfactory service. The writer believes that nearly all of the trouble with the present arresters is due to improper grounds. From the writer's standpoint, the above holds true with direct current and low-tension alternating current distribution.

BERT H. SHEPARD, Const. Eng., Black River, N. Y.

We have had little or no trouble. We rely mainly on lightning arresters on back of switchboard.

I. E. MATTHEWS, Eng., Rochester Ry. Co.

SAFEGUARDS

No. 43.—What is the most efficient method of protecting high-tension lines from contact with trees?

If trees are properly trimmed no trouble will be experienced from contact with high-tension wires.

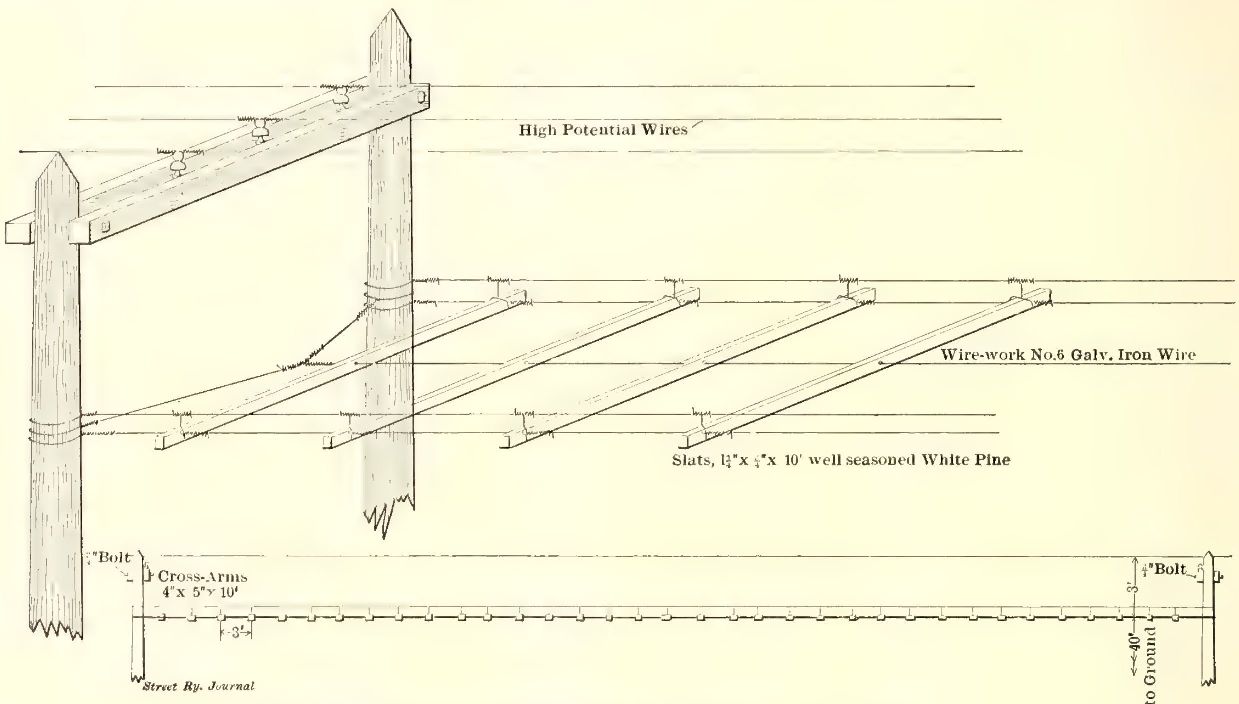
W. J. HARVIE, Elec. Eng., Utica & Mohawk Valley Ry. Co.

I consider the most efficient method of protection against trees is, if it is possible, to cut the trees. I deem it advisable to construct high-tension lines in a way somewhat different from that followed by some companies at the present time. It seems that the object of some of the companies (especially contractors and companies that build lines to sell) is to build just as cheap as they possibly can, never caring anything about what the trouble is nor who has it after they have been paid for the work or have sold out.

Instead of building the transmission line through towns and villages where there are countless numbers of trees, which are sure to cause trouble in the course of time, a line should be built on private right of way around the villages, thus having no trees to cause trouble at any time, and in case of lines breaking, from any cause, instead of having high-voltage wire down along the street, where anyone may be killed (as may happen and quite frequently does), it would be at a place where no one would be in danger.

In my opinion it would be cheaper to build the line around the villages than to take the chance of paying for the lives that are apt to be lost in case of a break in a busy street. Because, almost as sure as a green limb of a tree, wet from a recent rain, touches the wire, whether the line be insulated or not, the wire will fuse especially if it be aluminium, which is often used now-a-days.

W. F. BURKET, Chief Lineman, Rochester & Eastern Rapid Ry. Co.



CRADLE UNDER HIGH-TENSION WIRES, ROCHESTER RAILWAY

Set high poles or cut down trees that are near wires.

H. L. MACK, Supt. of Line, International Ry. Co., Buffalo.

The cutting down of all trees within a distance from the line equal to their height is the only sure method of protection against them. If it is impossible to secure the right to do this, as in villages or cities the line may be built above them. When built above them, the trees will in time grow to reach the line. This may be prevented by frequent trimming.

BERT H. SHEPARD, Const. Eng., Black River, N. Y.

Get rid of the trees entirely.

W. R. W. GRIFFIN, Supt., Rochester & Eastern Rapid Ry.

Where allowable we chop off intervening branches; otherwise, wooden sleeves are placed on wire.

I. E. MATTHEWS, Eng., Rochester Ry. Co.

No. 44.—What is the best form of cradle or other device for catching broken high-tension lines at highway crossings, or where the lines cross over or under other wires?

The best device of this kind I know of is constructed with 5-16-in. galvanized wire, made similar to a woven wire fence. A cradle of this kind is very simple to construct, as nothing is needed but wire and clamps, and it is very neat in appearance.

W. F. BURKET, Chief Lineman, Rochester & Eastern Rapid Ry. Co.

We make a cradle by stretching two 5-16-in. iron cables from the ends of cross-arms, which are 3 ft. longer than our standard arm, and on these cables at intervals of about 10 ft. we place wooden slats, triangular in section and measuring 2 ins. on a side. Such cradles may either be grounded or insulated; in our case they are insulated. We have never had a line drop on one of these cradles, and, therefore, cannot say from experience which method is advisable. Any device which will prevent the broken wires from reaching pedestrians or vehicles is satisfactory.

W. J. HARVIE, Elec. Eng.,
Utica & Mohawk Valley Ry. Co.

Wire cradle, using three strands of 5-16-in. galvanized steel cable, one from center of pole and from either end of double cross arm properly guyed, using a No. 9 wire at right angles about every 5 ft.

H. L. MACK, Supt. of Line,
International Ry. Co., Buffalo.

Cradle made of steel cable with good substantial wooden cross pieces.

W. R. W. GRIFFIN, Supt.,
Rochester & Eastern Rapid Ry.

A cradle of wooden slats. See drawing on opposite page.

I. E. MATTHEWS, Eng., Rochester, Ry. Co.

PAINTING POLES

No. 45.—What is the best way to paint trolley poles? Give sketch or photograph and description of apparatus used; also detailed cost of doing the work.

We do not paint poles except in cities and towns, where they are painted in the ordinary manner.

W. J. HARVIE, Elec. Eng.,
Utica & Mohawk Valley Ry. Co.

Use ladder and paint with brushes. The cost depends largely on the condition of poles. Ordinarily, the cost would be about 20 cents per pole.

H. L. MACK, Supt. of Line,
International Ry. Co., Buffalo.

Wooden poles can be painted very cheaply by a man equipped with paint pot, brush and safety belt, climbing to the top of the pole and painting downward. One man will paint 30 30-ft. poles per day.

BERT H. SHEPARD, Const. Eng.,
Black River, N. Y.

OVERHEAD WORK

No. 46.—What is the best method for attaching span wires to iron and wooden poles?

For iron poles, use a wooden pole plug made of seasoned beech, maple or birch, over which the cast-pole cap is placed, and attach the span-wire to an insulated eye-bolt, which passes through the iron cap and wooden plug. For wooden poles, use the uninsulated eye-bolt, as the trolley hanger is sufficient insulation.

W. J. HARVIE, Elec. Eng.,
Utica & Mohawk Valley Ry. Co.

Use a plain eye bolt for wooden poles, weld ring or eye and bolt in wood strain insulator for iron poles. This makes a very neat and durable attachment.

H. L. MACK, Supt. of Line,
International Ry. Co., Buffalo.

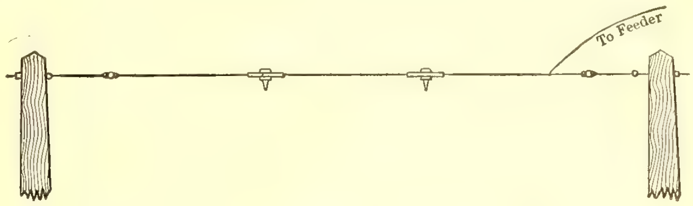
Span wires should be attached to iron poles by means of a clamp of strap iron passing around the pole, the two ends of the clamp being held together by two bolts. The span wire should be attached to one of the bolts by means of a thimble and guy clamp. The two ends of the span wire should be fastened by means of a three-bolt strand clamp in preference to twisting them together, as it makes a stronger, neater, quicker and cheaper job. In addition, it permits of readily undoing the connection when desired for any reason, and does away with the use of expensive and unsightly turnbuckles for taking up slack.

Attachment may be made to wooden poles by means of an iron eye bolt passing through the pole and the end of the span wire made up as described above. While an eye-bolt with a long thread provides an excellent method for taking up slack in the span wire, the writer prefers to do away with eye-bolts altogether, and fasten the span wire by passing the end twice around the pole and fastening the end with a strand clamp. With this method it is not necessary to bore a hole through the center of the pole, where strength is most needed, especially when the pole is carrying other wires above the span wire, and at the same time slack may be taken up with the aid of a pair of blocks almost as quickly as with eye-bolts, and more so when there is more slack to be taken up than can be cared for by the bolt thread. With the clamp placed close to the pole it will be impossible for the span wire to slip, and the two wraps around the pole will be sufficient bearing surface to prevent serious cutting of the pole.

BERT H. SHEPARD, Const. Eng., Black River, N. Y.

We use ball insulators principally. See drawing herewith.

I. E. MATTHEWS, Eng., Rochester Ry. Co.



SPAN-WIRE ATTACHMENT, ROCHESTER

No. 47.—What is the best form of bracket suspension?

Pipe arm with span to support trolley wire.

H. L. MACK, Supt. of Line, International Ry. Co., Buffalo.

The form of bracket consisting of a horizontal member, with a diagonal brace underneath, is liable to be bent downward, at the point of attachment of the brace, by the strains inflicted upon it by the trolley wire. The bracket which is supported only by a truss from the outer end to a point on the pole above the bracket is liable to be bent downward in the center if the truss is pulled tight enough to counteract the strain of the trolley wire. Altogether, the best form of bracket is a combination of the two with a short flexible member to which the trolley wire may be attached. Steel tubing which is usally employed in the manufacture of brackets has an equal resistance to bending in all directions, but this is not really necessary, as resistance to side strain is not of so much importance, for from the nature of the bracket and the method of attachment to the pole, this is better cared for by means of strain guys. A bracket of T-iron would offer much more resistance to vertical bending strains, and at the time be sufficiently strong to resist all ordinary side strains.

BERT H. SHEPARD, Cons. Eng., Black River, N. Y.

Flexible brackets.

I. E. MATTHEWS, Eng.,
Rochester Ry. Co.

No. 48.—What is your practice in guying?

Guy all curves even though slight, and head-guy at all strain ears or anchors; these anchors should be placed every 1000 ft. for span construction with No. 0000 trolley. We have found it necessary to side-guy poles in bad ground, and we are inclined to believe that the best construction is to set the poles straight and side-guy each pole for the entire length of the line.

W. J. HARVIE, Elec. Eng.,
Utica & Mohawk Valley Ry. Co.

Make the guy strong enough to hold any strain it is liable to get at any time, and have it at the right place.

W. F. BURKET, Chief Lineman,
Rochester & Eastern Rapid Ry. Co.

Use wood block with rod, rod and block to be of sufficient strength to carry the strain.

H. L. MACK, Supt. of Line,
International Ry. Co., Buffalo.

For light guys a 5-16-in. strand, composed of seven No. 12 steel wires may be used. For heavy strains the same sized strand, made of Siemens-Martin steel may be used. The end of the strand should be fastened to the pole by wrapping twice around the pole and fastening with a three-bolt strand clamp. With heavy strains, pole shims should be placed around the pole to prevent the strand from cutting into the pole. The other end of the strand should be attached to some permanent object, strong enough to withstand the strain, as an anchor or dead-man.

For light guys there is a form of harpoon anchor which is secured by driving into the ground, and when the strand is attached and pulled up the anchor pulls up about 6 ins., and the wings,

spreading out, furnish enough bearing surface against the soil to hold fast. These anchors are very cheap to install, and in ordinary earth—not sand or new fills—will hold as much strain as is safe to place upon the ordinary 5-16-in. strand. For heavy strains there is an anchor which screws into the ground. These anchors are made in sizes large enough to withstand any strain which it may be desired to use them for. All straight lines should be double-head and side-guyed every half mile, as a protection against storms.

BERT H. SHEPARD, Cons. Eng., Black River, N. Y.

We use anchors where possible.

I. E. MATTHEWS, Eng., Rochester Ry. Co.

No. 49.—What is the most efficient method of tapping trolley wire to feeders?

In using aluminium feeders it is impossible to get a first-class joint. The best, however, is made on the feeder with a clamp made of the same metal as the feed-wire and having a hole drilled for the tap, which is held by two set screws. In my opinion it is impractical to use aluminium until a better joint can be made.

W. F. BURKET, Chief Lineman, Rochester & Eastern Rapid Ry. Co.

The wire tapping from feed to trolley should not be smaller than trolley wire. The taps should not be a greater distance apart than 1200 ft., and where cars are running at frequent intervals the taps should be closer.

H. L. MACK, Supt. of Line, International Ry. Co., Buffalo.

The most satisfactory method of attaching feeder taps to trolley wires, in span-wire construction, is to make a separate span of the feeder tap between the poles and above the span wire, and to connect the feeder to the ear by means of a flexible connection. In this way if the trolley wire falls the feeder is disconnected, likewise an easy method is provided for disconnecting the feeders at any time. It is not necessary to continue the feeder tap across the entire span, but it may be ended at the trolley wire and connected to a section of steel strand by means of a strain insulator.

BERT H. SHEPARD, Cons. Eng., Black River, N. Y.

A soldered connection well taped over.

I. E. MATTHEWS, Eng., Rochester Ry. Co.

TRACK DEPARTMENT

BONDING

No. 51.—What is a good method of testing rail-bonds?

There are on the market several bond-testing devices that determine the resistance at the joint in proportional length of the abutting solid rail that have given satisfaction. It is a good practice to test all joints at least once a year, preferably in the late spring, and remedy all defects before summer travel begins. On new work bonds should be tested immediately after installation and, if defective, renewed at once.

M. J. FRENCH, JR., Eng. M. of W., Utica & Mohawk Valley Ry. Co.

We consider the best method of testing bonds is with a test car. Equip a car with water tank, necessary switches and contacts; allow a certain amount of current to flow, note line voltage and note drop at each joint. The resistance test comparing the bond to a standard length of rail gives fair results and locates very bad bonds.

F. D. JACKSON, Supt. of Track, International Ry. Co., Buffalo.

We use a patented bond testing instrument, or a mili-voltmeter, and get satisfactory results with either.

I. E. MATTHEWS, Eng., Rochester Ry. Co.

No. 52.—What is the best method of keeping records of individual rail-bond tests?

Number one line of poles, number rails across right of way, and number joint with reference to pole nearest zero stationing. For example: Pole 53, rail 3, joint 2, would be the second joint from pole 53 towards pole 54 on the right hand rail of track number two. A section between poles can be tabulated on a card of a card index system and an accurate record of dates of tests and results may be kept by changing color of ink each year.

M. J. FRENCH, JR., Eng. M. of W., Utica & Mohawk Valley Ry. Co.

Divide your line into short sections. Number the right-hand rail in the direction in which you are going with whole numbers and the joints on the left-hand side with fractions, and keep a record of each joint. From your record you can pick up any joint.

F. D. JACKSON, Supt. of Tracks, International Ry. Co., Buffalo.

On forms, a reproduction of one of which is herewith given. "Locality" should be given as on such and such a street, between X and Y streets. It is a good policy to choose for X and Y streets,

BANK AND BUNK RAILWAY COMPANY,

Bank, Bu.

BOND TEST SHEETS.

.... Test. Sheet No. ....

Tests made by ....

Date ....

Weather ....

Preceding weather .... for .... days.

Locality.	Joint No.	North Track.		South Track.		West Track.		East Track.	
		N. Rail.	S. Rail.	N. Rail.	S. Rail.	W. Rail.	E. Rail.	W. Rail.	E. Rail.

FORM FOR KEEPING BOND-TEST RECORDS

those having special work; and the joints should be numbered consecutively from one piece of special work to the next piece. Short bond tests on special work are not recorded on these sheets, but are recorded on rough sketches of the special work.

J. STANLEY RICHMOND, Conslt. Expert, New York City.

No. 53.—What has been the experience with soldered bonds?

In 1896 and 1897, at Syracuse, a bond, not strictly a bond of the present soldered bond type, was installed in the following manner: A hole about ½-in. in diameter was drilled through the web of rail to receive the pin of a 2-in. milling facer, with which the rail was faced off bright. A bond consisted of a No. 0000 wire screwed and brazed to cast terminals having a circular milled face 2 in. in diameter, thoroughly tinned, and with a ⅜-in. hole through a boss in the center of the terminal. This terminal was bolted to the brightened rail with a bolt and spring washer and a gasoline blow torch applied until the solder on the terminal reached the melting point. Some of these bonds removed in 1904 and 1905 showed from one-third to two-thirds bright contact, and there is no doubt in the writer's mind that, if the rail had been thoroughly heated and tinned before placing the bond and then, after the bond was tightened in place, soldered according to the present practice of installing soldered bonds, more uniform and better results would have been obtained. From experimental installation of soldered bonds in February, 1905, in my opinion soldered bonds on the outside of ball of T rail and from web of girder rail to fish-plate, are economical, strong and efficient, and I believe will, after a term of years, show a higher efficiency than compression or plug terminal bonds.

M. J. FRENCH, JR., Eng. M. of W., Utica & Mohawk Valley Ry. Co.

Soldered bonds do not give good results. Some joints may be all right but they are few, and the remainder show up bad, as it is difficult to eliminate grease, dirt, rust, etc. Solder, owing to mixture of tin and lead, contracts unequally when cooling and crystalizes under the influences of the hammering at joints and the flow of current.

F. D. JACKSON, Supt. of Tracks, International Ry. Co., Buffalo.

On a branch of our system recently equipped with soldered bonds we note a decrease of 10 per cent in the drop. We have not used them long enough to attest as to their wearing qualities.

I. E. MATTHEWS, Eng., Rochester Ry. Co.

No. 54.—In using bond tester on special work in which each joint is bonded in addition to long bonding, what is the method of procedure in case the tie-rods span two or more joints?

Test bond in the usual way, except that contact point for bond test must be carried to cover two joints if bond spans two joints, and disregard the fact that tie-rod is in, as the error is too small, owing to resistance of iron rod as compared to bond.

F. D. JACKSON, Supt. of Track,
International Ry. Co., Buffalo.

CONCRETE FOUNDATIONS

No. 57.—What has been the experience with concrete foundations under rails or roadbed? Please give details as to how concrete was laid, cost of construction and results secured.

In 1900 a track was built on Thirty-Fourth Street, Island of Manhattan, from First Avenue to Tenth Avenue. For the greater portion of this distance the rail was supported by a concrete beam, built as follows: 5-in. x 7-in. x 5-ft. ties were first laid, on 5-ft. centres. Then to these ties the rails were spiked, to bring them to the proper line and gage. Each alternate tie was then tamped with earth, to bring the track to surface. After this was done, the intermediate ties were tamped up with concrete, so that there would be about 5 ins. of concrete underneath them. At the same time a beam of concrete was placed underneath the rail, about 8 in. in depth and 16 in. in width, all being tamped well underneath the rail and any imperfections in surface brought up, either by temporary shimming or by the action of the tamping itself. The concrete was composed of Portland cement, sand and broken stone, mixed one part of cement, three parts of sharp sand and five parts of 1½-in. broken stone. Under granite pavement concrete was also laid at the same time as the beam for the foundations for the pavement, so that on granite block pavement the result was really a bed of concrete, intercepted each 10 ft. by a tie. In asphalt pavement the space between the ties and the concrete beam and outside of the track was filled up with earth, well tamped, over which was placed a layer of concrete, for the foundation of the pavement. Care was taken not to put in this foundation under the asphalt until after the concrete beam had in a measure settled, so that there would not be a bond between the two. This was done in order to facilitate excavation, in case the same had to be made for the replacing of rails or for any other purpose. The cost of this work was approximately $6 per cubic yard of concrete, in place. One reason for adopting this particular method was that horsecars were operated over the track during the course of construction, so that it was necessary to keep the rails at proper gage for the operating of these cars.

On the above-mentioned track storage battery cars, with 9 ft. wheel base, weighing 37,000 lbs. each, with 9250 lbs. on each wheel, were operated for a period of three or four years, when the style of construction was entirely changed, the tracks being made into slotted tracks, when other arrangements had to be made for the foundations. There seemed to be some disintegration of the concrete at some of the joints, which became loose, but it was not during the three years of sufficient moment to warrant any repairs. Repairs could easily have been made by placing steel shims underneath the end of the drop rail, where this disintegration had taken place.

W. BOARDMAN REED, Eng. M. of W. & B.,
New York City Ry. Co.

Portland cement concrete mixed in proportions 1:3:6, thoroughly tamped under base of rail, and extending from bottom of tie to within 5 ins. of top of rail, gives excellent results. Tie rods should be used on girder rail to prevent spreading, and pavement should be of heavy stone poured with tar, or artificial paving blocks thoroughly flushed with Portland cement grout. Brick paving of this class will cost about $3.75 per sq. yd., and sandstone block poured with tar about $4.25 per sq. yd. If Portland cement concrete mixed 1:3:6 is used, and is allowed to set before the tracks are used, there should be no disintegration of the concrete, although I have seen girder rails that have become loosened through neglect to use tie-rods, resulting in the disintegration of the asphalt paving immediately adjoining the rails. Asphalt should never be laid next to the rails, but two rows of alternating headers and stretchers, of heavy stone block, thoroughly set in rich grouting, should intervene between the rails and the asphalt.

M. J. FRENCH, JR., Eng. M. of W.,
Utica & Mohawk Valley Ry. Co.

We generally use 6 ins. under tie. Results are very satisfactory. Cost, $1.00 per foot with 9-in. rails. We have had no trouble with concrete.

I. E. MATTHEWS, Eng.,
Rochester Ry. Co.

SUITABLE CARS FOR CITY AND SUBURBAN SERVICE *

BY T. W. WILSON,
General Manager of the International Railway Company, Buffalo, N. Y.

No subject connected with the business of electric railroading presents such an interesting topic for discussion and investigation, and upon which there is such a diversity of opinion, as that of "Suitable Cars for City and Suburban Service." Every city and every system has an equipment to which it points with pride and calls its standard, and very rarely do any two standards agree. This is, of course, justified, to some extent, by the fact that local conditions of climate or franchise must govern, but too often does the personal equation of the management have the deciding vote. It does seem, however, that, in view of the experience of the last 20 years, we should be able to approximate some general standard to which we could work as nearly as may be.

On inspecting the cars in use in the various localities, one is impressed by the fact that the general trend is towards a larger and more commodious car. In interurban traffic we seem to be approaching very nearly to steam railroad practice, and very rightly, too, as the conditions existing on a modern, up-to-date interurban line are very similar to those on a steam road. By comparing the average dimensions, it will be seen that while an interurban electric car averages 40 ft. over corner posts, the steam coach averages about 60 ft.; that while the length over buffers of the trolley car averages about 50 ft., the steam passenger coach goes to 70 ft., and that while the weight of the interurban car body averages about 30,000 lbs. the steam passenger coach will average about 40,000 lbs. These increases in the weights and lengths of interurban cars have all been gradual, but sure, and the reasons for them may be summarized as follows:

First, it must be kept in mind that the chief business of an interurban electric road is to compete with the steam roads. Up to a few years ago the suburban traffic was entirely handled by the latter, and the people have become accustomed to the wide seats and commodious quarters of those roads. In order to divert the traffic to the trolley lines it is necessary to furnish as many of these conveniences as possible, added to which are the natural advantages of electricity over steam, such as the freedom from smoke and dirt, the transfer privilege and frequency of service.

In order to make a paying proposition out of an interurban line it is absolutely necessary that everyone shall be provided with a seat, except in cases of emergency; therefore, the larger the car the more it will earn per mile and per hour. The limits of size will be largely at the mercy of local conditions.

In 1895, when the Buffalo & Niagara Falls line was first equipped, a car was adopted having a 28-ft. body, with a length over all of 37 ft. 6 ins., a width over all of 8 ft. 3½ ins., and a seating capacity of 40 persons. In 1898, when the Buffalo & Lockport line was built, the body was increased to 31 ft. 8 ins., the length over all to 42 ft. 8 ins., the width over all to 8 ft. 4½ ins., and the seating capacity to 44 persons. Last year in the new interurban car for Buffalo, the length of the body was still further increased to 34 ft., the length over all of 44 ft. 6 ins., the width over all to 8 ft. 6 ins., and the seating capacity to 48 persons. This latter type is the maximum which it is safe to operate over the Buffalo bridges. If we had been entirely unhampered by local conditions we would have probably made the car one window longer and 6 ins. wider, with an added seating capacity of 8 persons; in other words, 56 instead of 48. This would have made the car about 50 ft. long over all, and about 9 ft. wide.

Another reason for the increase in weight and length of the interurban car is the question of safety. In order to compete successfully with steam roads (and that is surely the object of all interurban properties), it is necessary to operate the cars at 45 or 50 miles an hour. In order to do this safely, heavy M. C. B trucks, powerful motors and strong bodies are necessary, and all of these factors tend to increase the dimensions.

When there is heavy traffic from one thickly populated city or town to another, and one car will not carry the people, then the multiple control, or the trailer service, becomes advisable. In Buffalo, it was found that a three-car train, composed of two multiple control motor cars and one trailer, gave the best results. Economy in wages is evident, only one motorman and three conductors being required for the train. The movement of cars in trains also minimizes the danger of collision, in that, instead of having three separate units under three separate controls and sets of orders there is but one unit and one set of orders. This method of operation is especially valuable on single-track road with sidings, where the liability of accident is directly proportioned to the

*Paper read on June 27, 1905, at the Lake George Convention of the Street Railway Association of the State of New York.

number of sections. It may be possible that eventually it will be advisable to operate a four-car train, though it would seem that this would be a little unwieldy for the run in the city. On the Buffalo & Niagara Falls line, on the other hand, it is not practicable to operate three-car trains, primarily because the line is full of curves and grades, necessitating the constant slowing down of the car and the subsequent building up of speed, and it would be impossible to make the schedule run except with a single car. Buffalo experimented last year with a 44½-ft. trailer behind the same length motor car on this division, and found that the service was too much for the motors.

In summing up the interurban situation, it would seem that 60 ft. is about the limit of the length over all of cars which are operated on an interurban line with city terminals. Where the line is entirely on private right of way there is no reason why the cars cannot more closely approximate steam practice. As the steam roads have had years of experience, there is no reason why we should not avail ourselves of that experience.

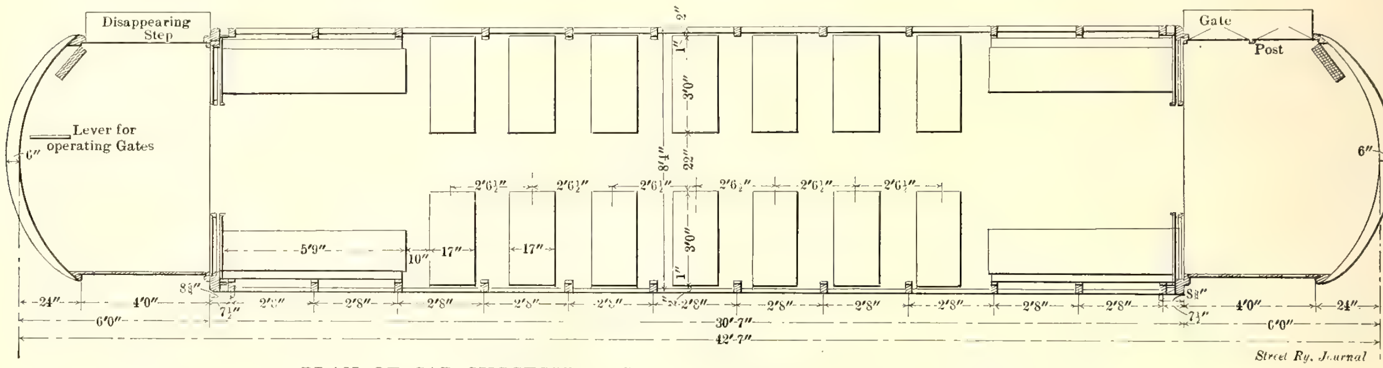
Turning now to the subject of city service, we are confronted with different conditions in different cities which require many varieties of equipment ranging from the small motor and trailer car of Washington to the commodious 46-ft. cars of St. Louis and Chicago. The local conditions must be considered before criticising the equipment of any city. In Washington they have two small open cars, one a motor and one a trailer, the whole train being handled by one motorman and one conductor. The climate is so mild that portions of these open cars are run all the year 'round. The carrying capacity of these two cars is about 80 people seated, and when it is considered that the weight of the motor car is only 17,000 lbs., and the weight of the trailer car 7000 lbs., it will be seen at once that for this service this system is probably as economical as could be devised, both in the consumption of power and in the wages of trainmen. An interesting fact in connection with this service is that they have fewer accidents with one conductor handling the two cars than they formerly had with two.

The trailer service, however, as a general rule (except in very large cities), is only economical and advisable for travel during rush hours and handling crowds from amusement parks, baseball games, etc. As an all-day proposition, in cities with moderate travel, it is hard to fill two cars unless the schedule is arranged to fill the cars rather than to give adequate service to the public. If the motor car is a closed car and the trailer an open car, as is the case in Buffalo, the people naturally take the open car, and the closed motors run practically empty in summer. For the handling of crowds Buffalo has found the trailers invaluable, as at least three trailers, and sometimes four, can be attached to a motor car, thus giving a total capacity of 250 persons to the five-car train. The motor and trailer cars, of course, are equipped with air brakes and controlled entirely by one motorman from the front car, with a conductor on each car. The economy of this method of handling crowds in trainmen's wages and power consumed is obvious.

During the past year Buffalo has been operating closed trailers as "Smokers" during the winter, and open smoking trailers during the summer, but, as stated above, except in rush hours it is hard to comfortably fill the train.

In answer to the query as to what is a suitable car for the city service, it seems that first and foremost the car should be designed for both summer and winter conditions. It is not economical to carry a long line of open cars which have to be jacked up in the fall and stored away for six or seven months without earning a dollar, and the same is true of the closed cars which are stored during the summer. This fact is becoming generally recognized among street railway managers, and has caused the development of the "convertible" and the "semi-convertible" types. During the past year, hundreds of these cars of both types have been built and are now in successful operation. As to the meaning of the terms "convertible" and "semi-convertible," it may be said that the former is a car which, during the summer time, is entirely open, with either a running board on the side or an aisle in the center, or both, and in the winter time is a closed car; while the latter is simply a closed car with cross seat and large windows, the bottom sill of the window averaging about 25 ins. from the floor, and the sash disappearing into roof pockets. For mild climates a full convertible car is most appropriate, while for cities such as Buffalo, Detroit and Chicago, the semi-convertible car is preferable. Cleveland experimented with the full convertible type last year, and during the summer was delighted with them; but when the cold weather came on it was found almost impossible to keep the cars warm.

The following is submitted as our idea of the best car for service in Northern cities: First, the car should be a semi-convertible one with a width the maximum that track center and clearances will allow, and the length of body averaging about 30 ft. The openings into the body of the car should be as wide as possible with double sliding doors. The platform should be at least 6 ft. in length, to allow two persons to enter or leave the car at the same time, and also to accommodate a large number of standing passengers. The car may be either a double or single ender, but for Buffalo service it is necessary to operate the car from either end, and even where the car is normally operated from one end only, it would seem to be poor economy not to install an emergency controller at the other



PLAN OF CAR SUGGESTED AS MOST SUITABLE FOR NORTHERN CITIES

LATEST STANDARDS OF ELECTRIC CARS IN AMERICAN CITIES.

PLACE.	Car Length Over Bumpers.	Car Length Over Corners.	Platform Length.	Width Maximum.	Car Op. 1 or 2 Dir'ns.	Seats No. Cross.	Seats No. Long.	Total.	Length Cross Seats.	Width Aisle.
Brooklyn	41′	......	......	......	2	40	8	48	34″	24″
Buffalo	36′ 5″	26′	4′ 8½″	8′	2	0	34	34	0	0
Chicago	45′ 9″	32′ 5″	6′ 2″	9′	2	28	16	44	35″	28″
Detroit	41′	29′	5′ and 6′-.″	8′ 1″ (over sills)	1	24	19	43	..	..
Jersey City, Newark, etc.	42′ 8″	30′ 8″	6′ (includes bumpers)	7′ 11½″	2	35	8	43	..	..
Kansas City	43′ 3″	30′ 7″	5′ 9″	8′ 6″	2	36	8	44	34″	..
Nashville	42′	30′ 6″	5′	7′ 11½″	2	28	16	44	34″	23½″
Philadelphia	37′ (over crown pieces)	28′	4′ 6″	8′ 3″ (over posts)	2	32	8	40	..	..
Queens Borough, New York City	40′ 8″ (over vestibules)	30′ 8″	5′	8′ 6″	2	28	16	44	37″	24″
St. Louis	46′ (approx.)	33′ 4⅜″	3′ and 7′	9′ 1″	1	40	12	52	32″	32″
Toledo	41′ 4½″	30′ 8″	4′ 8½″ and 6′	8′ 2″	1	28	16	44	34″	26″

end. A platform similar to the Detroit platform, but without the railing dividing it into two compartments, is suggested; instead of this railing an upright rod on both sides of the platform might be preferable. In arranging the seats, those near the door should be longitudinal, in order to allow more standing room, while those in the center of the car can be transverse, in order to encourage the people to ride and also for the reason that standing room is not so valuable in this portion of the car. With a 30-ft. body it would be possible to get seven cross seats on each side, or a seating capacity of 28 people, and this, together with four on each of the longitudinal seats, would make the total seating capacity of the car 44, with plenty of standing room at rush hours. This seems to be the average seating capacity of the latest types of cars in American cities, as will be seen by examining the accompanying table.

It may be argued that a 30-ft. body makes too large a car for the

MOTOR CAR WITH FOUR OPEN TRAILERS, BUFFALO

conductor to handle comfortably and economically, and this is true of cars in which the seats are longitudinal; for example, in Buffalo the cars of the "800" type have a 30-ft. body, will seat 40, and will stand, in a pinch, about 60 more, making a total of 100 passengers. This is a great many people for the conductor to handle, as invariably the best of the old conductors miss quite a number, while the new conductor will usually fail to get more than 90 per cent of his fares. The 30-ft. body, however, with the cross-seating arrangement, as suggested above, precludes the crowding of the car to the extent possible in the longitudinal seat type, and for this reason we think it will make a reasonable and practicable car with cross seats.

In order to encourage pleasure riding, the windows in the semi-convertible car should be very large, thus making the car cool and inviting in the summer time. In the winter, in order to provide

THREE-CAR TRAIN, BUFFALO

against snow and bitter weather, it will be necessary to have a permanent storm sash which can be put on during severe weather.

One of the classes of accidents which is most prevalent in electric railway service to-day is that of "falling on or off the car." In order to minimize this class, we suggest the adoption of swinging gates similar to those now in use in Minneapolis. These gates should be placed on the right-hand side of the rear platform and should be operated by the motorman by means of a lever. It does not seem that the gate would be needed or advisable for the front platform, as the motorman can watch the entering and exit of passengers at his platform very readily. Having equipped the car with this gate, and having installed a mirror, by means of which the motorman can see everything that occurs at the rear step, the starting of the car can then devolve upon the motorman, who, after glancing at his front step and seeing in his mirror that the rear step is clear, can then close his rear gates, give two taps with the gong as a signal to the conductor that all is clear and then start his car upon two bells from the conductor. This will leave the latter free to devote his time to the collection of fares and the stopping of the car upon signal from the passengers.

The car as above described is a practicable proposition and should be well liked by the public. The cross-seat arrangement will afford all the delights and conveniences of an open car without any of the dangers on account of running board. In case of sudden change in the weather, such as a thunder storm, the conductor can, within a very few minutes, convert the car into a closed one. With the gate, as above described, it may be possible to educate the public to enter by the front platform and leave by the rear, which will very greatly facilitate the loading and unloading of the car, and decrease the number of accidents. The wide platforms will accommodate smokers, both in front and rear, anl smoking is something that will have to be provided for.

The equipment of this car should be four motors of a type sufficiently powerful to pull three or four trailers, if necessary, and with a truck which will be most suitable for all-year service.

In conclusion, it may be said that in recent years the traveling public has awakened to the fact that it has rights. The laws are becoming more exacting, and too much attention cannot be paid to the wishes of the people and their representatives, the State and city officials. These people, having granted valuable franchises, have a right to demand good service and modern conveniences. It is the business of street railway companies to give this service and more, too, for the best policy of a management is not only to give the service the people demand, but to make that service so attractive that the people will wish to ride, thus creating an entirely new business as well as taking care of the old.

The cross-seat car is one of these modern conveniences. It is prescribed by law to-day in Chicago and other cities, and, in our opinion, will be within a few years the standard street railway car of America.

NEW PUBLICATIONS

Trolley Trips Through Southern New England; White & Warner, Hartford, Conn.; 104 pages. Price by mail, 12 cents.

Southern New England has long been the shrine to which the enthusiastic trolley rider turns because its many spots of beautiful scenery and wealth of historical associations offer irresistible attractions. Gradually the electric railway has penetrated almost every nook and cranny, so that to-day even the experienced traveler feels the need for an accurate guide about place, time, distance and cost. An inspection of the handsome booklet entitled "Trolley Trips Through New England," shows how well its publihers have satisfied this want. It is needless to go into any detailed analysis of its contents, but it suffices to say that with this booklet one can visit the territory described to the best advantage, not only happier for enjoying the sight of hill, meadow, river and ocean, but also richer in knowledge of the lore of historic New England.

SUBWAY MATTERS IN NEW YORK

Plans for the ventilation of the subway are being discussed at great length at the meetings of the New York Rapid Transit Commission. Chief Engineer Rice reported that he has men engaged installing electric fans at the Brooklyn Bridge, Fourteenth and Forty-Second Street express stations. These fans, it is declared, will force the foul air of the tunnel through ducts and manholes to the street, thus creating currents that will make pure air rush in through the kiosk entrances. The big fans to be installed each will be capable of forcing out 15,000 cubic feet of air per minute.

DETROIT UNITED RAILWAY ENCOURAGES BOTANICAL STUDIES

The first prize of twenty-five dollars ($25.00) offered by the Detroit United Railway for the best catalogue-list of wild flowers indigenous to the counties traversed by that company's lines, has been won by Warren J. Vinton, Detroit. After a critical study and comparison of the many lists submitted by school children, Prof. Frederick Newcombe, of the University of Michigan, has selected this young man as the winner. Mr. Vinton is 15 years of age, and a pupil of the Central High School. He offered a list comprising 518 names of wild flowers, and of these 502 were correctly designated and classified. Mr. Vinton had a commanding lead over his nearest competitor. Of the excellence of his contribution there can be no question. There were, however, many lists submitted, which, because of the study and botanical knowledge shown, are worthy of honorable mention in the opinion of Prof. Newcombe.

EXHIBIT NOTES OF THE LAKE GEORGE CONVENTION

The Continuous Rail Joint Company of America had a neat exhibit of all types of its rail joints. The representatives present were: B. M. Barr, of the New York office, and W. A. Chapman, of Boston.

Machado & Roller, of New York, had on exhibition with Mayer & Englund, of Philadelphia, Pa., the Roller bond tester and Sage ohmeter, manufactured by the Whitney Electrical Instrument Company. The company was represented by T. F. McKenna.

The Chas. N. Wood Electric Company, of Boston, Mass., was represented by its president, Chas. N. Wood.

The Barbour-Stockwell Company, of Cambridgeport, Mass., was ably and cordially represented by Wm. W. Field. A number of delegates and friends of this company at the convention were indebted to Mr. Field for a very enjoyable trip in a steam launch up Lake George and return.

The Frank Ridlon Company, of Boston, Mass., was very much in evidence at the convention in the person of its popular representative, Jerry M. Hayes.

The interests of the Philadelphia Air Brake Company were well cared for at the Lake George convention by F. S. Drake and J. E. R. Lambert.

The Kalamazoo Railway Supply Company, of Kalamazoo, Mich, had a full size track scraper on exhibition at the Casino. The actual operation of the machine was demonstrated to the delegates at the convention by F. N. Root, the manager of the track scraper department of this company. The Root scraper is in general use on a great number of roads throughout the country, and judging from the number of endorsements it has received by railway managers, its merits stand unquestioned.

The Atlas Railway Supply Company, of Chicago, exhibited a number of full-sized Atlas rail joints for grooved T and girder rails. The company was represented at the convention by James G. McMichael.

Giles S. Allison, of 42 Broadway, New York, had on exhibition, in Parlor A, on the main floor of the hotel, several types of the Security registers. The lately perfected recording type of the Security elicited a great deal of interest and attention among the railway men at the convention. The colonel demonstrated to the satisfaction of a number of the delegates that this machine is mechanically perfect and absolutely reliable, giving the railway manager an absolute record of the conductors' work during the day. Col. Allison also had on exhibition his detachable register handles now coming into general use on a number of railroads throughout the country. The colonel's genial hospitality was enjoyed by all the delegates who visited him at his headquarters. Daniel J. Fitch, from the New York office, was also present at the convention.

The Ohio Brass Company, of Mansfield, Ohio, had a comprehensive exhibit of its overhead line material, Nichols-Lintern sander, and all types of rail bonds and motor bearings. The company was represented by N. M. Garland and R. M. Campbell.

The H. W. Johns-Manville Company, of New York, was represented by S. G. Meek.

Wm. Wharton, Jr., & Company, Inc., of Philadelphia, Pa., had as representatives at the convention, A. C. McClay and Thomas K. Bell.

The Taylor Iron & Steel Company, of High Bridge, N. J., was represented by S. Hewes Mattson.

The General Electric Company's exhibit occupied about one-half of the northern end of the exhibit hall. The company's latest design of 40-hp railway motor, known as the GE 80, was shown, as well as various renewal parts for this and other railway motors. These included field coils, assembled commutator segments and armature coils. An interesting feature was the air compressor automatic governor which was shown in section. A complete assortment of line material was attractively displayed. This included a full complement of catenary suspension devices for use with alternating-current trolley installation. There were also shown a few general railway supplies, such as controller contact fingers, fuse blocks, etc. Moving pictures of electric railway subjects were shown in this exhibit. These included a Ballston-Schenectady alternating-current trolley car in operation, the electric cars operating on the company's experimental track at Schenectady, the Interborough Rapid Transit cars, and the New York Central electric locomotive racing with a steam locomotive. The company was represented by T. Beran, manager New York office; H. G. Grier, New York; J. C. Calisch, Buffalo; H. H. Crowell, Syracuse; W. Gibson Carey, Schenectady; E. M. Kinney, Schenectady, and F. H. Gale.

The Electric Storage Battery Company, of Philadelphia, Pa., had a comprehensive exhibit consisting of a railway power house switchboard, showing the regulation of fluctuating loads as exemplified in street railway practice. The type R, 71-cell of 1050 amps., at nominal rate capacity, similar to those to be furnished to the New York Central & Hudson River Railroad, was shown as were also several small cells for various other purposes. The company had as representatives present F. L. Kellogg and R. C. Hull.

The American Ventilating Company, of New York, was represented at the convention by H. M. Shaw, its treasurer and general manager. A number of types of the American ventilators were on exhibition at the convention.

R. A. Byrns, of New York, presented the claims of the General Storage Battery Company at the convention.

The Hale & Kilburn Manufacturing Company, Philadelphia, Pa., exhibited several types of car seats for city and interurban service. A notable feature of one of these seats was a steel end plate with top forming an arm rest. This seat does away with the old type seat with a separate arm rest. The company was represented by S. A. Walker.

The Pennsylvania Steel Company had its New York agent, John C. Jay, Jr., at the convention.

H. N. Powers was present to represent the American Automatic Switch Company.

The Power Specialty Company, of New York, was well represented by E. H. Foster.

The Traction Equipment Company, of Brooklyn, N. Y., had on exhibition its ventilated spiral car starting resistances, the Hammond sander, and Weber illuminated signs. This company is preparing to push a number of specialties in the street railway field. Its excellent exhibit at the convention was an evidence of its intentions. The company was represented at the convention by George Best and C. V. Rapelje.

The Crouse-Hinds Company, of Syracuse, N. Y., had on exhibition its imperial arc headlights and its well-known harpoon guy anchors. The company was represented at the convention by A. M. Hills and Frank Buchanan.

Dossert & Company, of New York, exhibited all shapes, sizes and types of the Dossert cable joints at the convention. The company was represented by H. A. Bristol.

The Lorain Steel Company, of Lorain, Ohio, had one of the most elaborate exhibits at the convention. One of the first objects to attract attention was a new type of tongue switch in which the tongue performed its function without a pivotal pin fastening of any character whatever. The construction at the heel of the tongue is such that the grooves for the flanges are part of the tongue structure, which is broadened out so that the entire width of the bed of the switch at the heel is utilized for a solid bearing surface for the tongue. The latter is held in place by a method of steel holding-plates along the sides of the tongue, which, in turn, are fastened and held firmly in place by spelter. When worn out the tongue may be easily renewed from the surface of the switch bed without removing the bed, and the wear which takes place at heel of the tongue is entirely eliminated. The hard steel plate which extends from the heel to the toe of the tongue switch forms the guard and running rail as well as the bed of the switch, and is also renewable from the surface. The arms of the switch are formed of rolled rails, and are fitted into extension pockets, which are an integral part of the solid steel body which envelops the rail ends a portion of their length, and are firmly secured to the sub-structure with bolts and spelter. Another interesting exhibit was a renewable frog of 9-in. guarantee construction, and on the two days of the convention the operation of removing and replacing the hard steel center plate was shown, to demonstrate the ease and rapidity with which such removal could be accomplished. This plate is held in place at each corner by two steel wedges, which, in turn, are kept in place by spelter. The actual time consumed in removing the plate during the demonstration on Tuesday evening was exactly ten minutes, while the time consumed in replacing the same plate and repouring with melted spelter did not exceed half an hour, making the total time in which two men were engaged in this work less than three-quarters of an hour. The delegates present watched the operation with great interest, and at its conclusion congratulated the Lorain Steel Company representatives on the successful accomplishment of this most practical test. The company also exhibited, in great variety, samples of electrically-welded rails. Those representing the company were E. B. Entwisle, chief engineer, Johnstown, Pa.; H. F. A. Kleinschmidt, manager electric welding department, Johnstown, Pa., and Randolph Clitz, of New York office.

The Goldschmidt Thermit Company, of New York, had on exhibition a number of samples of rails welded by the Thermit process. Some of these samples were sawed through the welded part, showing the completeness of the weld between the ends of the rail. A number of the various shaped moulds used in Thermit welding were also shown. R. F. Kelker, Jr., who represented the company, made two demonstrations of Thermit welding during the convention. Judging from the number of delegates who witnessed the tests, this process of rail welding is attracting a great deal of popular interest.

The Chase-Shawmut Company, of Newburyport, Mass., had Frank D. Masterson at the convention.

The Sherwin Williams Company, of Cleveland, Ohio, was represented at Lake George by F. A. Elmquist.

The Vendor Company, of New York, was represented by J. Henry Carson.

The O. M. Edwards Company, of Syracuse, N. Y., which was represented by O. M. Edwards and George G. Norris, showed several designs of car window fixtures and vestibule trap-doors. These fixtures are adopted by a great many of the large steam railroads in the United States, as well as in several foreign countries. This fact is enough to commend their use on electric cars, and the fixtures are being adopted on these roads very rapidly.

The president of the R. D. Nuttall Company, of Pittsburg, Pa., F. A. Estep, attended the convention.

The Weber Railway Joint Manufacturing Company, of New York, was represented by Alfred K. Downes.

The Mayer & Englund Company, of Philadelphia, was represented at the convention by H. E. Beach, of the New York office. A comprehensive exhibit of nearly all the street railways specialties handled by this company was prominently placed and neatly arranged in the Casino, and elicited considerable interest among the delegates at the convention.

The National Car Wheel Company, of New York, was as usual represented in an able manner by Edward H. Chapin.

The Magnet Wire Company, of New York, was represented by Frederick H. Cowles.

Harold P. Brown, of New York, was represented at the convention by Julius Alsberg, his consulting engineer, who had a neat exhibit of the well-known Brown plastic and solid copper bond. There was also shown the new switch contact bond, which is soldered to the rail by a unique gasoline torch, capable of heating up a 60-lb. standard T-rail in less than three minutes.

The Continuous Rail Joint Company of America, Newark. N. J., had as its representatives at the Fort William Henry, B. M. Barr and Wm. H. Chapman.

Berry Bros., Ltd., of Detroit, Mich., were represented by F. B. Archibald.

The Lord Electric Company, of Boston and New York, was represented at the convention by H. M. Shaw, of the New York office, and G. B. Crane of Boston. A neat exhibit of all of the various types of Thomas soldered rail bonds was on exhibition at the Casino. The Shaw non-arcing lighting arrester, the manufacture and sale of which have recently been taken over by the Lord Electric Company, was also on exhibition.

The Westinghouse Traction Brake Company, of New York, was ably represented at the Lake George convention by F. V. Green and J. R. Ellicott.

The Heywood Bros. & Wakefield Company, of Wakefield, Mass., had on exhibition an especially designed seat upholstered in leather, with high three-part back, and mahogany arm-rest for long-distance interurban cars. This seat has a brass back band with a grab handle set in the corner of the back, and a pedestal base with shifting foot rest. The company was represented at the convention by Bertram Berry, its New York sales agent.

The National Electric Company, of Milwaukee, Wis., had as its representative J. T. Cunningham.

R. W. Marshall was present in the interests of E. G. Long, of New York.

The Curtain Supply Company, of Chicago, had an especially neat and well-arranged exhibit, showing the Forsyth & Burrows roller tip closed car curtain fixtures, and their Acme, Climax and Forsyth cable fixtures for open cars. The Keeler "pinch handles" and "eccentric" are now owned by this company and were on exhibition. This company was represented at the convention by A. L. Whipple, general sales agent, and distributed as a souvenir a light bamboo cane, which was quite popular.

The National Brake Company, of Buffalo, N. Y., had on exhibition at the Casino a full size Peacock brake, finished in aluminum. A neatly arranged sign was also displayed announcing the fact that the Peacock brake is now in use on 250 roads in the United States. Considering the fact that this company has been in business only about one year, this is a remarkable showing and an indication that the Peacock brake has all the merit claimed for it. The company was represented at the convention by W. D. Brewster and F. D. Miller.

Standard Underground Cable Company, of Pittsburg, Pa., sent as its representative H. P. Kimball.

The interests of the Van Dorn & Dutton Company, of Cleveland, Ohio, were well cared for at the convention by W. A. Dutton.

The Consolidated Car Heating Company, of Albany, exhibited two large panels, one containing several types of Consolidated heaters, and the other different types of switches, and a complete switchboard, such as furnished for Brooklyn elevated cars. The exhibit contained a card, stating that 30,676 Consolidated electric heaters were sold from March 1 to June 24, 1905. These heaters were for 2709 cars. The company was represented by Cornell S. Hawley, general sales agent, and S. B. Keys, district manager.

The Peckham Manufacturing Company, of New York, was well represented by Wm. Wampler and Geo. H. Bowers.

The Standard Steel Works, of Philadelphia, had as its representatives Harry W. Sheldon and E. Sidney Lewis.

The Sterling-Meaker Company, of Newark, N. J., had an exhibit of its various types of registers, register fittings, punches, Sterling brakes and a number of other products manufactured by the company. The company was represented by George E. Willis, of the Newark office.

The Schoen Steel Wheel Company, of Philadelphia, Pa., had a complete exhibit of its pressed steel wheels for steam and electric railway service Samples of all the processes which steel goes through to make the finished wheel were also shown. The company was represented by W. Martin Johnson and N. B. Trist. Through the courtesy of Mr. Johnson, invitations to several trips on Lake George were extended the ladies in attendance. These excursions were made in a private launch, and Mr. Johnson's hospitality was greatly appreciated.

The interests of the St. Louis Car Company, of St. Louis, at the convention were cared for by A. H. Sisson.

H. L. Shippy and G. W. Swan were present in the interest of the John A. Roebling's Sons Company, New York.

The Peerless Rubber Manufacturing Company, of New York, exhibited all kinds of its famous Peerless packing at the Casino. The company was ably represented by C. S. Prosser and W. J. Courtney.

The Pittsburg Reduction Company, of Steelton, Pa., sent four representatives to Lake George in the persons of H. K. Spalding, B. M. Polley, Walter R. Darby and Safford K. Colby.

The Yale & Towne Manufacturing Company, of New York, had on exhibition its chain blocks and electric hoists, which are extensively used in street railway repair shops. This company was represented by William Hazelton, who was one of the pioneers in the electric railway field, and who had many friends at the convention.

American Steel & Wire Company, of New York, had as representatives at Lake George, F. A. Keyes and A. G. Greenberg.

The Sterling Varnish Company, Pittsburg, Pa., had Alvin C. King in attendance at the convention.

The American Electrical Works, of Phillipsdale, R. I., was represented by Albert F. Hills.

The Recording Fare Register Company, of New Haven, Conn., had a comprehensive exhibit at the Casino, consisting of three types of recording registers and one plain register, without the recording feature known as type E. A large assortment of register fittings and car trimmings was also on exhibition. A unique type of a detachable trolley harp recently invented, and for the first time shown to the railway public, was also on exhibition. This harp is remarkably simple in its construction, consisting of only two parts, aside from the shank which is used in all trolley poles. A new type of wheel was also shown, the principal feature of which is the large area of contact. The wheel is so constructed that the current does not pass through the bushing, thus giving greater life to the wheel. A new trolley wheel bushing was also exhibited, constructed on the same principle as the bearings heretofore used in the new Haven trolley wheels. The company was represented by the president, M. DeForest Yates, and the secretary, F. B. Kennedy.

A NEW STEEL TIE

At the Lake George convention of the Street Railway Association of the State of New York, the Carnegie Steel Company exhibited a steel cross-tie which shows a new departure in steel tie construction. It consists of a modified I-beam with depth of 5½ ins., lower flange 8 ins., upper flange 4½ ins., weight per foot 19 7-10 lbs.

The section is extremely simple, and offers a substance which in every respect performs the function of a good cross-tie. The broad lower flange with its flat surface gives a uniform bearing on the road-bed, and can be tamped in the same manner as a wooden tie. The depth is such that the tie can be held firmly in the ballast,

The rail is secured to the tie with four ¾-in. bolts by means of rolled steel clips fitting accurately on the flange of the rail, thus making a positive fastening.

The objection to many of the steel ties offered heretofore has been their light weight. This objection is freely met in this tie, as its actual weight is equal to, but no more than, that of the wooden tie which it replaces. The column of ballast resting on the lower flange gives of course additional weight, insuring the most satisfactory track. The noise which is objectionable in the old hollow type of tie is eliminated entirely in this one, as one familiar with track work can see from the section. This has also been demonstrated at all places where they have been installed.

The first cost of the tie is somewhat in excess of that of a woden tie, but the manufacturers claim that when safety of construction, saving in maintenance, reduction in renewals is considered, the actual cost at the end of a number of years should be a very small item.

The steel tie in track construction is not only consistent with good engineering, but from the growing scarcity and constant increase in price of wooden ties, is daily more forcibly presenting itself to those charged with maintenance. In fact it is probably truly a question of a few years when steel ties will not only be extensively used by street railways, but also on all steam railroads.

The Carnegie people also exhibited the Duquesne spliced bar, an improved joint which embodies all the features of a first-class rail joint. It consists of the simple angle bar to which is attached a depending curvilinear flange, giving depth, and thereby great strength, to the weakest portion of railway track with the maximum saving in maintenance.

The following representatives of the company were present: Fred C. Deming and Fred C. Brunke, of the Buffalo sales department, and N. M. Hench, engineer track appliances, Pittsburg, Pa.

CANADIAN WHITE COMPANY INCORPORATED TO CARRY ON ENGINEERING WORK IN THE DOMINION

The announcement is made of the incorporation in Canada of the Canadian White Company, Ltd., to carry on a general contracting and engineering business on lines similar to J. G. White & Company, Inc., of New York; J. G. White & Company, Ltd., London, England, and the Waring-White Company, London, England. The letters patent of the incorporation were granted the latter part of May, and the organization of the company is now practically completed. The Canadian White Company, Ltd., will carry on a general contracting and engineering business, and will undertake civil, mechanical, electrical, hydraulic and building work. It will be fully equipped to handle large construction contracts for steam or electric railways, and will be prepared to design, build, equip and operate electric lighting plants and power installations, gas works, water supply, sewage systems, piers, docks, harbor works, office buildings, apartment houses, hotels, etc.

The contracting and engineering departments of J. G. White & Company, of New York, will at all times be at the services of the Canadian company, and the company will further have the benefit of the experience of J. G. White & Company, Ltd., London, England, and the Waring-White Building Company, London, England. This insures the Canadian company, from its inception, the benefits and advantages to be derived from very long and successful experience in the contracting and engineering business.

The Canadian White Company, Ltd., has upon its board of stockholders strong representative business men well known throughout Canada. The general manager of the company will be a prominent civil engineer with large experience in railway construction, etc., and who has held executive positions.

H. P. Douglas, formerly vice-president and general manager of the Canadian Otis Elevator Company, Ltd., is treasurer of the company. H. C. Hitch has been secured as superintendent of building construction. Mr. Hitch has been for several years connected with the Thompson-Starrett Company, of New York, as superintendent. Recently he has had full charge of the erection, for the Thompson-Starrett Company, of the Union Bank Building, at Winnipeg. This in one of the largest and most important buildings in Canada, and the record made by Mr. Hitch in connection with this and previous work insures the efficient handling of the building department.

COPIES OF NEW YORK STATE QUESTION BOX

Announcement is made that a limited number of copies of the Question Box, prepared for the Lake George convention of the Street Railway Association of the State of New York, are on hand, and copies may be had by any one interested in electric railway matters, without charge, upon application to the secretary, room 1002, 114 Liberty Street, New York City. This pamphlet contains a large amount of valuable information on practical electric railway subjects.

SPECIAL LEGISLATIVE HEARINGS ON RAILROADS AND STREET RAILWAYS BEGIN AT BOSTON

The first hearing of the joint special committee on railroad and street railway laws, which was made up by the last legislature to sit during the summer recess, was held at the State House in Boston, on June 30. The committee is composed of four Senators and ten Representatives, the chairman being Hon. W. F. Dana. Its object is to revise the laws of the State pertaining to both railroad and street railway corporations, and to consider the expediency of such additional legislation as will better protect the interests of the public and the investors in those corporations.

The session was almost entirely occupied in endeavoring to find out what subjects are likely to come before the committee. Suggestions from the various steam and street railway attorneys present included the matter of merger of steam and electric roads, capitalization, the right of eminent domain, locations, fares, accommodations and relations between corporations and employees. Chairman Carter of the Winchester board of selectmen advocated wide publicity in the advertisement of hearings, and stated that it was his intention to bring before the committee the questions as to civic amendments for the street railway laws, free passes and free tickets, and a speed limit for street cars.

Chairman Jackson, of the Massachusetts Railroad Commission, suggested the advisability of offering amendments to existing laws rather than restating the law in a new code. He advocated general instead of special legislation to give opportunity for the legitimate railway enterprises, and intimated that the treatment of the interurban railway problem might be improved; emphasizing the desirability of the board's determining the necessity of new lines prior to the consideration of that question by local governing bodies along the route.

After an executive session it was announced that a hearing would be held July 11, and continued three days, upon the so-called "merger bill," and the acquisition of land by street railways, whether by purchase or eminent domain.

WIDENER-ELKINS DOINGS IN OHIO

Among Ohio roads much interest attaches to the conflicting reports from high authorities relative to the alleged purchase or lease by the so-called Widener-Elkins syndicate of the Toledo, Bowling Green & Southern Traction Company. Cincinnati newspapers claim that W. Kesley Schoepf and J. Benson Foraker, of the Cincinnati syndicate, make the assertion that the deal has practically been closed for the taking over of this property and the Toledo Urban & Interurban Railway Company, the leasing company of the Bowling Green road. On the other hand, officials of the Toledo, Bowling Green & Southern Traction Company are quoted as saying that no options on the property have been given, and that it has not been leased or sold. It is not denied, however, that the Widener-Elkins interests are negotiating for the property. The line extends from Toledo to Findlay, and is a direct link in the chain of lines which the Widener-Elkins interests are evidently bent upon acquiring to complete a through line from Cincinnati to Toledo. George B. Kerper, president of the Toledo, Bowling Green & Southern Company, leaves this week for a three months' trip abroad, which indicates that if negotiations of this kind are under way the details have been agreed upon.

FINANCIAL INTELLIGENCE

WALL STREET, July 5, 1905.

The Money Market

There were no important changes in the money market this week. The tone was steady throughout, and apart from the flurry in demand money, rates for all maturities ruled practically unchanged from those prevailing at the close a week ago. At the opening call money was in abundant supply at 2¼ to 2½ per cent, but near the close of last week the rate jumped to 6 per cent, as a result of the heavy calling and shifting of loans preparatory to the July 1 interest and dividend disbursements. Very little business, however, was transacted at the high figure. Subsequently, heavy offerings by an international banking house broke the rate to 2½ per cent, which was the closing quotation. In the time loan department business continued quiet. The demand was comparatively small, considering the activity on the part of commission houses in the stock market, and lenders experienced considerable difficulty in placing their funds at the current asking rates. Sixty and ninety day maturities were offered in liberal amounts at 3 per cent, but borrowers were not disposed to enter into contracts for this period. Six months money was in good request at 3¾ per cent, but bankers were not disposed to put out their funds at under 4 per cent, as loans made now would carry the borrowers well into the new year. Sterling exchange was easier, at 4.87 for prime demand bills, thus arresting, temporarily at least, the outward movement of gold to Europe. Mercantile paper continued in good request, at 3¾ to 4 per cent for the best grade. Dealers, however, report a very moderate supply of choice material. The bank statement, published last Saturday, showed an increase in loans of $18,056,300, and probably represented bond syndicate operations. Deposits increased $19,246,000. Cash increased $1,375,700, but the reserve required was $4,811,500 larger than in the preceding week, resulting in a decrease in the surplus reserve of $3,435,800. The reserve now is $11,658,875, as against $36,105,300 in 1904, $8,377,675 in 1903, $10,084,725 in 1902, $5,211,525 in 1901, and $15,389,200 in 1900. The European markets continued easy and practically unchanged. At London the discount rate was 1⅞ to 2 per cent. At Berlin the rate was quoted at 2⅛ per cent, and at Paris 1 15-16, a decline of 1-10 per cent.

The Stock Market

The stock market was fairly active during the past week, and although prices at times displayed a reactionary tendency as a result of profit taking sales, the general tone of the market was decidedly firm. In the early dealings prices were influenced to a great extent by the improved political situation in Europe, and London's heavy purchases of stocks in the local market, and later by the encouraging reports from the Western traffic managers, the progress of the peace negotiations between Russia and Japan, and the reported improvement in the steel and iron industry. Commission house business was also large, indicating a keener public interest in the market, and the failure of the money market to harden as a result of the heavy July 1 disbursements imparted a more cheerful sentiment. The opening was active and strong under the lead of Reading, which crossed par for the first time in its history. In other parts of the market pronounced strength was displayed. Later, however, the advance in the call money rate to 6 per cent caused considerable selling, but the readiness with which the offerings were absorbed prevented any serious reaction. The bank statement, published on Saturday, showing a loss of nearly $3,500,000 in the surplus reserve and a large increase in loans, failed to have the slightest influence on values. There were no unfavorable developments over the holiday, and at the beginning of the present week the upward movment was resumed. Reading continued to be the center of interest, the price rising to 103¼, the highest on record on heavy buying. The Steel stocks, Union Pacific, Pennsylvania and Erie were also conspicuously strong, and all of them established new high records for the present upward movement. Other strong features included Chicago Northwestern, Northern Pacific, New York Central, Louisville & Nashville, Atlantic Coast Line and many of the less important issues. The bond market was only moderately active, and prices generally acted in sympathy with the strength in the stock market. The closing was decidedly strong, at near the highest prices of the week. The cotton market closed active and strong, prices for certain options advancing a cent a pound, owing to the Government report showing a condition of 77, which was considerably below general expectations.

The local traction issues attracted considerable attention, both on account of activity and strength. Metropolitan Street Railway and Metropolitan securities rose sharply on a much larger volume of business, while Brooklyn Rapid Transit touched 73⅜, the highest price recorded in many months. The strength in the latter issue was due in part to pool operations and partly increased earnings. There was also talk of the property being absorbed by one of the large systems in the near future.

Philadelphia

There was a sharp falling off in the dealings in traction stocks this week. Fewer issues were traded in and the individual totals were the smallest recorded for some time. The general tone of the market, however, was firm, in sympathy with the strength prevailing in the New York market. Philadelphia Rapid Transit was the leading feature, both as regards activity and strength. At the opening there was evidence of buying by New York interests, and despite the hostile attitude of the city administration the price rose from 27¼ to 28⅞, and closed at the highest. In all about 11,000 shares were traded in. Philadelphia Company's stock were moderately active and strong, the common advancing from 44⅝ to 44¾, but later on the stock sold at 43¼, ex. the dividend, where it closed, The preferred was decidedly strong, the price rising a full point to 48. Upwards of 3000 shares of the common and about 200 shares of the preferred changed hands. Philadelphia Traction was decidedly strong, 122 shares selling from 100 to 100½. Union Traction was quiet, several hundred shares changing hands at 60¼ to 60. American Railways sold to the extent of 300 shares at 51. Other transactions included United Railways of San Francisco common at 55, the preferred at 87¾ to 87, United Railways Investment preferred at 87½, and a small lot of United Companies of New Jersey at 268½.

Chicago

Trading in this market was extremely dull, and prices displayed some irregularity. Chicago & Oak Park common, after selling at 6 at the opening, broke to 5, from which it failed to rally. The preferred sold at 19. An odd lot of Chicago Union Traction brought 6⅛, and thirty-five shares of North Chicago sold at 64. Northwest Elevated displayed unusual strength, the price advancing from 21⅞ to 24 on the purchase of 270 shares. South Side Elevated held firm, with sales at 95. Metropolitan was firm at 24.

Other Traction Securities

The Baltimore market was decidedly less active, but prices, with few exceptions, scored substantial gains. Interest centered largely in United Railway issues, all of which displayed pronounced strength, owing to the efforts being made to form a syndicate of Baltimore and New York bankers to discount the deferred and coming coupons on the income bonds. The 4 per cent bonds were the most active—about $60,000 of them changing hands at from 93½ to 94. The incomes were in light supply throughout the week, the total transactions for the week aggregating only $22,000, at prices ranging from 60⅛ to 60⅞. The stock sold at 13. Other sales included Atlanta Street Railway 5s at 107½, Augusta Street Railway 5s at 104, Central Street Passenger 5s at 117, Macon Street Railway 5s at 99½ to 98, and Norfolk Railway & Light 5s at 92¾.

Little interest was manifest in the Boston market. Trading was extremely quiet, and price changes were insignificant. Transactions were as follows: Boston Elevated at 157¾ to 157, Boston & Worcester common at 29, the preferred at 74½, Massachusetts Electric common at 18¾, Boston & Suburban at 21½, West End common at 97½, and the preferred at 114½, ex. the dividend. The New York curb market was dull and featureless. Interborough Rapid Transit declined from 202 to 200½ on the sale of less than 1500 shares. New Orleans Railway common and preferred were fractionally lower, about 1000 shares of the former selling at 36, and a like amount of the preferred changing hands at 79½ to 80. The 4½ per cent bonds, however, held firm, $17,000 changing hands at 90 to 90¾. North Jersey Street Railway 4s sold at 77¾ and interest for $15,000, and $30,000 Jersey City, Hoboken & Paterson 4s brought 75½ and 76 and interest, Public Service Corporation certificates sold 68¾ to 68½ for $70,000, United Electric 4s brought 74¼ to 74⅝ and interest for $30,000.

The bonds of the Cincinnati, Dayton & Toledo Traction Company were active in Cincinnati last week, several hundred thousand worth selling at 94½ to 95. The securities of the Cincinnati Northern Traction Company, which is the leasing company, are being

financed in Cincinnati at present, which accounts for the activity in the underlying issues. Cincinnati Street Railway sold at 146¾ to 147, factional declines from recent markets. Detroit United moved up to 93¾ on news of increased dividend. Cincinnati, Newport & Covington common sold at 33¾ and the preferred at 93¾.

Muncie, Hartford & Fort Wayne showed a phenomenal gain at Cleveland, due to prospects of increased dividends. It opened the week at 50½, and advanced to 56¾, with few offerings at that. Northern Texas Traction made a gain from 61 to 63½, Northern Ohio Traction sold at 22½ and 23, Aurora, Elgin & Chicago at 16½, and Cleveland Electric at 78.

Security Quotations

The following table shows the present bid quotations for the leading traction stocks, and the active bonds, as compared with last week:

	June 28	July 5
American Railways	51	50½
Boston Elevated	157¾	a157
Brooklyn Rapid Transit	68¾	72½
Chicago City	a190	a190
Chicago Union Traction (common)	7⅜	7
Chicago Union Traction (preferred)	34	32
Cleveland Electric	79½	79½
Consolidated Traction of New Jersey	82	82
Consolidated Traction of New Jersey 5s	108½	108½
Detroit United	93½	93¾
Interborough Rapid Transit	200¾	200⅞
Manhattan Railway	165	165
Massachusetts Electric Cos. (common)	18½	18
Massachusetts Electric Cos. (preferred)	61½	a62
Metropolitan Elevated, Chicago (common)	24	24
Metropolitan Elevated, Chicago (preferred)	66	65
Metropolitan Street	124	129¾
Metropolitan Securities	81	84½
New Orleans Railways (common), W. I.	37⅛	38
New Orleans Railways (preferred), W. I.	79	80¾
New Orleans Railways 4½s	90	90
North American	104¼	99¾
North Jersey Street Railway	25	25
Philadelphia Company (common)	44½	*43¼
Philadelphia Rapid Transit	27¼	28⅝
Philadelphia Traction	100	100
Public Service Corporation 5 per cent notes	97	97
Public Service Corporation certificates	69	69
South Side Elevated (Chicago)	95	94½
Third Avenue	130	130
Twin City, Minneapolis (common)	113¾	113
Union Traction (Philadelphia)	60	60
West End (common)	97½	97
West End (preferred)	116½	*114

a Asked. W. I., when issued. * Ex-dividend.

Iron and Steel

The "Iron Age" says the feeling in the iron trade generally is distinctly hopeful, and yet there is little that is tangible to justify increased optimism. Those branches which saved the situation after the check of the late spring are still the backbone of good times. These are the plate and structural trades which are flourishing through the railroad buying of cars and engines, and heavy requirements for buildings, bridges and ships. Some good rail orders have been placed lately. The event of the week was adjustment of the sheet and tin plate scales. This removes practically the only cloud on the horizon. There are indications that at least one large consuming interest in the foundry trade has begun to feel the market for pig iron seriously.

WEST SHORE ELECTRIFICATION PLANS

It is announced that the contracts soon to be let for the construction work upon the electrification of the portion of the West Shore Railroad between Syracuse and Utica will be made with the Oneida (N. Y.) Railway Company, which has already built as far west as Canastota. According to the latest plans the electric cars will not come all the way into Syracuse on the West Shore, but near Eastwood, connection will be made with the Eastwood line of the Syracuse Rapid Transit Railway Company. One reason for this plan, it is understood, is that when the New York Central Railroad takes up the matter of eliminating grade crossings in the city of Syracuse, there is a strong probability that the West Shore tracks will be elevated through the city. Power for the electrified West Shore will be secured from the Hudson River, and will be supplemented by the power house now being built near Utica. Syracuse is to be the dividing point between the zones using Niagara and Hudson power.

PHILADELPHIA & WESTERN AWARDS CONTRACT FOR ELECTRICAL EQUIPMENT

A contract has been awarded by the Philadelphia & Western Railroad, which is constructing a double-track line from Philadelphia to Parkesburg, for its entire electrical equipment to the General Electric Company, involving an expenditure of over a million dollars. The contract involved the complete equipment of both a temporary and a permanent power house and all of the passenger cars now under construction by the St. Louis Car Company. The location of the permanent power house has not yet been definitely determined upon, but it will be at a point on the line convenient to water and fuel supply. The temporary power house will be located on Cobb's Creek, about three miles beyond Sixty-Third and Market Streets, Philadelphia. Contracts for the power house, which are not embraced in the General Electric contract, will be awarded in a few days, as it is the purpose to push this work, especially upon the temporary power house, as rapidly as possible.

The constant speculation and rumors as to this or that interest said to be back of the Philadelphia & Western Railroad, has led L. N. Downs, the treasurer of the company, to make the following statement regarding the control of the enterprise:

"None of the various railroads—the Pennsylvania, Wabash, Reading or Lehigh Valley—mentioned at various times as identified with the road are in any way interested, nor have they a dollar in the property. The only persons interested are George J. Kobusch, president of the St. Louis Car Company, and W. T. Van Brunt, president of the St. Joseph & Grand Island Railroad, and who is also president of the Philadelphia & Western, and their financial friends."

Since the construction of the Philadelphia & Western was started, the plans of the Pennsylvania Railroad for a low-grade freight line between Fifty-Second Street and Atglen have developed so far as to show that the two lines will be parallel and probably not far apart. The building of these two roads, which will be of the most modern and up-to-date character, is expected to have a very marked effect on a territory which at present is without adequate railroad facilities, but which in the near future will be brought into close touch with the city.

THE HAVANA (CUBA) CENTRAL RAILWAY SYSTEM

The Havana Central Railway Company, of Havana, Cuba, has placed orders with the foreign department of the General Electric Company, of Schenectady, N. Y., for complete electrical equipment of a network of interurban electric railway lines radiating from Havana and covering an extensive territory inland.

The system will consist of a central power house in Havana and eight outside sub-stations, together with line material for about 125 miles of trackage and rolling stock for passenger and freight service over the entire system.

The power house in Havana will furnish 5000 kw of 19,000 volts, 25-cycle three-phase alternating current, generated by two 2000-kw generators and 1000 Curtis steam turbine generators at 2200 volts and stepped up through air blast transformers to line voltage. The transmission lines will parallel the various lines of the railway to the sub-stations, where step-down transformers supply low voltage to rotary converters, furnishing 600-volt direct current to trolley lines and feeders.

From Havana one branch will run southeast through Cuatro Caminos, Lomas de Candela, Guines, Providencia to Rosario, a distance of about 40 miles. Sub-stations will be located at Cuatro Caminos Lomas de Candela and Providencia. A second line will run from Havana 17 miles south to Bejucal, with a sub-station on the line at Santiago de las Vegas. A third line, running southwest from Havana to Mariel, will have a length of 37 miles, and branch lines, running north and south to El Carmelo, Santiago de las Vegas anl Tuira de Malena, amounting to about 30 miles in addition. Sub-stations on the line to Mariel will be placed at Mariano, Hoyo Colorado, Guanagay and at San Antonio Melena.

The rolling stock for passenger service will consist of twenty-four 30-ton cars seating fifty passengers and equipped with four GE-74 motors, geared for a maximum speed of 40 m.p.h. The freight service will be handled by ten 40-ton General Electric locomotives equipped with four GE-55 motors geared for a speed of 17 m.p.h. when hauling a 300-ton train. The entire system will have double overhead trolley both in Havana and on the interurban lines. The high potential transmission lines will be designated for a future potential of 30,000 volts to provide for extensions. The transformers in the Havana power house and in the sub-stations are also suitable for use on the increased potential. It is expected that the entire system will be in operation inside of eighteen months, and that portions of it will be giving service before that time.

MORE POWER FOR THE B. R. T.

The Brooklyn Heights Railroad Company has closed contracts with the Westinghouse Companies for two steam turbo-generator sets, each of 10,500 brake hp, and a guaranteed overload of 50 per cent, or a maximum guaranteed capacity of about 16,000 hp each. The turbines will operate on dry steam at 175 lbs. pressure, and a vacuum of about 28 ins., and the turbo-generators will deliver three-phase, 25-cycle current at 11,000 volts.

CLEVELAND TRACTION AFFAIRS

Mayor Johnson and the Cleveland Electric Railway have exchanged drafts of agreements relative to the operation of cars on the Central Avenue and Quincy Street lines pending the decision of the courts as to the matter of the expiration of the companies' franchises on these routes. The company offers, in event of its losing the case, to refund to the city the net profits from the operation of this portion of the system, in determining which there shall be deducted from the estimated gross earnings: the operating expenses and taxes, the depreciation charges and 6 per cent interest upon the value of physical property used in the service mentioned. The city under this agreement would get about $250 a day from the line if the case is decided against the company.

LOS ANGELES BEGINS FIGHT TO PREVENT ELECTRIC RAILWAY FREIGHT TRANSPORTATION ON ITS STREETS

By order of Mayor McAleer, the city of Los Angeles has caused the arrest of officers of the Los Angeles Interurban Railway Company to test the right of the electric railways to carry freight in cars over their lines through the city. Warrants charging two specific offenses have been served. The defendants are General Manager A. D. Schindler, Superintendent S. B. McLenegan and Motorman H. A. Tourville. They are accused of maintaining a nuisance by running freight cars over the city streets. A police officer appears as complainant, and the move is said to be the opening of an active campaign against the street railways on the part of Mayor McAleer. Specifically, the complaints allege that Third Street was "obstructed" on certain dates by a freight car owned and run by the company, and operated by Tourville.

Several weeks ago the Mayor demanded from the City Council an ordinance prohibiting street railways from carrying freight. At the time it was said that the object of the Mayor was not so much to prevent freight-carrying as to use the ordinance as a club whereby universal transfers might be secured for the people. This was not denied, but the City Council, after considering the matter and conferring with business men, declined to pass the ordinance, sending a communication to the Mayor in which the opinion was expressed that existing laws were sufficient to cover the matter, and urging him to enforce them. This the Mayor now proposes to do.

No franchise has ever been granted to the Los Angeles Interurban Railway Company for carrying freight, and the new move is expected to provide a precedent for future action. Trial in the police court will be but a preliminary step, as it is understood that either side will carry the case to the Supreme Court if defeated. If the courts sustain the city's contention, similar action will be instituted against the other local electric railway companies engaged in freight traffic, and an attempt will be made to secure perpetual injunctions restraining them from carrying freight through the city without a franchise.

Discussing the arrest of the traction officials, City Attorney Matthews said: "We expect to determine by this proceeding whether the street railway companies may continue to haul freight over the city streets. The complaints were drawn on a section of the penal code which declares the obstruction of streets to be a public nuisance. The case for the city has been carefully prepared. We have a large number of authorities to sustain our contention, that a freight car, if operated upon a street railway line within a congested or residence district, is a nuisance, and is an obstruction. The Los Angeles Interurban Railway Company has no authority whatever to operate freight cars on its lines within the city limits of Los Angeles, and its having done so constitutes a usurpation of the public thoroughfares. We anticipate a demurrer to the complaint and a contest upon the question at issue which will probably go to the Supreme Court."

Henry E. Huntington, president of the Los Angeles Interurban Railway Company, has the following to say about the freight-carrying cases: "The question is not whether or not the hauling of produce, milk, berries and packages, in cars on the streets, is a nuisance. The people themselves have settled that question, and I think that I do not exaggerate when I say that 90 per cent of our citizens directly favor the carrying on of the local small freight and produce transportation in the manner in which we are now handling it. Our men were arrested for hauling a carload of berries along the public streets. Now which is the greater nuisance and causes the greater obstruction; a car such as this, running on a fixed track, or three or four big trucks hauling the same berries on the same street, and blocking transportation from curb to curb? Modern invention and progress have brought about this simple, convenient and speedy manner of handling local light freight and produce over streets between towns and cities. Throughout the East and in Europe these freight cars are recognized as a great convenience, if not a necessity. The freighting we do here is cheaper and quicker than by any other method. We shall continue to carry on our business in such a manner as not to offend either the artistic or substantial sensibilities of our fellow-citizens, until such time as the courts shall say we are wrong, and in that event I shall, as I have always done, yield without criticism to such judgment."

MR. CONNETTE TO REMAIN IN SYRACUSE

Edward G. Connette will remain as general manager of the Syracuse Rapid Transit Railway Company, as the directors of the company have refused to release him from his contract, which has a year and a half to run. Mr. Connette, as announced in the last number of the Street Railway Journal, was offered the position of general manager of the Consolidated Street Railway Company, of Worcester, Mass., and had accepted the position conditional upon his release from his contract at Syracuse. The directors of the Rapid Transit Company met at the Grand Central Station on June 29. Both President Horace E. Andrews, of Cleveland, and Vice-President William K. Vanderbilt, Jr., were present. Mr. Connette's resignation was considered, but it was decided that his services at Syracuse could not be dispensed with.

INDIANA RAILWAY COMMISSION DEMANDS NAMES OF ELECTRIC RAILWAY PASS HOLDERS

The railway companies operating in Indiana have declined to honor the demand of the railway commission for a list of the pass holders. The commission interprets the law to prohibit officials or their deputies from receiving, and the railway and interurban roads from granting to such public officials or their deputies, passes. The companies have not taken an arbitrary stand and flatly refused to concede the commission has a right to interfere with the issuance of passes, but suggest a friendly suit to settle the question. Railway attorneys say they do not believe the commission has the right, under the law creating it, to demand a list of the pass holders, but in order to have it determined definitely, they are willing to submit an agreed statement of facts to the Supreme Court, on which the law may be construed. The members of the commission refused to state what action will be taken, or what will be their course, but it is generally believed that the matter will be submitted to the court on an agreed statement of facts as proposed.

EAST RIVER TUNNEL TO LONG ISLAND CITY SANCTIONED BY WAR DEPARTMENT

Representatives of August Belmont state that the Forty-Second Street tunnel, connecting the Grand Central Station and the Interborough subway with Long Island City, will be begun within thirty days. Robert S. Oliver, the acting Secretary of War, has approved the application of the New York & Long Island Railroad for permission to construct the tunnel and to sink a shaft on Man-o'-War Reef, immediately south of Blackwell's Island, in order to facilitate the work of building the tunnel. The shaft is authorized to be maintained for two years, indicating that the company intends to push the work with vigor. The company is owned or controlled by August Belmont and his friends. Arthur Turnbull is the president. The sinking of the shaft on the Man-o'-War Reef will enable four tunnel gangs to work simultaneously. If the State Land Commission also assents to this shaft, the tunnel will be driven in record time, it is said.

STREET RAILWAY PATENTS

[This department is conducted by Rosenbaum & Stockbridge. patent attorneys, 140 Nassau Street, New York.]

UNITED STATES PATENTS ISSUED JUNE 20, 1905

792,634. Trolley Head for Electric Tram Cars; Samuel R. Thompson, Liverpool, England. App. filed Jan, 17, 1905. Mounted below the trolley wheel is a cylinder containing lubricating material, and a piston is spring-pressed in the cylinder to force the lubricating material upward through suitable ducts to the periphery of the trolley wheel.

792,672. Station Indicator; James H. Shepherd, Denver, Col., App. filed Aug. 22, 1903. The names of the streets or stations are indicated on panels in the end of the car, and the motorman operates a sliding contact to close circuits to glow lamps behind the panel indicating the next street or station.

792,741. Electric Railway Switch; Thomas B. Stewart, William H. Turner and Rowland E. Dixon, Leads, England. App. filed Nov. 26, 1904. A track switch having an insulated trolley section through which current may or may not be taken by the car to operate the switch in the usual way. A supplemental switch is provided on the branch line to restore the switch point to its normal position.

792,903. Trolley Stand; Frank N. Kelsey, New Haven, Conn. App. filed April 14, 1905. An arrangement of tension springs, such that the pressure of the trolley wheel upon the wire will always remain uniform regardless of the angular variations in the position of the pole.

792,907. Brake Beam Fulcrum Block; Robert P. Lamont, Chicago, Ill. App. filed Jan. 19, 1904. Comprises two forged pieces having flange portions to engage the brake beam and forwardly extending parallel jaws perforated to receive the brake lever bolt and attach outside the brake lever by means of a pin.

792,919. Car Fender; John O'Leary, Cohoes, N. Y. App. filed Nov. 7, 1904. Details of construction. Relates to means whereby a person may be picked up by the fender and not injured thereby in so doing.

792,920. Car Fender; John O'Leary, Cohoes, N. Y. App. filed Feb. 28, 1905. The fender is adjustable forward and backward to adapt it to both city and suburban traffic . Other details.

792,929. Wheel; Edward M. Roberts, Ashland, Ky. App. filed Nov. 17, 1904. A cast-metal wheel having integral rim, spoke and hub members and a separately formed chilled cast bushing around which the wheel is cast.

792,946. Car Axle; Frank M. Thompson, East Liverpool, Ohio. App. filed Jan. 10, 1905. Details of a construction of a divided car axle.

792,959. Clamp for Trolley Wires; Chris. C. Bakewell, Kaylor, Pa. App. filed March 31, 1905. A clamping device for trolley wires in which one jaw of the clamp is fixed, and the other jaw pivoted, the jaws being forced together to clamp the wire by means of a screw in the fixed jaw.

792,985. Safety Device for Trolley Poles of Electric Cars; Daniel R. W. Hardman, Liverpool, England. App. filed March 14, 1905. A spring drum device for the control of trolley poles in which a detent is controlled by a magnet normally energized by the trolley current. When the pole leaves the wire, the magnet is de-energized and the spring-drum actuated to wind up the trolley cord and pull the pole down.

UNITED STATES PATENTS ISSUED JUNE 27, 1905.

793,304. Trolley Wheels and Guard Therefor; Fridolin Koenig, Newark, N. J. App. filed Dec. 17, 1904. A pair of arms loosely pivoted in the trolley harp and normally held in an upright position by springs. When guy wires or other obstructions are encountered the springs readily yield.

793,311. Wheel; David A. Moore, Harvey, Ill. App. filed July 18, 1904. A wheel formed from plate or sheet metal and comprising a web portion and a rim portion integrally connected with the web portion and having thread and flange portions, each of which is of greater thickness than the body of the rim portion.

793,312. Automatic Trolley Pole; Alfred W. Morgan, Longbeach, Cal. App. filed Jan. 30, 1905. The trolley wheel is journaled in a supplemental frame whose movement when the wheel leaves the wire, tends to release the upward spring pressure on the pole, and the pole falls by gravity.

793,343. Car Fender; Peter Best, Elizabeth, N. J. App. filed Sept. 27, 1904. Relates to manual and automatic means for tripping the fender to allow it to drop by gravity to operative position.

793,344. Trolley Base; Peter Best Elizabeth, N. J. App. filed Sept. 29, 1904. The pole is so mounted that when it is pulled down flat upon the roof of the car, the spring tension thereon will be almost entirely removed.

793,379. Switch for Electric Railways; Carl Voss, New York, N. Y. App. filed April 1, 1905. Relates to means for throwing the switch from a moving car, and consists of a system of levers in the roadbed and suitable engaging means on the car.

793,480. Electrically-Operated Railway Switch; Bryan S. Wakeman, Scranton, Pa. App. filed Aug. 30, 1904. A pair of electromagnets control a two-arm lever by which the switch point is actuated. The lever arms are extensible, and the magnets are laterally adjustable in order to vary the leverage.

793,481. Switch Throwing Device; William J. Ward, Pittsburg, Pa. App. filed Dec. 9, 1904. A lever on the car is adapted to engage a cam-block in the roadbed which is suitably attached to the switch tongue.

793,516. Car Truck Bolster; George G. Floyd, St. Louis, Mo. App. filel Aug. 12, 1903. A T-shaped bolster whose web has a footflange increasing in thickness from the ends toward the center.

793,605. Car Seat; William M. Norcross, Philadelphia, Pa. App. filed Oct. 11, 1901. Consists of two chairs pivotally mounted upon a pivotal yoke, a reversing-arm and slot and pin connections between the arm and the chairs.

PERSONAL MENTION

Mr. CHARLES R. MORLEY, president of the Stark Electric Railway Company, has returned from a six months pleasure trip around the world, visiting European, North African and Oriental countries. The newspaper reports that this was a wedding tour was a canard. The Mrs. Morley who accompanied him was his mother.

MR. H. N. RANSOM, who has been associated for some time with the National Electric Company, has resigned to join the forces of the General Electric Company, for the present having offices at Schenectady. Mr. Ransom's many friends will be pleased to note this move which materially broadens his field of action.

MR. WILLIAM AIKINS has resigned as general manager of the Ohio Central Traction Company, of Galion, Ohio, with which he has been identified for two years. Mr. Aikins was formerly with the Western Ohio, and before that with the Cleveland & Southwestern and the Tuscarawas Traction Company. Mr. T. C. Cherry, formerly with the Lorain Street Railway, of Lorain, has succeeded Mr. Aikins.

MR. BLAKE A. MAPLEDORAN has been appointed general manager of the Northern Texas Traction Company, succeeding the late Mr. F. M. Haines. Mr. Mapledoran was formerly identified with the Memphis Street Railway Company, of Memphis, Tenn. It was the desire of the Northern Texas management to secure some one who was thoroughly familiar with Southern ideas and methods, and Mr. Mapledoran was selected accordingly.

MR. S. L. F. DEYO, chief engineer of the subway division of the Interborough Rapid Transit Company, of New York, has resigned to join the Metropolitan traction interests. Mr. George H. Pegram, who since Feb. 1, 1898, has been chief engineer of the Manhattan division of the Interborough Company, has been promoted to Mr. Deyo's place, and will hereafter bear the title of chief engineer of the Rapid Transit Subway Construction Company.

MR. JOHN MURPHY, general superintendent of the Pittsburg Railways, was the subject of an extended biographical article in the "Pittsburg Despatch" for June 11. Mr. Murphy has been connected with the Pittsburg railway system for some fifteen years. In the early days of electric railroading he took a course in the handling of electrical apparatus at the Thomson-Houston works at Lynn, and has had charge of electrical and mechanical engineering on the Pittsburg system, as well as of operation, for a number of years. Mr. Murphy has taken out a number of valuable patents in connection with railway work.

MR. F. L. FULLER, vice-president and general manager of the New York & Queens County Railway Company, with headquarters at Long Island City, N. Y., has accepted the like-named positions on the executive staff of the New York & Long Island Traction Company, which property was recently purchased by the New York Interborough and Pennsylvania Railroad interests. He will manage both companies, although each is separate and distinct from the other. Mr. Fuller began his street railway career with the St. Paul City Railway and remained with that company four years as assistant superintendent. In the spring of 1893 he resigned to accept the position of assistant superintendent of the West Chicago Street Railroad Company; this was the year of the World's Fair, and during that summer he was appointed general superintendent, which position he held until the fall of 1899. He then resigned to accept the position of assistant to the president and general manager of the Interstate Railway Company, of Philadelphia, formerly the United Power & Transportation Company. Mr. Fuller left this position in the spring of 1903, to take those of vice-president and general manager of the New York & Queens County Railway Company, which he holds at present besides his new positions.

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Changes of advertising copy should reach this office by 10 a. m. Monday preceding the date of publication, except the first issue of the month, for which changes of copy should be received two weeks prior to publication date. New advertisements for any issue will be accepted up to noon of Tuesday for the paper dated the following Saturday.

Of this issue of the Street Railway Journal 8000 copies are printed. Total circulation for 1905, to date, 229,350 copies, an average of 8191 copies per week.

The Subway Critics

It is with pleasure that we print in this issue the reply of Mr. Stillwell to the criticism on the electrical equipment of the New York Subway, offered by Mr. Tesla and printed in part in our issue of June 24. If Mr. Tesla's audience had been confined to electrical engineers only, no answer would have been necessary to his comments, as they carry their own refutation, but so long as Mr. Tesla chooses to ignore Mr. Stillwell's challenge to debate these subjects before the American Institute of Electrical Engineers, it is well to place the facts before the public. There is so much that is mysterious in the operation of electrical machinery in the popular mind that it might not be surprising if certain of the claims offered in the original Tesla letter should have left an impression with some that a radical mistake had been made in the system adopted in the subway. Mr. Stillwell, however, takes up the criticisms seriatim and disposes of them so completely as to leave no excuse for resurrecting the subject again.

Fireproofing Cars

The discussion at the Lake George convention of the New York State Association on the question, "What can the master mechanic of the average surface road do to prevent fires on cars, and to render his cars more nearly fireproof," develops the fact that the minds of many of the master mechanics of the State have been working to this same end, namely, the prevention of fires on cars due to electrical causes. The trend of opinion seems to be that all cables and wiring should be carried in iron-pipe conduits, or at least in good wood moldings, one or two of the speakers rather favoring the latter. Inasmuch as nearly all fires in cars arise from defective wiring, it is extremely interesting to note this common recognition of the axiomatic proposition that modern transportation conditions require more painstaking attention to the car wiring than the makeshift methods of not so many years ago. It is safe to say that the car-wiring specifications of the future, if they are to be considered complete, will call for heavily insulated and protected flexible stranded cables of ample capacity to be carried in conduits, either of iron pipe, wood or fire-resisting composition; all cables to be located inside the car, so far as possible, and to be protected by suitable bushings where the cables enter and leave the conduits. For especially heavy equipments, a fire-resisting lining under the bottom of the car floor framing, and particularly over the resistance boxes, offers an additional and commendable protection.

Electric Railway Service and Technical Graduates

At this time of the year, when so many technical graduates are seeking for the first time positions in the industrial field, it is interesting to consider the opportunities which electric railway service offers to the man who desires to specialize in rapid transit work. It is to be feared that in many quarters the impression prevails that electric railway work is a short cut to affluence, and that individual progress in it is faster than in any other branch of the engineering industry. Seldom does the enthusiastic graduate stop to realize that the great bulk of transportation work, both steam and electric, is compensated by wages instead of salaries. There is always a certain leveling tendency in established engineering enterprises which expresses itself in a demand for routine work and which results in the employment of a large number of men whose training and compensation cannot in the nature of things

equal the qualifications and rewards possessed and enjoyed by the executives and heads of departments. In electric railway work we find no exception to this tendency, and the heavy pressure brought to bear to keep operating expenses down often renders regular and substantial advances in salary exceedingly slow.

If the graduate of this year is unwilling to take up any line of work in which he cannot expect quick profits and rapid advance into responsible positions, electric transportation has little use for him. If the Saturday half-holiday and the nine to five hours of the rest of the week are unto him a necessity, the operation of a modern rapid transit system is something to be let severely alone. A bank or a Government office will supply the desired environment far better than the electric railway, with its frequent emergency calls, night or Sunday work on rush propositions, forgetfulness of office hours and a generally strenuous life. The handling of from half a million to a million passengers per day in the restricted and congested area of the modern large city is no kid glove affair, and the gigantic pressure of the public desire for rapid transit often leaves little time for the golf links.

Granted that a graduate of ability, force and persistence enters such work with his eyes open to the probability of a long period of apprenticeship at moderate pay, it still remains true that few if any branches of engineering offer greater possibilities in the long run than does electric transportation. Remarkable as have been the developments of the past quarter century in this field, the future unquestionably holds work in store which will dwarf the achievements of to-day, as modern successes overshadow those of the early 90's. The application of electricity to certain operating phases of steam railroad work is virgin soil in this country as yet, although the beginning of a mighty development is close at hand. Real rapid transit has as yet been but slowly developed in the larger cities, considering the ever broadening requirements of increasing population and traffic density. The harmonious unifying of through transportation facilities on interurban railways has still to be worked out in a satisfactory manner, and the standardizing of electric railway freight business is a long way from realization. In the department of motive power and machinery, the evolution of the steam turbine and the commercial adoption of the alternating-current motor open up possibilities in the design and operation of power plants and rolling stock radically different from previous work, while the more gradual development of the gas engine offers many interesting and revolutionary opportunities. The improvement of repair shop design and methods, adoption of motor-driven machine tools, and the study of new types of cars specially adapted to the quick loading and discharging of passengers, are all progressive steps leading to a still higher development of the efficiency of the transportation machine as a whole. Finally, the improvement in auditing methods, which marks the more recent progressive administrations of electric railway properties, points to the greater realization on the part of the officials of the importance of saving time and money through the prevention of unnecessary waste in every department of the industry. Perhaps there is no line of railway work in which keen analysis counts as much as it does in this. The electric railway needs the technical graduate, and to the man who realizes its developing possibilities and makes the most of opportunity, it offers an exceptionally interesting career, which in many cases will not be destitute of adequate ultimate reward.

The Value of Technical Training

Apropos of this subject, that of the recent graduate, a recent address by William Barclay Parsons before a convention of teachers lays beautiful emphasis upon the acute need for manual and technical training to meet the requirements of modern life. It is a subject upon which it would be hard to lay too much stress. The basic idea which Mr. Parsons used as his text, so to speak, was the change of manual to mechanical operations in modern civilization. A hundred years ago machinery, save of the simplest sort, was practically unknown. The operations of daily work were not complex, and the manifold elaborate trains of manufacture had not appeared. At the present time all that is changed, and there is hardly to-day a man, in city or country, who does not daily come into necessary contact with somewhat intricate mechanisms. Trades, for the most part, are no longer handicraft, but machine craft, and the best workman is not he who can use a plane or a chisel, a bit or a file with the truest hand, but he who can most skilfully set the tools and adjust the cut on a machine which will do ten men's work. The gain in efficiency brought about by such a change is enormous, but to make the most of it, it becomes necessary to train workmen how to use the new and complicated tools with which they have to deal. A carpenter, in the modern sense, must not only know the tools of a hundred years ago for the occasional necessities of their use, but must learn how to work with a dozen kinds of labor-saving machines, big and little, and the other trades are, with few exceptions, in the same case.

A first-class craftsman, therefore, must know machines and their uses, and, moreover, he must understand the principles of their use, else they will become his masters instead of his servants. A man who merely learns how to run a machine is in a sorry plight if anything goes wrong or if he has to change to another job. One of the greatest current labor problems is how, under modern conditions, to preserve the laborer's initiative and to make him something of more vital possibilities than the steel and brass structure of which he has become a component part. And the only way to free him is to so instruct him that he can at an hour's notice master a new machine and become an expert at operating it in a day or two. The man who is familiar with a dozen automatic machines has greater resources than he who merely knows the hand tools of a century gone. But this new facility implies a broader and more thorough training than of old, and the necessity of acquiring this is obvious. The old methods of training have gone with the old methods of work, and our main industrial difficulty is that new methods of training have not come in to take their place. To be sure, we have in this country many technical schools, but they do not turn out, nor are they intended to turn out, skilled craftsmen. With few exceptions, they are engaged in training men for the more responsible, but less needed, work of the engineer. One cannot decry the training of engineers, but the men from engineering schools are training themselves to escape the very kind of work that the world must have in large amounts. Their ambition is laudable, though it does nothing in supplying the demand for skilled labor as such.

The trade school, in one form or another, must come to help the world out of its difficulty. It is as legitimate a sequence of the age of machinery as the apprentice system was of the age of handicraft. There are those who grieve that the old methods of labor are gone, but the world must leave them with their lamentations and make the best of the changed conditions.

There may come a change of vision when the present order of things will have disappeared, but until it comes one must meet the problems of to-day. We need trade schools where skilled workmen can be trained to take their places in the world's industrial programme, and we need them very badly and at once. How much of the millions that have been given for education in the past decade has been devoted to the uplifting task of bettering the workman's condition? We do not grudge the beneficence that has fallen to the lot of existing institutions, for knowledge is desirable in and of itself, but the sum that provides chairs of Ashantee philosophy and Thibetan ethics for the benefit of half a dozen be-spectacled collegians per year would help in making a hundred young workmen steady and efficient, fitted for better places in the world. And just at the present moment the world needs first-class craftsmen much more than it needs students of the occult. Abroad, the current necessity has been felt as forcefully as here, and already something has been done, but with us there is apathy in this phase of education. We have manual training of a purposeless sort in the public schools, and some workmanship finds its way into the crannies left among theoretical studies in the universities. Between these two there is woefully little. From prejudice or false pride there are few schools instituted frankly for the purpose of training the workmen who shall become the motive power of the world's industry, and ten such are needed for every university to preserve a just balance of the necessities.

Train Despatching and Red Tape

Red tape usually comes under the head of a necessary evil, to be avoided as far as possible, but if there is any one place where it is justified, it is in train despatching on an interurban road. The principal argument that advocates of a telegraphic train-order system urge against train despatching by telephone is the informality of the telephone method and the fact that the recipient of a telephone message is not necessarily a person of as much training and responsibility as a telegraph operator. We are inclined to think that there is some ground for this objection, in that the greatest weakness in interurban despatching at the present day is a certain lack of formality and discipline. The familiarity which sometimes is painfully evident in the conversation between despatchers and conductors and motormen operating cars over the line is not conducive to care in giving or receiving orders. If there is one thing that a despatcher should studiously avoid, it is such familiarity shown, either by himself or by his assistants. It is at best difficult to educate motormen and conductors in the short time available to train them in their duties, and it is very unfortunate if the younger men acquire from their more experienced fellow trainmen habits of carelessness in receiving train orders. As stated at a recent Indiana convention, the interurban roads of the country have all sorts of systems of despatching. It can be said to the credit of the business, however, that practically all of the important interurban roads have despatching systems which approach those of steam railroads in efficiency if carried out according to rules. The principal points upon which different interurban roads differ is in the mode of receiving orders from the despatcher and in the frequency with which trainmen must report to the despatcher. Some roads insist on trainmen taking written orders at all times; others require written orders only under certain conditions, while others require none at all. Some insist that the orders should be taken by the motorman in writing and should then be read back by the conductor. Others require them to be simply repeated back by the motorman who receives them. In fact, all sorts of variations between these two extremes can be found. The requirement that crews should report for orders with unnecessary frequency can hardly be called a formality which adds anything to the efficiency or discipline of the service. It is better to have crews report for orders as infrequently as is consistent with the successful operation of the road, but when they do report, it is well to make the receipt of an order a matter of sufficient formality so that the motorman and conductor are sure to understand it and realize its importance.

The Right of the Road

We have, from time to time, half in sport and half in earnest, alluded to the automobile danger as bearing upon electric railways, their rights and immunities. Now, in fact, the thing to which we directed attention is coming to pass, and we are continually hearing of automobile routes about to be established across country. The ordinary private automobile is in no proper sense a competitor of the trolley car. It is in about the same category as the so-called "public" coach "tooled" by J. Algernon Chappie for the amusement of others of his kind. But the public automobile, carrying a dozen or twenty passengers and operated for profit, is quite another matter, since it is very likely to gather in a very considerable amount of profitable tourist traffic. How well it can be made to pay is dubious, and perhaps the wholesome effect of experience may be felt after a season or two, but the thing here material is that injustice by which the street car, which is a safe and peaceable tenant of the edge of the highway, is subjected to severe regulations as to speed, while the public automobile, which is, from its huge bulk, a menace to every other vehicle on the road, is given the long end of the bargain. The tourist automobile is of no use whatever to the public that owns the highways which it abuses; it is merely an apparatus for the conversion of public property to private gain without compensating benefits. A trolley line is of use locally, but this coming nuisance of an automobile line is quite otherwise. It is of value practically only as a money getter to its owners, and contributes nothing whatever to the up-keep of the roads which it destroys, save in its local habitation. It certainly should be made rigidly to adhere to local speed regulations and should be subject to a round license fee in every town whose roads it batters, open to revocation for abuse of its privileges. It should in no wise be allowed to escape the restrictions imposed upon public vehicles that run upon and keep in repair their own tracks.

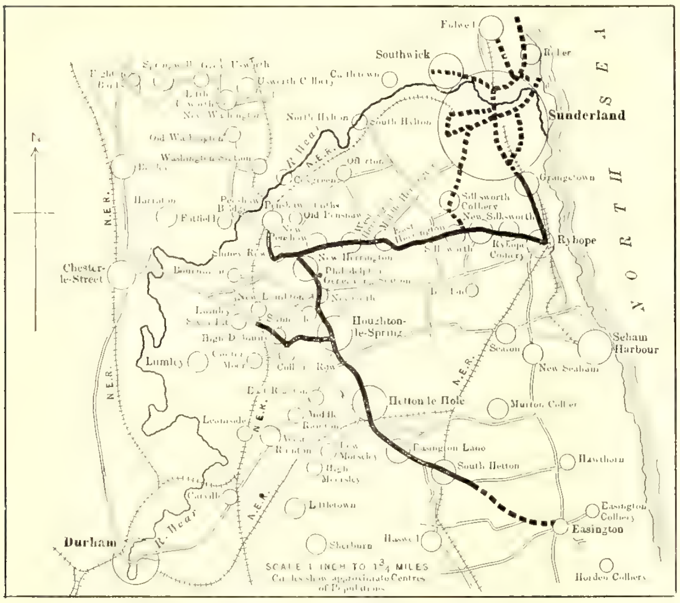
Grease vs. Oil Lubrication

Judging from the discussion at the Lake George convention, and also from the answers received for the Question Box, the grease question is a thing of the past. So nearly unanimous are the opinions, the conclusion is warranted that the use of oil is practically supplanting the use of grease for lubricating armature and axle bearings. The only question now open for discussion is as to a suitable form of oil cup that will provide for ample lubrication while the car is in motion, but will cut off the feed of oil when the car is at rest. In the various forms of cups described, the feeding is accomplished by modifications of wicks, felt, piston, ball and other forms of valves, rotating discs, etc., but none of the forms suggested seems to meet with unanimous approval. Here appears to be a good opportunity for the overworked inventor to turn his mind for a while from the study of car fenders and non-refillable bottles and devote his attention to designing a suitable oil cup for motor and axle bearings on electric cars.

THE SUNDERLAND DISTRICT TRAMWAYS

The majority of the large cities in England are now so well equipped with tramway systems that keener interest may be said to center on the exploitation of traction facilities in the less heavily populated districts. Naturally, the constructional and operative methods which must be adopted on such systems differ largely from those suited to cities in which the returns per mile of route are such as to warrant much larger capital expenditure.

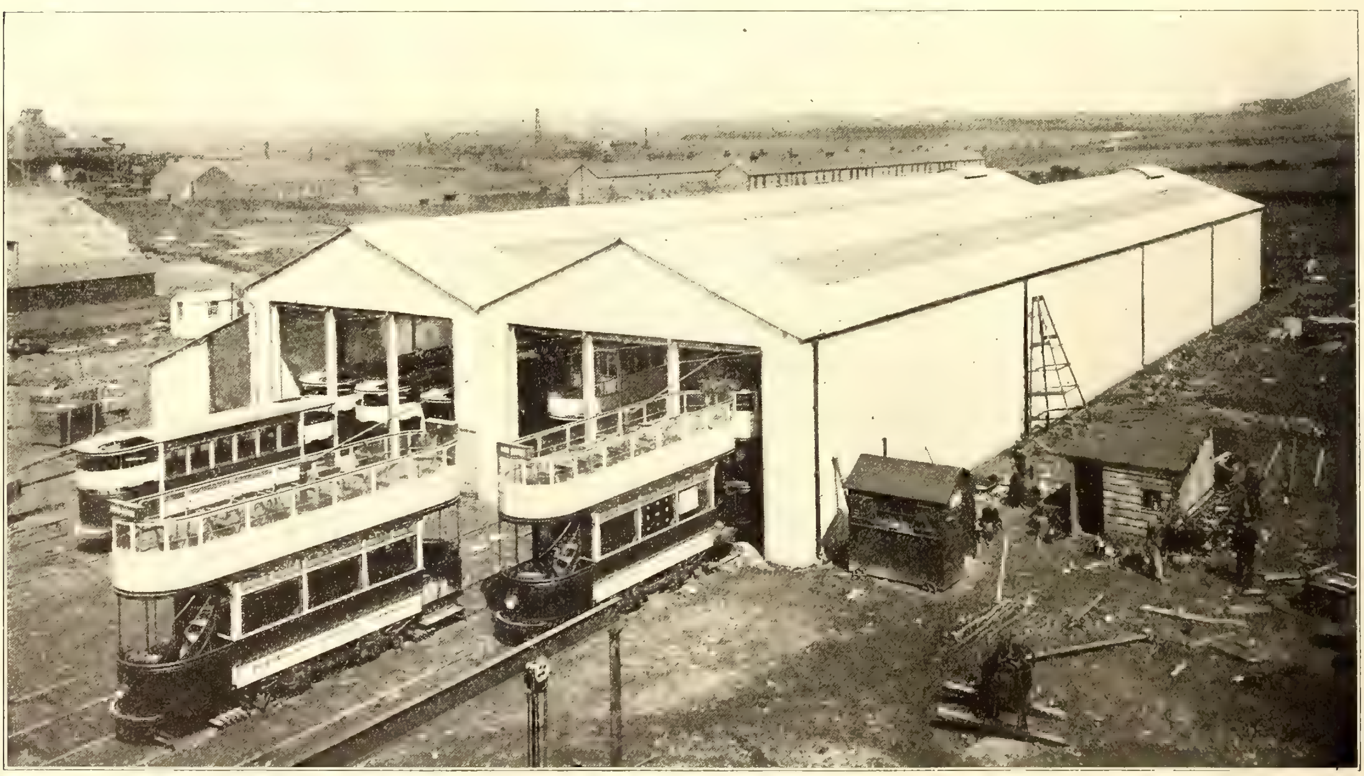
The Sunderland District Tramways, which have lately been placed in operation, are an excellent example of a system constructed to meet efficiently the needs of a population of only moderate density. These tramways run from the outskirts of Sunderland, where they connect with the Corporation system, through a large number of small towns which have been practically neglected by the railroads, and among which the means of transit have consequently been of the worst. As will be gathered from a glance at the map, collieries form the main source of occupation in the neighborhood, and the crying need for conveyance between the miners' homes and the various pits was doubtless a factor in the movement which culminated in the formation of the Sunderland District Tramways Company, Ltd.



Map of the Sunderland District Electric Tramways.
Sunderland District Routes shown thus
Sunderland Corporation Tramway

TERRITORY COVERED BY THE SUNDERLAND TRAMWAYS

A VIEW OF THE CAR HOUSE INTERIOR



GENERAL VIEW OF THE CAR SHEDS, POWER HOUSE, ETC., OF THE SUNDERLAND DISTRICT TRAMWAYS

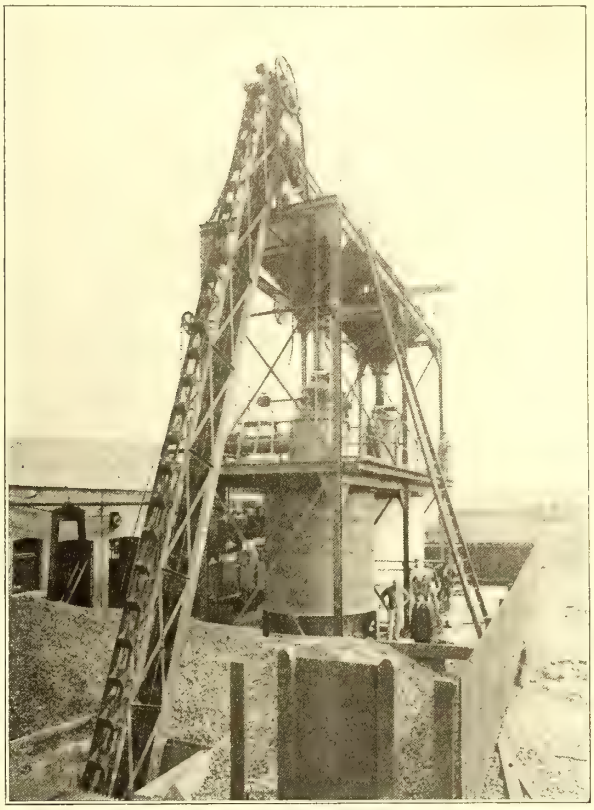
In 1904 the entire contract for the electrical and power equipment of the system was let to Bruce Peebles & Company, Ltd., of Edinburgh. Bruce Peebles electrical apparatus is accordingly employed throughout.

The total route mileage of the system comprises about 17 miles of single track. With the exception of turn-outs, there

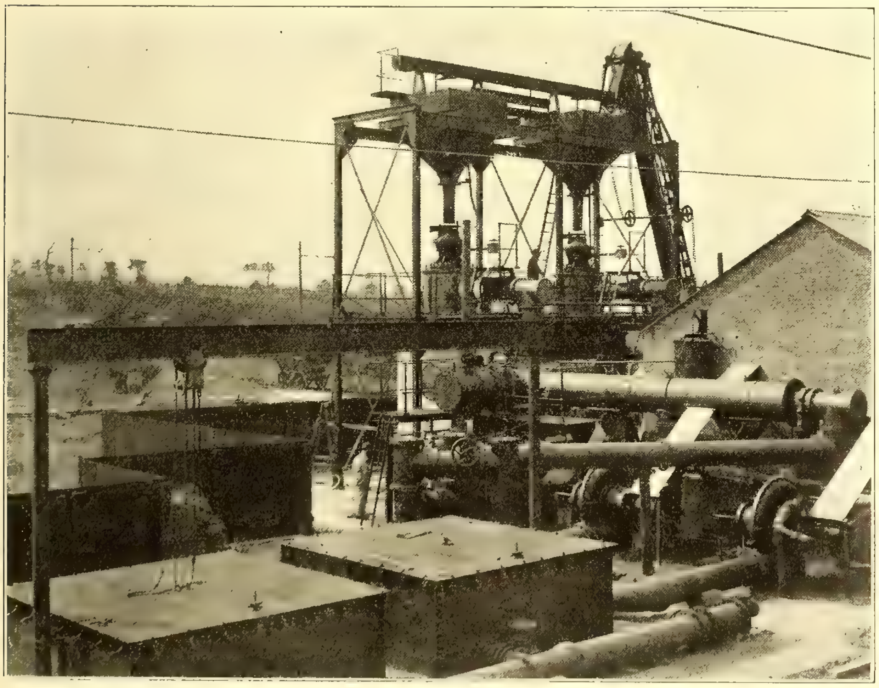
is no double-track work on the route. The type of track construction varies in different parts. In the towns and places where the traffic is heavy, city railway construction is adopted, the whole space between the rails and 18 ins. outside being paved with Whinstone setts 5 ins. deep x 4 ins. broad x 9 ins. long. On the less busy portions of the route light railway construction has been adopted, the paving in this case being 9 ins. on each side of the rail. The rails are of the girder type, 6½ ins. in depth, weighing 90 lbs. per yard; they are butt-jointed and secured with steel fish-plates 24 ins. long, weighing 40 lbs. per pair. In tramway construction, mild steel tie-bars 5 ft. long over all x 2 ins. x ⅜ in., screwed ⅞ in. at one end and notched at the other end, are used, spaced 9 ft. apart, except at the curves and crossings, where they are spaced 6 ft. apart. In the light railway construction, on the other hand, the spacing is all 6 ins. At every joint, copper anchor joints 2 ft. long are fitted to the rails by 12¾-in. rivets and at the center of each rail 2¾ ins., holding down bolts 6 ins. long, are used to prevent hogbacking.

The rail-bonds are of sectional area No. 0000 S. W. G.; cross-bonds are provided at intervals of 120 ft., and all points and crossings are double-bonded. The resistance of track per mile is under .015 ohm. All points and crossings are of toughened cast steel, with manganese steel tongues of the spring type. The points are 6 ft. 6 ins. long, and have an angle of 1 in 7½.

A general view of the car sheds, power plant, etc., is shown on page 96. Nearby is a Mond gas generator, which supplies producer gas for the power station. This plant includes two producer units, together with the necessary subsidiary apparatus, such as gas cleaners, governor, coal-handling plant, etc. The producers are of cylindrical shape, and consist of internal and external wrought-iron shells; the blast, which is delivered by a Roots blower, enters the external shell near the top and passing downward becomes superheated before passing into the combustion chamber through the grate. The fuel bed is kept at a constant level by an internal bell which connects directly with the hopper; poking holes are provided, so that the whole of the fuel bed can be reached and if necessary stirred without any appreciable escape of gas. By means of a water seal the ashes can be withdrawn at any time while the producer is in operation.



FUEL CONVEYOR USED IN CONNECTION WITH GAS PRODUCERS

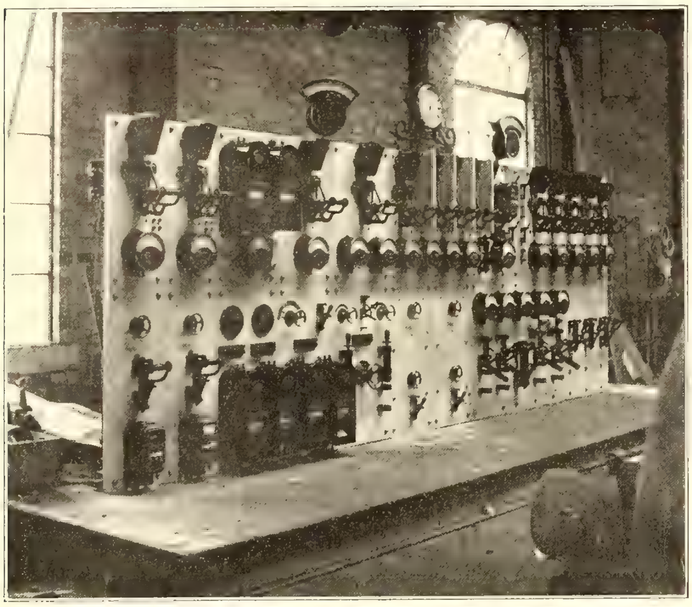


THE POWER GAS GENERATING PLANT OF THE SUNDERLAND DISTRICT TRAMWAYS

The gas from the producers passes straight into the mechanical washer, where it comes into contact with water thrown up in a very fine spray. This removes the dust and at the same time causes a considerable lowering of temperature. Any tar or other impurity that may still remain in the gas is removed by passing it through a specially constructed fan and finally through a sawdust scrubber. The plant is entirely automatic in operation, being fitted with a governor, which, in conjunction with the blower, accurately controls the production of the gas as it is required. The coal is fed into the bunkers by a bucket elevator and screw conveyor capable of dealing with 5 tons of coal per hour. The steam required for the operation of the producer is raised in multitubular boilers heated by the exhaust gases from the gas engines. Besides supplying the necessary moisture in the producers, the steam is used to drive two small single-cylinder engines belted to fans. A supplementary boiler, coal-fired, is provided as a standby and for initially starting the plant. By this plan it becomes unnecessary to use extra coal for steam raising, and a maximum economy is secured.

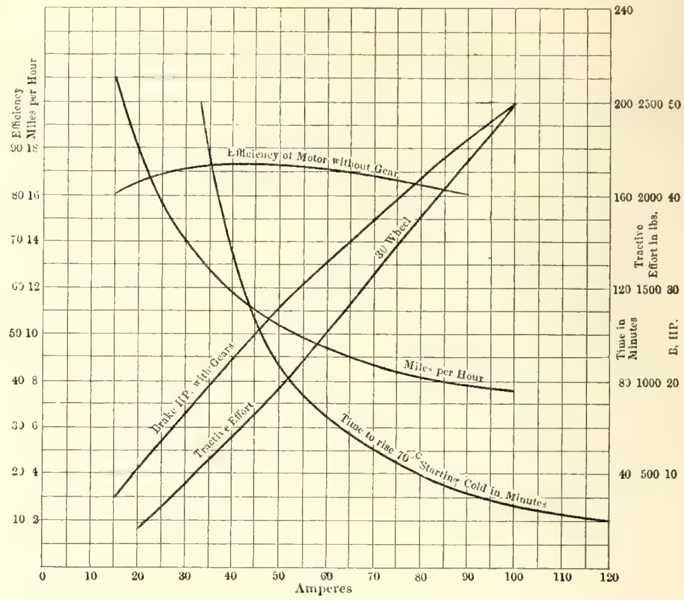
At the side of the yard opposite to the producer stands the power house and office building. The offices of the tramway are on the first floor above the battery room, while the generating plant occupies the other end of the building. The two gas-driven sets are of 210 bhp and 330 bhp capacity, respectively. The engines are of the Crossley Brothers two-cylinder vis-a-vis type, specially constructed for working on producer gas; the larger one has cylinders 25 ins. in diameter x 30-in. stroke, and runs at 150 r. p. m., while the smaller has cylinders 18½ ins. in diameter x 27-in. stroke, running at 190 r. p. m. Both machines are, of course, fitted with heavy fly-wheels to

smooth out the cyclic irregularity common to gas engines, the fly-wheel of the larger engine being 11 ft. in diameter x 26 ins. wide, and of the smaller engine 9 ft. in diameter x 22 ins. wide. Electric ignition is used and duplicate igniters, which can be fed from the dynamos driven by the engine, are supplied as a standby. The larger engine has balanced and water-cooled exhaust valves, and also water-cooled pistons. Both engines have been specially designed to make the wearing parts as easily renewed as possible, with a view to reducing the cost of upkeep. The pistons are made with loose liners, which when worn can be easily withdrawn and renewed at small cost, and the pistons of the in-running cylinder are fitted with slipper guides to take up any wear that may occur. The side shafts of the engines which carry the cams for operating the different valves are driven by steel machine-cut scroll wheels, each engine having an independent side shaft and governor. The engines are started by compressed air, the compressor being driven by a small Crossley gas engine. Hand-barring gear is, of course, provided for each engine.



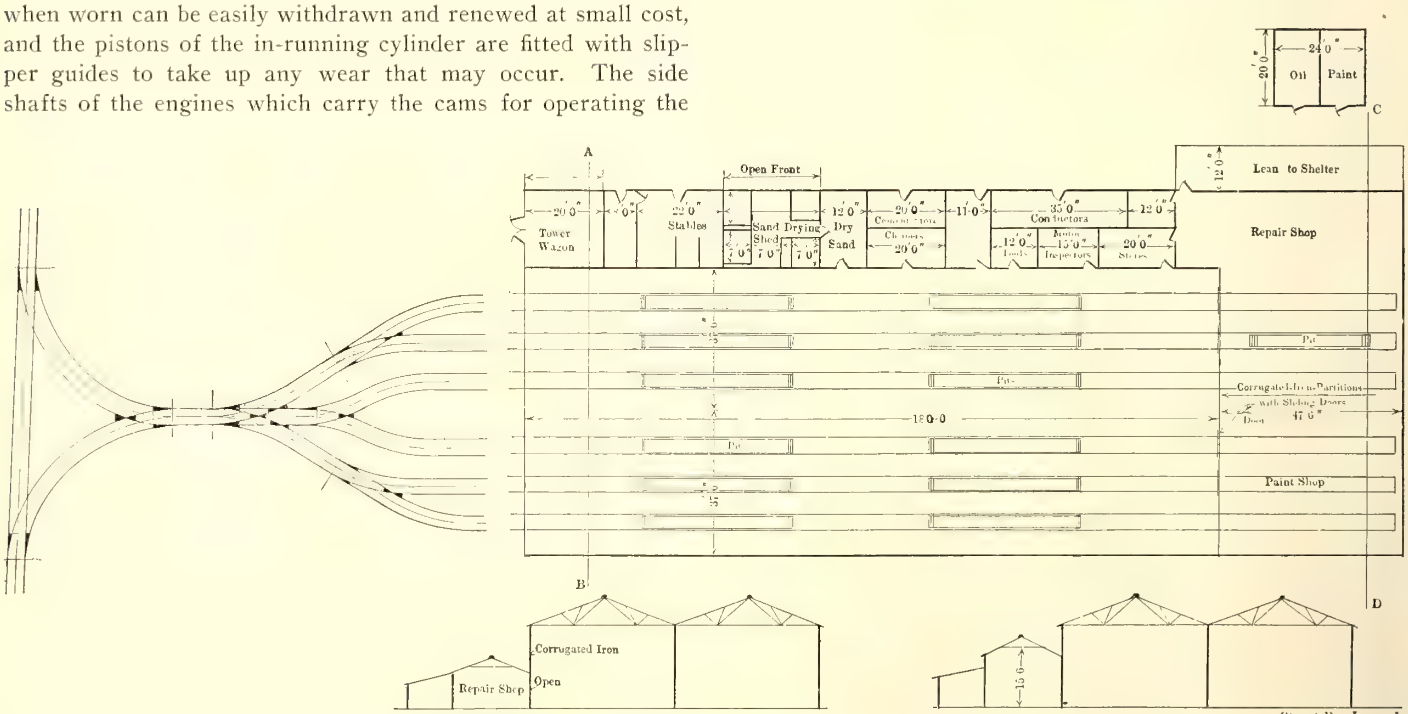
SWITCHBOARD IN POWER STATION OF SUNDERLAND DISTRICT TRAMWAYS

The generators are of the multipolar type, of output corresponding to that of the gas engines by which they are driven. Both machines have six poles, and are compound wound for 500-550 volts. The machines are of very generous proportions for the output required and the overload capacity is very large. The cables between the generator and the switchboard are of the St. Helen's Cable Company's manufacture, consisting of "Dialite" dipped in fireproof compound. The switchboard, which occupies one side of the power house, consists of fourteen panels, arranged as follows: Two generator panels; one standard Board of Trade panel; two automatic reversible battery booster panels; one line booster panel; one track (negative) booster panel; one car shed feeder and negative feeder panel; one station lighting and track return panel, and five positive feeder panels.



PERFORMANCE CURVES OF STANDARD DIRECT-CURRENT MOTOR USED ON THE SUNDERLAND DISTRICT TRAMWAYS

The panels are of Sicilian marble, mounted on an angle steel frame, neither woodwork nor other combustible material being used in the construction. Two of the positive feeder panels are fitted with throw-over switches, so that they can be connected to the line booster if desired. On the top of the switchboard, mounted on swivel brackets, are two illuminated dial



PLAN AND SECTIONS OF SUNDERLAND DISTRICT TRAMWAYS CAR SHED, SHOWING TRACK ARRANGEMENT AND LOCATION OF TOWER WAGON, STABLES AND DRYING SHED, REPAIR SHOP, ETC.

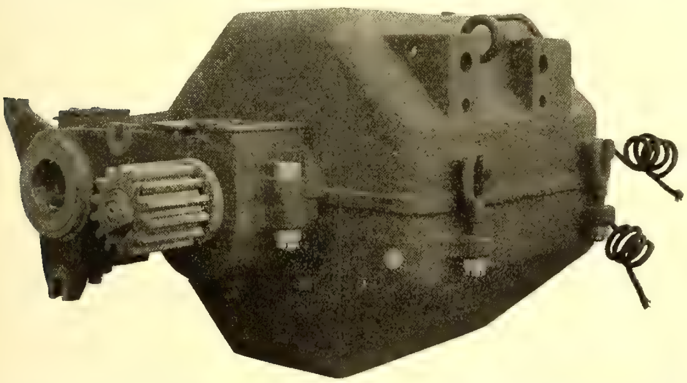
voltmeters for bus-bar and generator volts, respectively, and a non-magnetic clock in neat wrought-iron scroll is fitted in the center. The instruments are of Kelvin & James White's manufacture.

There are in all seven positive feeders, of which two are boosted. The positive booster will give any current from 0 amp. to 430 amps. at any voltage from 5 volts to 35 volts. The motor is shunt wound 500 volts to 550 volts, and direct coupled to the dynamo. There are two negatively boosted feeders, these being worked together by motor-driven set, which is a duplicate of the positive booster. In addition to the above, there is an automatic reversible battery booster working in connection with a battery of 264 Tudor cells, the capacity of the battery being 480 amp.-hours.

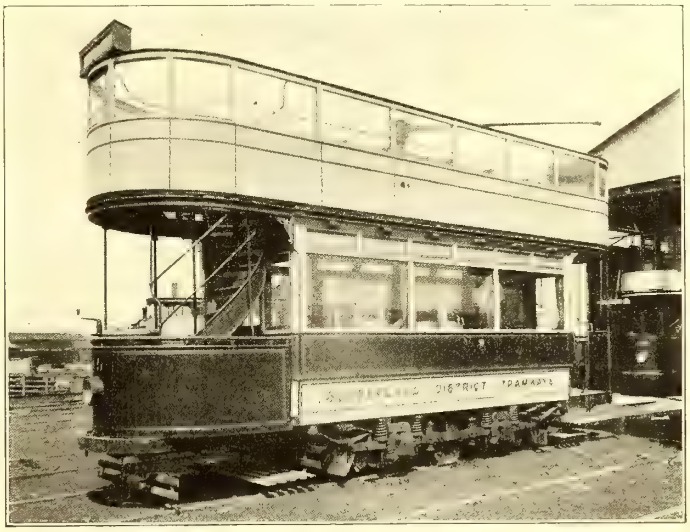
The cables were manufactured by the St. Helen's Cable Company, and are of its "Dialite" insulation, laid in wooden troughing and filled in with bitumen. On the whole system there are seven positive feeding points, the cables for these being .3 sq. in., and two negative feeding points, the cables being .5 sq. in. in section.

The car shed, of which a plan is reproduced, is constructed of corrugated iron on steel framing and combustible elements are entirely absent in its construction. As will be seen, it has six tracks, and the car shed proper has accommodation for five cars on each track, or thirty in all. In addition to this, the repairing and painting shops at the back of the car shed can accommodate another six cars. The rolling doors at the entrance to the car shed were supplied to the order of Bruce Peebles & Company, Ltd., by the Lift & Hoist Company, of Deptford. There are the usual pits on each track in the car shed for examination and repairs.

VIEW SHOWING LOCATION OF GAS PRODUCER PLANT IN FRONT OF THE CAR SHEDS



TYPE OF 35-HP RAILWAY MOTOR USED BY THE SUNDERLAND DISTRICT TRAMWAYS



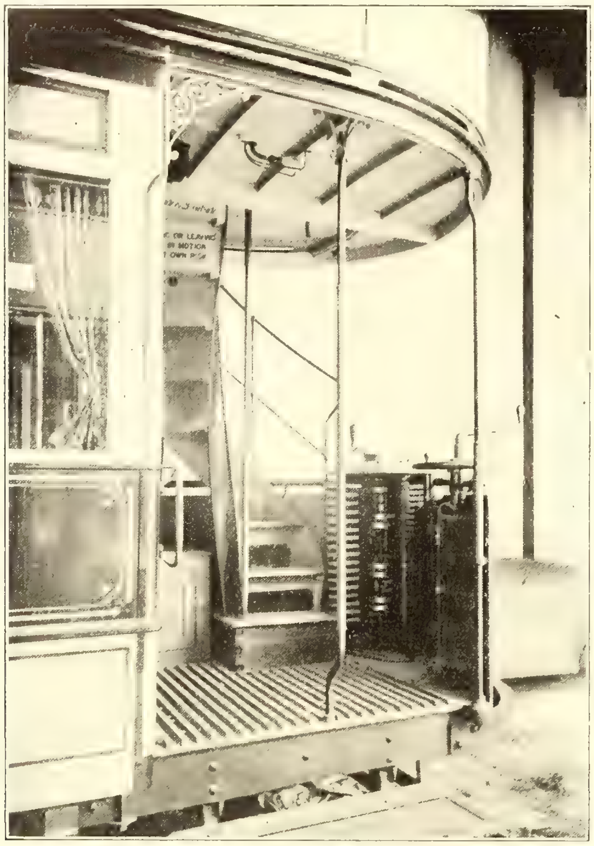
SUNDERLAND DISTRICT TRAMWAY DOUBLE-DECK CAR FITTED WITH WIND SHIELDS

A TRACK SWITCH IN SUNDERLAND, SHOWING ALSO THE TYPE OF OVERHEAD CONSTRUCTION

The cars, which were supplied by the main contractors, are thirty in number. The bodies and trucks were supplied by the Brush Company, the trucks being of its standard type with 6-ft. wheel base, and fitted with hand and slipper brakes. Each car is constructed to carry forty-six passengers, of which twenty-two are inside, and is 6 ft. 6 ins. wide. As will be seen, this car is fitted with wind shields on the upper deck, 4 ft. 6 ins. in height, and of a type which the Brush Company has lately supplied to several other tramway systems.

The electrical equipment of each car consists of two 35-hp Peebles type-S tramway motors and type-B controllers. These motors weigh approximately 1 ton, complete with gears, and are suspended by means of spring-supported suspension bars bolted to the frame of the motor. As will be seen from the performance curves, the motor is of ample power for driving the cars, even considering that there are several very long and heavy grades on the system. Its construction is of the type which has been practically standardized, comprising an exter-

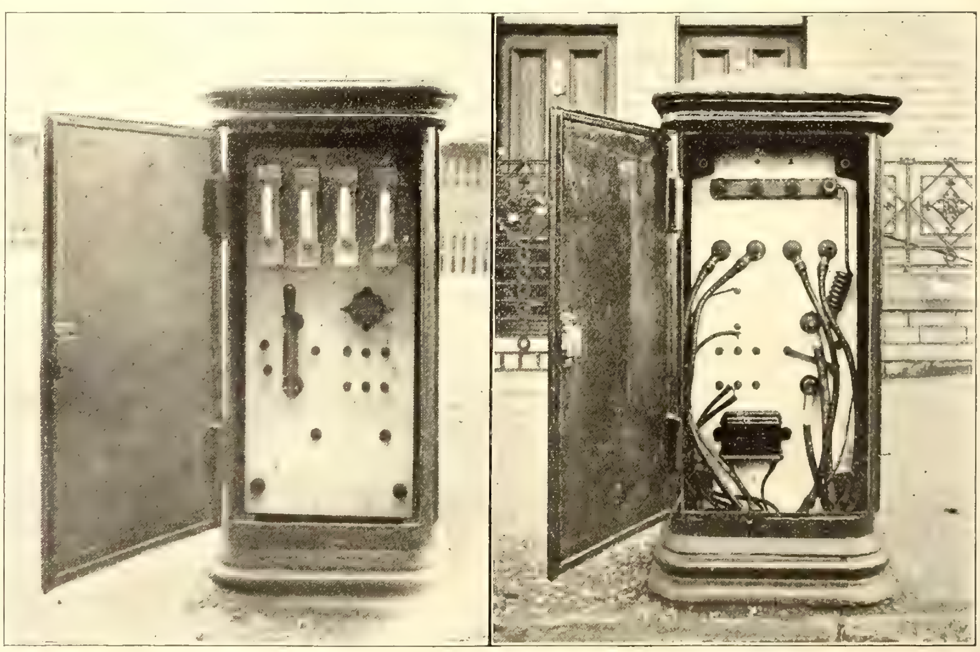
nal steel case horizontally divided and forming a water-tight casing for the entire motor, having four poles projecting inwardly, carrying the series-field coils. The armature has been designed with small fly-wheel action in order to reduce the waste of power which occurs in destroying the momentum of the armature each time the car is pulled up by the brakes. All



ARRANGEMENT OF STAIRWAY TO UPPER DECK OF SUNDERLAND CAR

the usual details of equipment are fitted, including lightning arresters of the Garton type, circuit breakers, fuse blocks and E. P. D. earth indicators. The trolley standards are of Brecknell, Munro & Rogers type. The controllers have five series and four parallel notches for power, and seven notches for the rheostat braking. Special attention has been paid to the rheostatic braking, owing to the liability of a motor to flash over to the case when acting as a generator, and any trouble from this source has been avoided entirely. Hudson-Bowring lifeguards are fitted on all the cars.

The overhead equipment consists of 30-ft. poles of light type used on straight runs, with medium type on all curves and heavy type for anchor poles, the poles being all tested to conform with the requirements of the British standard specification for tubular tramway poles, issued by the Engineering Standard Committee in August, 1904. The trolley wire is of hard-drawn copper No. 0000 S. W. G., the span and pull-off wires being No. 7-14 S. W. G. The insulation throughout is "Dirigo." The telephone and pilot wires are for the greater part of the route carried overhead on insulators.



FRONT AND REAR VIEWS OF PANEL IN JUNCTION BOX

The section boxes are fitted with porcelain switch fuses, quick-break switches, lightning arresters, etc. The accompanying illustrations show the back and front of a standard section box, from which will be seen the arrangement of the incoming feeders and the leads to the overhead wire and lightning arresters, fuses, etc.

R. D. McCarter, who is well known as manager of the Bath Tramway system, is acting as general manager of the Sunderland District Tramways. For the electrical part of the work the consulting engineers were Harper Brothers and Handcock & Dykes, both of London. David Balfour & Son, of Cathedral Buildings, Newcastle-on-Tyne, acted in a similar capacity as regards the civil engineering work.

A CASE OF MISTAKEN IDENTITY

A curious incident, in which one of the starters of the Boston Elevated Railway Company figured prominently, occurred during President Roosevelt's recent visit to Cambridge, Mass. As the presidential party was passing the transfer point where the starter is stationed it naturally occurred to the latter to salute the Chief Executive, and he did so, raising his hand to his cap. Unfortunately, the starter's hand carried a transfer punch, which gleamed in the evening light like a revolver, and the moment the salute was given the mounted sleuths of the Secret Service gave chase and attempted to ride down the astonished street railway man. A moment's explanation cleared the atmosphere, and the procession wended its way rejoicing. Question: On whom was the joke?

THE ELECTRIC RAILWAY IN ROME, ITALY

The ancient city of Rome is enjoying a considerable growth in its rapid transit facilities, the present lines aggregating about 30 miles. The city is circular in shape and has an extreme diameter of 3 miles. Two suburban lines are now nearing completion, one of which will run through the city to the Alban Hills and the other to Civita Castellana, each about 20 miles long. The power for operating both the city and suburban railways is obtained from a hydro-electric plant located at the Tivoli waterfall, near Rome. The overhead trolley system is standard throughout. The number of passengers carried on any one year on the city lines exceeds 25,000,000; the number of cars is about 150, and over 1000 men are employed.

PROCEEDINGS OF THE LAKE GEORGE CONVENTION

In the last issue were published the proceedings for the first day of the twenty-third annual convention of the Street Railway Association of the State of New York, held at Fort William Henry Hotel, Lake George, N. Y., June 27 and 28. The proceedings for the second day are published herewith:

WEDNESDAY'S SESSION

President Allen called the meeting to order at 10:10 o'clock a. m.

The President—I will appoint as the committee on nominations H. M. Robinson, of New York; H. J. Clark, of Syracuse, and J. E. Stephenson, of Buffalo, who will report nominations for officers for the ensuing year.

UNIFORM STANDARDS FOR EMPLOYEES

Dr. F. H. Peck then read a paper on "Uniform Standards of Examination of Railway Employees." This paper was published in the issue of the Street Railway Journal for July 1.

Dr J. J. Higgins, of the New York City Railway Company—In outlining the examination made of applicants for employment by the New York City Railway Company I should describe them substantially the same as Dr. Peck has described them. The only thing I have to say in regard to the paper is that in New York where we need so many men, we do not get enough men to permit us to inforce the regulation of perfect eyesight. We find hard work in securing men with perfect vision, and so we pass a man with a fraction of vision of 15-20 for new men, and for the old men who have been driving horse cars we pass them at about 12-20. We have a special advantage in New York in our facilities for watching our men, because, after they have been passed as motormen, in two or three months they are re-examined when they become applicants for admission to the benefit society of which I have charge. In this way we are able to keep track of our men all the time; and during the last eight years I have been medical examiner for the road and have also taken care of the men when they are ill.

A feature in the examination of men which Dr. Peck has not spoken of in his paper is the range of vision and also the field of vision. The roads in New York City find side vision of great importance, because most of our accidents come from persons running into the cars, not coming from a distance, but the people who run off the sidewalk and run into the cars, and it is important that a motorman should have good side vision in order to avoid such accidents. If a man is blind in his right or left eye, he cannot see people coming from that side of the street toward the car, so that it is important that a man be able to see on both sides. It is also important that he should not be far-sighted. A man may be able to read correctly at 20-20, but will not be able to read small print at 10 ins. or 12 ins. from him.

In regard to the tests for color blindness, our tests are the same as those described by Dr. Peck. The great difficulty in examinations for color blindness is the stupidity of the men under examination. Men will actually tell you that they do not know what the color green is, although they will match it up all right. Many of the men are very sluggish. Many of the men who apply to us for positions come from the country, and many of them are foreigners, but I cannot say which are the more stupid, the fellows from the country or the foreigners. I sometimes think the country-born natives are greener than the foreigners. You have to use a good deal of discretion in color examination.

In regard to hearing, that is also a very important thing. I think hearing is very necessary, especially ability to hear conversation. The acuteness of hearing in detecting sounds from a watch or tuning fork, is not so important as the ability to hear conversation. It is really remarkable, however, how some of these men become educated to the ring of the bell. We had several years ago a driver on one of the roads in New York who could not hear a word of ordinary conversation. The superintendent told me the man never had an accident; the superintendent did not know that the man was deaf. That fellow became accustomed to the vibration of the ringing of the bell, whether because of the jar of the car through his feet, or how, I cannot say, but he always heard one bell or two bells, yet he could not hear ordinary conversation at 12 ft. or 5 ft. He was practically deaf.

In regard to physical examinations, as to rupture and things of that kind, there are very few men who are perfect—very few indeed. I believe there has been one perfect man discovered, named Ross, in the University of Chicago. There are very few men but have some deformity. In regard to ruptures, no man should run a car without a truss. If he has a good fitting truss he can run a car all right. As for the heart and lungs any man with a bad heart is dangerous. The thing we have difficulty with are the fellows who drink and get up with acute indigestion in the morning. They will collapse in the car, and they are the fellows who are most dangerous of all. The fellows who have ruptures and things of that sort always look after themselves. A lot of men pay me to act as their medical adviser. Of course, it is an advantage to the company to have the company doctor look after the men, but the men are also benefited, because if they are not able to run their cars and their strength gives out I am able to give them tonics and advice through which they can build up their strength. I am, of course, expected to keep the company protected as well as the men themselves. It is for the good of all concerned that the health of the men should be maintained.

One thing I want to say, and that is, that no man under 150 lbs. in weight should be appointed to the front end of a car. Nearly all men weighing from 135 lbs. to 150 lbs. have petered out and want to be changed to the rear end, or something else. As to the age limit, I think that most of these men should be at least 23 or 24 years old. They have reached their maturity at that time, and very few men over 35 years old should be broken in as new motormen. How long they are able to work on the front end of a car depends entirely on their mode of living.

As to re-examination, I think these men should be re-examined every five years, and after all acute diseases and infectious diseases, such as scarlet fever and typhoid fever and things of that kind, there should be a re-examination before they are put on a car. In the way we have it arranged for in New York, it is only a matter of a few seconds to examine them before they are returned to work. One of the troubles we have in New York from eyesight difficulties are the men who have opacity of the corona, which frequently comes from cinders blowing into their eyes, of which there were many cases when the elevated railroads were operated by locomotives. They would get a little cinder from the elevated road and that would practically blind them. It practically puts them out of business, and that is what causes us considerable trouble. The eyesight of the men, after they have worked five years, most of them, remains very good indeed, and there are very few of them thrown down unless they have had some serious illness.

Dr Albert B. Van Vranken, of the Schenectady Railway Company—There are one or two points that I might mention, and one of them is in connection with hearing. You will often find a man whom you believe has poor hearing, but he will simply have some wax in his ears. That is one point we should look after.

In the matter of re-examination I believe every man should be examined at periods of less than five years after he goes on the road. I remember a case we had about two years ago where a man was in our employ and left to go in the employ of a road in the West. He returned to Schenectady and sought a

position again upon our road. He was subject to re-examination, of course. I examined him and found that one eye was practically blind. After telling him there was no possibility of his having employment upon the road, I asked him frankly to tell me what the trouble was. He said he had received a flash two or three months previously, and had had a great deal of trouble with his eye. We are not troubled so much with cinders as we are by eye-flash ills. Many of our men have this flash, and that seems to cause a contraction of the corona of the eye so that they are unable to see objects distinctly—the object will become distorted. If a man is on the front end of a car with an eye that way, and gets a cinder in the other eye, we have a man running the car who is practically blind, and all your safety devices amount to nothing. In reference to the physical health examination, as Dr. Higgins has said, a great many men can run cars who are not perfect men by any means. It is very hard to find perfect men. We should know, however, when a man goes on a car what the trouble with him is, and know all about him. If a man should meet with an accident before entering the service of the company and afterwards he was thrown out of employment, he might seek damages from the road for some trouble that he had received long before he entered the service of the company, and if we knew how his condition was when he entered upon the road then we would be in a position to fight and have some ground to stand on.

In the test for hearing, I believe we should eliminate entirely the sense of sight. The sense of sight and hearing are very closely connected. I generally stand behind a man, and either have a tuning fork or my watch in my hand, and I bring both hands up, with my arms extended full length from either side, and sometimes my watch is in one hand, and sometimes in the other, and sometimes in my pocket. The man being examined will say it is on the right or on the left side, and you can tell very easily if he is trying to cheat you. Another thing is, if you ask a man to put his finger in his ear he may only put it in half way. He may make the motion, but may not actually put his finger in his ear to close off the hearing. I always put my finger in his ear and then bring up the watch or tuning fork on either side, and sometimes it is in my hand and sometimes it is not.

I think the kidneys should be pretty well examined. I find that men who have had scarlet fever in their youth and have a small amount of albumen in their urine, the urine being of low specific gravity, suffer a great deal from backache and headache after they have been on the road for a little while. That is especially true of the men who run the small cars. The large cars do not seem to give them so much jolting. The heart, of course, should be examined. I think a man with an enlarged heart, or a heart in any way defective, should not be allowed to go on either the front or the rear end of a car. The lungs should be in fair condition, but if they are not absolutely normal a man can run a car all right.

In regard to the color test, I think many men are color ignorant. They can match the colors all right, but are unable to name them, or sometimes are very slow in doing so.

I believe if we had a uniform examination for all the street railway men in the State that it would be a great help to all of the roads. If a man for any reason, for family reasons, or what not, wished to change from one part of the State to another, and was examined, say, in Utica, and wanted to go to New York or Schenectady, or some other place, and had passed a proper examination one or two years previously at his former place, he could go to the next place and stand in the same relation as an old employee would upon that road in regard to physical examination; and if we had a uniform examination with numbers to indicate the rating, not using the words good, bad or indifferent, but actual numbers, these numbers being an indication of the rating of the employee, the numbers being standard throughout the State, then we could tell exactly his condition at the time of examination.

Albert Eastman, of the Public Service Corporation of New Jersey—Owing to the fact that we are generally short of platform men we have never been able to enforce as strict a physical examination as we would like to do. The hearing and eyesight test are conducted in my own office. I require the men to be at least 150 lbs. in weight. The only physical examination we apply is that based on appearance. We look the men over and if their physical appearance satisfies us they are passed. We have no medical examination and have not been able to adopt one. The age limit is between 21 and 40 years. Even with our apparently lax method of examining applicants, we are usually somewhat short of men. The proposition we have is entirely different from the smaller and suburban properties which most of the gentlemen present represent.

Dr. F. J. Ryan, of the Syracuse Rapid Transit Railway Company—Before discussing the subject of physical examinations, I would deem it advisable that a differentiation be made between the low and high-speed roads. In the case of the high-speed road, the question of velocity with which the car is passing along the highway—40 m.p.h. or 50 m.p.h.—the sameness of space and the uninterruption of the rays of the sun, have some effect on the visionary sense. The eye strain is greater than it is for a motorman who is running a car in the urban service, with the direct rays of the sun interrupted by the buildings, trees, etc., together with the fact that he is stopping here and there to let passengers off and let them on, and that he is busy escaping by an inch or two the unmindful pedestrian or the head-bent truck driver. The eye-strain is not so great in this case, but it requires more judgment than it does absolutely perfect vision.

Then, again, the color test should be more stringent in the high-speed roads than the low-speed roads, because of the necessity of observing color signals at night. In the urban service we do not use many lights, possibly one or two, whereas, in the high-speed roads several are used. As regards the hearing, I agree with the mode of examination outlined in the paper.

The examination of the lungs is quite important. It has been my experience within the last year or two to have been called suddenly to take care of one of our conductors who had fallen to the platform of our car stricken with pulmonary hemorrhage. Fortunately, the signal was given by a passenger to stop the car, the motorman stopped the car, and the conductor was removed to a place of safety and taken care of by a physician, and thus an accident was averted in that case. Had that occurred to a motorman when he was descending a hill, or at any moment of emergency, while the car was going at high speed, you can see the danger attending such an incident, possibly the loss of lives, or, at any rate, a serious accident.

With regard to the examination for hernia, it has been my experience within the last year or two to have been called to take care of two conductors whose ruptures suddenly came down, felled them to the floor and incapacitated them absolutely. Now, if such a thing should occur to a motorman in the moment of emergency, you can see the hazardous position the passengers would be placed in. The question of deformity must be left absolutely to the examining surgeon. It does not make much difference as regards service whether a motorman or conductor is minus a toe or a finger, but if any important member of the body is incapacitated then that precludes his admission as either a motorman or conductor.

The question of the use of alcohol is very important and should be investigated. I do not mean by that that I require every motorman or conductor to be a teetotaler; but I do, during the course of my examination, look very thoroughly for

any evidence of inebriety. Its presence, without any hesitation, precludes the examination. The question of cigarette smoking is also of some importance. In the single man more especially it leads into other practices, which in the end do not fit him for good service. I do not say that I can stop absolutely the smoking of cigarettes on the part of motormen or conductors, but I spend a minute or two during the examination in making inquiries and trying to bring out points which will best fit him for good service. To my mind the most important part of the whole examination has been omitted—that of intelligence. You might say, how are you going to estimate the intelligence of the applicant? In answer to that I say find out who answered the questions on the application blank handed to the applicant. Was it his wife, brother, sister, father or mother? Having signed his own name in the presence of the examiner, you can soon find out who answered the questions. It has been my experience oftentimes to see a very poor handwriting in the signature, with superior penmanship on the application blank. In such cases it immediately must occur to the examiner that some one else besides the applicant answered the questions. I do not mean that we need college graduates for motormen and conductors, but I do mean that if the damages and injuries account of your railroads is to be made smaller instead of greater, you must pay some attention to the intelligence of your motormen and conductors. If you do not believe me, refer this matter to the claim department. They will tell you that if there is anything that facilitates their work it is a complete report of each accident that occurs—a complete detailed statement of the occurrence, together with a proper recording of the names and addresses of the injured persons and witnesses. If you insist on your motormen and conductors being able to give a good history of an accident, being able to write a legible hand, and being able to read an ordinary newspaper, the ambulance chasers of this great Empire State will not be able to build mansions out of the moneys which they so often unjustly secure from our street railroad companies.

The President—There is no subject that has been considered more seriously by the members of the American Railway Association than the question of the standard examination of employees. In the published proceedings of the meeting of the American Railway Association, held at Philadelphia last October, out of a total of 150 pages, there are not less than ten or twelve pages which are devoted to the report of the committee on standard requirements for medical examination and re-examination of employees. I feel that this association could take no wiser step than at this convention to appoint a committee from its members to design blanks and to outline some form of examination which shall become the standard on all the roads throughout the State. You all know how much we appreciated the work which was done by the committee on rules, and I believe we could have the same results from a committee on standard examination of employees.

We have had this able paper by Dr. Peck and discussion of it by various physicians and surgeons, and I would like some discussion of the paper by the operating men.

R. E. Danforth, of Rochester—The papers and discussion describe in a general way the method followed in Rochester in examining applicants for employment. We have taken up the physical examination largely because of the fact that our employees are organized in a benefit association. The applicant for membership in this association must pass a physical examination, and we use the same examination for the purposes of the employees of the company.

T. W. Wilson, of Buffalo—I would say that in Buffalo we follow very closely the very excellent lines of examination laid down by Dr. Peck in his paper. We also have a benefit association, and nearly every train man who enters our service is a member of that association, so that our physical examination has to be very strict. The death benefit is $100, and we pay special attention to the examination of the eyes and the kidneys.

E. S. Fassett, of Albany—The methods pursued by the United Traction Company practically follow the suggestions of the talk that has gone before. The principal things we look to is the eye and the grasp, especially in the case of motormen. The standard for the eye must be not less than 10-15 and the grasp not less than 75 lbs. with each hand. The division superintendent is always present when the applicant fills out the application blank, so that there is no chance for anyone else to fill out the application, and the blank itself is gotten up with an idea of getting some knowledge of the man's intelligence, judging by his answers to the questions and his handwriting, spelling, etc. That is all taken into consideration. We have followed this method for many years and have not found any reason for changing it.

W. H. Pouch, of Newburgh—We have a method very similar to that which has been described here. We have had one or two cases of re-examination, in which it was discovered that the eyesight of the men had failed them to a certain extent.

It was then moved and seconded that a committee of five be appointed to recommend a standard system of blanks for the examination and re-examination of employees on street railways in this State, as well as the standard requirements of examination and re-examination of such employees. The motion was carried.

H. J. Clark, of Auburn—We follow practically the same method as has been described here. There is just one point I will refer to, and that is the re-examination every five years. An employee may have a serious illness in the meantime. We compel an employee who is off duty, as he says, owing to sickness, to give to the division superintendent a certificate from the attending physician, stating the nature of the illness and the extent of it. This is turned over to the medical department, and if the examining physician deems it necessary a re-examination takes place at that time.

W. E. Harrington—We have been practicing the Snellen test card and skein test for years. Insofar as the medical examination is concerned, the physical condition of the applicant, we depend entirely upon the physical appearance of the applicant. Ordinarily, we were so situated that we found it necessary to take some applicants we possibly would not have taken if we were not so much in need of men. The atmosphere of Southern New Jersey seems to affect the men to such an extent that they are continually changing. In one year we changed our entire force, insofar as numbers were concerned, 100 per cent and 10 per cent over in one year, so that we could not be very exacting as regards the physical examination. Insofar as the age is concerned we limit the age on one side to 21 years, and would seldom exceed 40 years. The applicant filled out his application sheet in the presence of the superintendent. That would overcome the point raised by Dr. Ryan. We found that method quite necessary, as many applicants would have other persons fill out their application blanks. I believe, however, that the practice of having a physician to supervise the examination of applicants is quite necessary and should be more generally practiced.

Mr. Fairchild—The question has been asked if any of the roads take on men as motormen and conductors who wear glasses. Do they accept a man who has a slight visual defect, which can be remedied by the use of glasses?

Dr. Peck—It is our practice in regard to the use of glasses not to accept at all motormen who are required to correct vision by the use of glasses. As I stated in the paper, we accept conductors with a vision of 20-30, which is practically two-thirds the normal vision, whose vision is susceptible of being practically corrected by the use of glasses. It seems to me that with conductors it is not so important that they have absolutely perfect vision. In closing this discussion I would

say that living in "Pent-up Utica," a provincial town, we are perhaps rather fortunate in the class of men who apply to us for employment. Most of them are young, healthy farmers, and a great majority of these are between the ages of 20 and 30 years, ages at which they have arrived at sufficient maturity to be placed in responsible positions, and ages at which no decadence of their normal powers has begun. I should think it would be very wise in formulating rules for examination to limit candidates between the ages of 20 and 30 years. We do not claim to have sculptures' models apply for our positions, but we do require an examination as rigid practically in its details as we physicians make in examining candidates for life insurance. We require that they shall be strong, healthy men, that all of their faculties shall be practically normal, that they shall be in the possession of good physical development in every way, muscular and otherwise, and it seems to me that it is extremely important that these men shall show, as Dr. Ryan has suggested, evidences of good general intelligence. Our applications are made out in the presence of the superintendent of the road, and then the examinations are conducted by me at my office, and the signature of the applicant is affixed to the blank in my presence. Of course, that is the only sample which I have of his handwriting, but during the examination I am particular to see whether he is bright and prompt in his answers. A man who is alert and quick in answering questions, and who does not get particularly rattled by the examination, is the man who is especially adapted to the work required at the front end of a motor car.

In regard to some physical defects, we accept men with slight defects other than those of vision and hearing. I think a man with a small hernia, which is supported by a well-fitting truss, is perfectly capable of going on the road, either the front or back end of the car. The man with a slight varicocele, or slight varicose veins, is not incapacitated for his work. The man with a slight hypertrophy of the heart, that is, overgrowth of the heart, is not incapacitated for his work. The majority of men who have worked very hard, who have done great physical effort of any kind, have a slight enlargement of the heart. The heart is a muscular organ, and by extraordinary physical effort the heart builds up to a somewhat extra size to compensate for the over-exertion of its possessor, and a slight hyperthrophy of the heart, overgrowth of the heart, is not material. If I find any organic lesion of the heart, by that I mean valvular lesion of the heart, leakage or obstruction, the man is not accepted. If I find a slight overgrowth of the muscular part of the heart without any change of the arteries or an iritable condition of the pulse, I accept him for either end of the car, and I think his life expectancy is practically as good as the man who has not a slight overgrowth of the heart so long as he lives a comparatively even out-of-door life.

We make it a point to look for evidences of inebriety. A man who comes with bleared eyes, a flushed countenance and red nose, we do not accept. We do not require that our applicants shall be total abstainers, but we do require that they shall be sober men, bearing evidences of intelligence and a fairly perfect physical development, and that they shall be physically equipped for the work.

In regard to obstructing the hearing during examination, I think that an examiner who is accustomed to testing the hearing can practically always tell whether a man is honestly excluding the sound from his ear. Most of the candidates whom I examine do not appreciate that I am testing their hearing when I ask them to put one finger in one of their ears. I continue this examination of the hearing as if it were a part of the test of the eyesight, and most of them will readily insert the forefinger well into the ear. If they do not do it I can readily see if they are obstructing the ear or not and instruct them to hold the finger forcibly in the ear. As a usual thing they think it is merely a continuation of the visual test, and do not understand I am testing the hearing until it is all over.

There is one other thing. I do not know whether it is practiced by many of the roads, but I think the schematic diagrams of the skeleton and outline of the figure on the back of our blanks are a good deal of value. We use this diagram to make a record of any existing defects in the applicant. We mark down the presence of slight varicose veins or of scars from any prior injury, so that we have a record of these injuries in our office, and if any man is in an accident he cannot subsequently bring claim that these scars are due to this accident.

Dr. Ryan—I think there has been an omission in this discussion as no special reference has been made to the height and weight of the motormen and conductors. Personally, I would prefer the motorman to be between 150 and 200 lbs. in weight, and his height to be between 5 ft. 7 ins. and 6 ft. For a conductor, I prefer a weight of between 135 lbs. and 175 lbs., with a height between 5 ft. 7 ins. and 5 ft. 11 ins. I raise the point of the difference between the heights of conductor and motorman, because it is easier for a motorman who is, say, 5 ft. 11 ins. or 6 ft. in height, to bend over and put more strength on the brake than it is for the low-sized motorman of 5 ft. 6 ins. The shorter man cannot get the strength out of himself. As far as the conductor is concerned, I dislike very much to see a conductor of 5 ft. 6 ins. passing through the car jumping for the bell rope, or a conductor of 6 ft. 1 in. trying to reach around in an ungainly way in the car.

J. C. Rothery, of Buffalo—In connection with this subject it appears to me there has been no consideration given to the various types of electric apparatus and the diversified conditions under which they are operated. Take a high-speed interurban road, if a motorman is bright and intelligent, and he only weighed 115 lbs., with the mechanical and electrical applances with which he operates his car, he would be satisfactory; and he would probably be more capable of operating the car than if he were 175 lbs. or 190 lbs. in weight and not as intelligent. Physical strength is not what is required in that case. In a densely populated city, where the motorman is required to use a hand-brake, strength is one of the first requisites. In a small town the qualifications might be between the two. Now, one standard type of examination to suit all of these diversified interests, it appears to me, would hardly be sufficient. I think there should be separate qualifications for urban roads, for interurban roads, and for high-speed roads. Would it not be well for the committee to bear that particular point in mind while they are considering the subject and draw up standard qualifications for each of these roads.

Mr. Clark—I will take issue with the gentleman on the light-weight man as a motorman for an interurban car. We operate a 34-ton car and sometimes, not often, the air brakes are out of order, and it is necessary to control the car with the hand-brake. No man of 135 lbs. could stop the car with any safety.

Mr. Rothery—I do not think there are 5 per cent of the cars operated in the State of New York to-day with air that can be stopped with a hand-brake within any reasonable distance. I think the operating men here will vouch for that. I find it is almost impossible to keep the hand-brake equipment in first-class working order at all times in a car on which air brakes are used.

Dr. Van Vranken—We never put new men on interurban cars. They always have to go through a preliminary service, a probationary service, on city cars. On our road it takes a man about two years before he is able to reach the dignity of running an interurban car. As far as the hand-brakes are concerned, I notice that our cars are always operated to stop by the hand-brake in going down hill, so that the hand-brakes in Schenectady are always kept in good order.

Mr. Fassett—We have exactly the same rule. On all cars

operated with the air brake the rule is that the last stop of the car must be made with the hand-brake—the last stop at each end of the line. We do not turn the cars. This shows that the brakes on both ends of the cars are in operating condition. The same rule applies to the large interurban cars that come onto our system from other roads, the Schenectady roads, for instance, where 40-ton cars are operated on a 9 per cent grade. For half a mile from the end of the line the motorman is obliged to use the hand-brake entirely. We have that rule so as to be absolutely certain that the hand-brake is all right, and the air brake can be used as an emergency brake, of course, if anything happens to the hand-brake. It seems to me all roads which operate with air-brake cars should have the hand-brake used regularly at certain times, so as to be sure it is all right and ready to be used when occasion requires.

The President—I think Mr. Rothery's suggestion is a good one, that the committee should take into consideration in outlining the requirements for the blank and the examinations the fact that the roads on which these blanks are to be used are not all interurban roads, but that there is a variety of roads to be considered and that a blank should be designed that would be suitable for each road, with certain modifications, as the conditions surrounding the road might require.

We will now return to the discussion of the most suitable car for city and interurban service.

CARS FOR CITY AND INTERURBAN SERVICE

E. S. Fassett, of Albany—I presume that I will be very much in the minority in my views and ideas of cars for city service, but I believe thoroughly the car for city service should not be over 20 ft. long and should be a single-truck car. Take, for instance, the road which I have the honor to represent in part. We can handle more people with that type of car than we can with any other. Our runs are short, comparatively, and we find in using the big car that every time a big car stops, in times of heavy travel, such as on ball game days and circus days, and it begins to unload its passengers, or stops to take on passengers, five or six of the short cars come up and lay behind the big car. With a short car the passengers are loaded and unloaded rapidly and easily, and I think when you get the number of people on a car that can be taken on a short car you come pretty near to taxing the intelligence of a conductor to handle the car properly, to collect his fares and to look after his passengers.

So far as interurban service is concerned, of course, that is an entirely different proposition, but for purely city service I thoroughly believe in a short car, single-truck, 20-ft. body.

The President—You evidently believe, Mr. Fassett, there is a limit to the number of passengers a conductor can handle. Will you give us your judgment on that point, as to the number of passengers a conductor can handle and handle safely?

Mr. Fassett—As to the number of people carried on a 20-ft. car, I think about sixty-five is the limit—anything beyond that is an overload for it, and I do not think that a conductor can take care of more than sixty-five passengers on such a car, get their fares and see that they properly get on and get off the car.

R. E. Danforth, of Rochester—I do not think that Mr. Fassett is entirely wrong. There are many places where, I think you will all agree, the single-truck, 20-ft. or 21-ft. body car is the most economical car for short hauls, short-distance riders, short lines and on lines where the traffic is fairly uniform during the day. I do not know about the conditions in Albany, but I do know that in Rochester, as well as in Buffalo, the majority of the cars in use must be over 20 ft. long, and those best suited to the service in those cities are cars having bodies of 28 ft. or 30 ft. But in both cities I have named some single-truck cars can be run to advantage. In our own city we operate forty or fifty single-truck cars on regular service, but find that on heavy lines, during the tripper service, we can make more money with the long cars. We have adopted as a standard length of car one having a body 28 ft. over all and with long platforms and with wide doors, and we permit passengers to leave the car by way of the front door. I believe in so doing we overcome the objection Mr. Fassett has to the use of the long car. At junction points we find that by the time the last passenger to leave is off the front platform, the last passenger to board the car is in the car by way of the rear platform. We try to enforce the rule of out the front door and in the rear door at all junction points. Without this rule we would lose considerable time in service, as Mr. Fassett indicated.

In the equipment of the car, local conditions govern very largely. We have found it impossible to operate with economy a double-truck car with two motors, because of the heavy snowfalls during winter, and we, therefore, adopted four motors, having ample capacity to operate the car without overload during the winter. We find that the double-truck cars now equipped with two motors per car run behind time during the winter, and, in fact, are usually pulled out of service and used only for trippers during the winter. The double-truck car has an added advantage in our climate in the fact that the service is maintained during snowstorms when it would be impossible to maintain the service with the average single-truck car. The added traction obtained from eight driving wheels keeps the car on time.

Concerning the seating arrangement, we are limited in the width of the car by local conditions to a body not over 8 ft. wide over all. This makes it well-nigh impossible to operate a strictly cross-seat car on lines having short riders and heavy traffic. We, therefore, adopted for such lines a compromise between the longitudinal-seat car and the cross-seat car, by having the cross-seats half-way down one side of the car with a longitudinal seat opposite, and then reversing the plan for the remaining half of the car. This gives a wide aisle, almost as wide as we obtain with the average longitudinal-seat car, with the advantage of seating half the passengers the popular way, with cross-seats. We find in summer that these cars are almost as popular as our semi-convertible cars with all cross-seats.

I note in Mr. Wilson's paper that he has referred to the practical inability to use the standard open car in summer. Our conditions are similar to those in Buffalo, and we find the most profitable car for summer service is one of the semi-convertible type.

QUESTION BOX

Mr. Fairchild, the editor of the Question Box, then took up the mechanical department of the Question Box.

Mr. Fairchild—The first question under the mechanical head is Question No. 20, relating to fireproofing cars. One of the most interesting suggestions made under this heading is the proposition advanced by George Gibbs, of New York City, as to the possibility of the all-steel car for ordinary surface electric railway service.

W. H. Collins, of the Fonda, Johnstown & Gloversville Railroad—Our usual practice on our large cars with steel underframing is that we carry all of our cables through iron pipes, and we use pretty much the same method as described in the Question Box by Mr. Baukat, of the Schenectady road. All of our cables are covered with rubber pipe insulation, and in putting up our rheostats we pay particular attention to using fireproof material, such as asbestos board, and in that manner we eliminate, practically, all trouble from fires. In fact, I cannot recall that we have ever had a burn-out or fire since I have been connected with the system.

H. A. Johnson, of Camden—I have given some attention to the subject of fire-proofing of cars. A meeting was held in New York by the Fire Underwriters to determine means for preventing fires on cars. The discussion of the metal car was

very thorough, but with the present method of wiring it was deemed at that time that fires would rather be enhanced than prevented by putting in metal floors and the present type of wiring. The general practice in street railways to-day in the smaller towns, apparently, is to use the old-fashion hose and cable. I believe, however, that it is now a proper time in the ordering of new equipment to follow the method which has just been described by the preceding speaker.

D. F. Carver, of Rochester—Personally, my observation has been that the cause of fires in the car house at night, when we put the equipment in the car house, has been from resistance. The car switchers put the brake on without shoving the controller entirely off. I know of a half dozen cases where fires started from resistance, because the car shifter at the car house had left the controller on all night. I have seen a good many cases where the leads caught fire from the motor, but I have never seen any worse fire. As to the use of the all-metal car, I think the success they are having with it in the subway has demonstrated that it is perfectly feasible, and more than feasible, for that heavy type of car. I understand the New York City Railway Company has almost completed a car of the all-steel type. My personal experience with the all-steel type amounts to practically nothing.

T. W. Wilson, of Buffalo—I think the principal thing is first to eliminate the cause of fires, because nearly all fires in cars arise from defective wiring. This being so, had we not better follow the standard rules of the Underwriters' Association.

In an interurban car I think it would be possible to have all cables in pipe conduits, and that will prevent entirely any fire starting from that cause. I saw a new car being designed for a Chicago road in a manufacturer's shop a week ago, in which that method was used, and all the cables and wires were run in pipe conduits.

J. G. Baukat, of Schenectady—We have adopted the same method Mr. Wilson has outlined. In the first place, I might say that we have taken another step which may be out of the ordinary. We use all flexible cable instead of solid wire, as has been the custom; that is used throughout. This flexible cable has extra heavy insulation. We found a great deal of trouble has come from the chafing of the cables. Then we lead all our cables through iron pipes, but before the cable enters the pipe we have a special mouth piece attached, which we designed ourselves, on the same lines as the mouth piece which the Manhattan Elevated Railway uses for its cars. Before the cable enters the pipe it goes through this rubber mouth piece, which makes the pipe waterproof, besides preventing chafing. When the cable comes out of the pipe the same precaution is taken again. By using iron pipe and rubber bushing throughout we have not experienced any trouble. We wired up the heaviest type of cars we have on our Ballston line in this manner, and we have not had any trouble from fire.

J. C. Calisch, of the General Electric Company—The Chicago car which Mr. Wilson referred to will be equipped with four 40-hp motors, and the question of wiring has been given very considerable attention. Where the wire leaves the trolley base on the roof of the car it is carried in a conduit to the corner post and from that point it will also be carried in a conduit to the point where it goes below the car. The main circuit will have in series a fuse with the circuit breaker, and the control and resistance cables below the car will be carried in separate conduits, that is, two for the control tables and one for the resistance. Where the taps are brought out for the resistance, and the motors' bell-mouths will be provided, and each motor will have a junction box, the idea being that the four leads from the motor can be readily disconnected, whereas, the controller cable, and resistance likewise, will never have to be touched except when general repairs are to be made. In this way, it is thought, absolute fire-proofiing will be secured.

George G. Blakeslee, of the Albany & Hudson Railroad—We operate the Albany & Hudson Railroad on the third-rail system. We recently lost a car from fire which occurred through a short circuit on the third-rail cable. We were never quite sure whether the cable picked up a piece of wire and connected things up, or what did happen. It is a subject which is very interesting to me. I would like to get what information I can from people who are running with the third-rail system. I have not anything to offer except to say that I shall follow out the suggestions and practice which have been mentioned in regard to fire-proofing. I think that is very important, and in reconstructing cars it is what we will follow. Our trouble is with our third-rail shoe, which has to be connected with a flexible cable long enough to allow us to make short curves. In other words, when the car moves around, the shoe has got to move away out in order to let us get around curves. The cable is bound to be dangling around and chafing and making trouble.

R. P. Leavitt, of the Albany & Hudson Railroad Company—I will say that this cable which connects to the third-rail shoe has to be long enough to permit the shoe to be tipped up in city streets, and that adds another feature to the shoe which makes it hard to take care of. I note that one feature mentioned by one of the gentlemen was a fuse in series with a circuit breaker. If that is used each fuse should be as near as possible either to the third rail or the trolley tap, so that there will be as little wire as possible to be protected by the same device.

W. J. Harvie, of the Utica & Mohawk Valley Railway—In regard to fire-proofing cars, I do not doubt that on new and heavy equipment there should be some extraordinary precautions taken. In a heavy express car we have just built we have the cables encased in iron pipe and also in oak mouldings. It is a question in my mind whether the iron pipe is preferable to a good wood moulding.

In regard to the cars which we already have in service on city and suburban work, it does not appeal to me that the extra expenditure for special fire-proofing is necessary, but that ordinary care and proper taping and hosing up of leads ought to take care of the trouble in these cars.

With regard to our new express car, we have a Westinghouse unit-switch control on that car. It is equipped with four No. 85 motors, 75-hp each. The control system, as is well known, is operated by air, the air valves being operated by a storage-battery circuit. The car itself is 57 ft. over all, and has a carrying capacity of 20 tons. Our trucks are special trucks made by the J. G. Brill Company for high-speed heavy service. We have run this car a mile in fifty-eight seconds, and thus far the equipment has proven entirely satisfactory. We have had but one case of trouble, which was due to an oversight, probably in the insulation. Our leads, motor wiring, etc., are laid in an oak molding, all four conduits, with a capping to correspond, and the turns are all square turns, and all of our low-voltage leads from the storage battery are in pipes, as I said before. We have no part of the 500-volt circuit in iron pipes.

W. E. Harrington, of Camden—The plan as outlined by Mr. Baukat seems to meet my views on the subject, and it is very clearly set forth on page 73 of the Question Box. As to the all-steel cars for ordinary street railway service being a possible development in the near future, I think that is a matter which can only be determined by practice. It certainly is a very remarkable departure from existing methods. We have our equipments in their present form and we have to take care of them in their present form, and that is the reason for my commenting favorably on the suggestions made by Mr. Baukat.

Mr. Baukat—In connection with wiring of cars and carrying wires in iron pipes, I will mention one thing. We experience quite a little trouble, especially with our heavy cables, in pulling them through the iron pipe, particularly where there are

bends in the pipe, without puncturing the insulation. We did away with that and now use nothing but straight pipes, and instead of having a special fitting for each different size—¾-in., 1-in., 1¼-in. and 1½-in. pipe—we have regular L's only of a larger radius, and they are cast in half and bolted together, so that we simply pull our cables through the straight pipes and clamp on the fittings afterward. I believe the Manhattan Elevated Company adopted that form, and I understand, in a roundabout way, that they have had some trouble with it. We have made it much wider, so as to get more packing between, and in that way we are wiring up our cars much quicker and are absolutely sure of not puncturing our insulation.

H. J. Clark, of the Auburn & Syracuse Railway—Speaking of fires, we take every precaution to prevent fires on our cars. We are now about to adopt extinguishers to prevent the fire disease—that is, to carry one hand extinguisher on each car, which, merely by turning it upside down, is ready for action. Within a week we nearly lost a full car of express matter, owing to the fact that a shipper had sent some explosive substance on our car. It was a package of small percussion caps. The conductor did not know the contents of the package; he dropped it on the floor and the car was set on fire. We happened to be in the city where there was an extinguisher at hand and our men were able to put out the fire instantly.

Mr. Blakeslee—What effect would the fluid in the fire extinguisher have on the electrical equipment?

Mr. Clark—I do not think it would have any more effect than water would have. The contents of the extinguisher are largely made up of water and soda.

Mr. Blakeslee—We found the liquid extinguisher made us a good deal of trouble when we allowed the men to use it on any of the apparatus, and we have adopted the powder extinguisher for the extinguishing of fires on our cars, and use a liquid extinguisher in case of other fires.

Mr. Fairchild—All the subway cars in New York are equipped with a fire extinguisher. I believe these extinguishers contain powder instead of liquid.

We will now take up the subject of bearing lubrication, covered in questions No. 21 and 22. This is a subject in which the mechanical men are all interested as well as the managers.

Before entering upon the discussion, I would ask Mr. Baukat if he will give a little longer description of the oil cup he is using and which is referred to on page 80 of the Question Box.

Mr. Baukat—In regard to oil cups, I am sorry to say I do not think we have the ideal cup, although it does our business. I am still in search of the ideal cup. Up to two years ago we used grease entirely for lubrication, and had all kinds of trouble. In the first place it is next to impossible to get the men who are doing the greasing to be clean, and as a rule considerable dirt is carried into the bearings with the grease. We had to make a quick change, and we got up a cup of our own, a cast-iron box with a pipe in the center, as you will see in the sketch, and then we have strands of the very best wool we can find to filter the oil and at the same time carry it down to the bearings. We have to change our oil three times a year. By experimenting quite a while we found by changing the oil twice or three times a year that we accomplish good results. The oil is affected by the temperature. Sometimes the oil would not feed; it got choked so that it would not flow, until the motor got heated up, and then it would feed down to the bearings. Suppose the oil is heavy enough to-day, and to-morrow should be a much warmer day, it will feed just the same.

The city authorities are complaining to us about the dirty streets. The other night I stepped into quite a large puddle of oil. The question is, Is there any ideal cup that would take care of thin oil? That is the thing I would like to hear discussed.

J. C. Rothery, of Buffalo—We have gone into oil lubrication and have tried it both in armature and axle bearings during the past year. Our experience, particularly in our high-speed interurban cars, has been very strongly in favor of oil. In the city cars, those operated on my division, where the speed is low, the improvement has not been so noticeable. The grease gave very good service, but the oil is an improvement upon the grease, and on the high-speed cars particularly we find the oil is a decided improvement over the grease, both economically and from every other viewpoint, hot bearings, etc. We frequently were troubled with hot bearings on account of the Buffalo & Niagara Falls line operating along the highway a long distance and the apparatus on the car being susceptible to the dust. Since we have used the oil we have had but very little trouble and are well satisfied with the result of our experience.

W. W. Cole, of Elmira—I think we are doing as nearly all the other roads are, accepting the journal boxes as the manufacturers send them out on the various classes of apparatus.

W. H. Collins, of the Fonda, Johnstown & Gloversville Railway—We have abandoned the use of grease entirely for both motor and axle bearings. We find by doing so that we have accomplished a remarkable saving in the matter of lubrication, as well as lengthening the life of our bearings to a great extent. We have been using a patent oil cup, with a special compound manufactured for use with that cup, very successfully. The only criticism we have to make on the cup is the price of the compound. I think if we could adopt the same cup and use a cheaper grade of oil, it would practically solve the lubrication question. We use oil entirely on all of our cars, both city, suburban and interurban cars, and I would not like to go back to the use of grease. On our large type of cars we use the GE 73 motor, which, as you gentlemen perhaps all know, has a sufficient oil space to permit of packing the journals with oil and waste similar to the way it it packed in the journal box of the car. We now have bearings running on these equipments with approximately 100,000 miles to their credit without changing the bearings, and we have had occasion to remove the armatures twice during that time, and the armature bearings are so little worn that we can hardly caliper the wear. I would like to ask a question of the gentleman who just preceded me, as to what kind of an oil cup he is using with his oil in the different types of motors.

Mr. Rothery—It is a simple oil cup with gravitation feed, which is adjusted by a screw in the motor bearings.

Mr. Fairchild—Is this the one you got from the manufacturers, with the car equipment?

Mr. Rothery—The cup we got from the manufacturers had the wick feed.

Mr. Fairchild—What is the objection to the wick feed?

Mr. Rothery—You have no way of stopping the flow of oil when the car is stopped. The feed is not automatic.

Mr. Fairchild—Are you working on anything in the way of an improvement on your present cup?

Mr. Rothery—No, it has been very satisfactory; but if anything which is better is presented to us we will be glad to give it a trial, but up to the present time the cup which we have now in use has been perfectly satisfactory to us.

Mr. Fairchild—Has anyone any comparative data on the lubricating item?

Mr. Baukat—Before we began to use oil it used to cost us for lubrication about $4,800 a year. We have got it down now to where it costs us about $1,800 a year. I guess these are about the best figures one can get as the total saving per year. I have not seen any figures which are better by comparison.

Mr. Johnson—We are doing about the same as the rest of the roads, trying oil and grease, and all the different cups made to produce the result. I would like to ask whether anyone has tried roller or ball bearings?

Mr. Baukat—I had the pleasure of trying that, and deliver me from ball bearings at the present time!

Mr. Clark—I think Mr. Du Boise, of Syracuse, has had some experience with roller bearings.

F. M. Du Boise, of Syracuse—We have a roller bearing that was made by a manufacturer in Syracuse. It is on experimental trial now. We have had it in use about two years, I believe. Up to the present time we do not find any wear whatever in the rollers themselves. We have had some trouble with the journal boxes they roll in, not being properly hardened when put on, and we renewed those, but the roller bearings and the action are as perfect as when they were put in. I think the car runs with a great deal less power. I have no figures to show how much less, but I feel safe in saying that the car is operated with considerably less power.

As to the oil cup question, I will state we are using a cup, but I guess I have the same trouble the others have, there is no way of stopping the feed of the oil when the car stops. Some of the members say that their streets are spattered up by the use of grease, and I see that our streets in Syracuse are also spattered, but we have not had any complaint yet from the city authorities on this account.

Mr. Fairchild—There have been suggested several forms of oil cups using a small ball at the bottom, the idea being the ball will vibrate when the car is in motion, allowing the oil to feed, and when the car stops, the ball will fall back into the opening and prevent the feed of the oil. Has anyone experimented with this, or is there any member who has any knowledge of a cup of that kind which is in general use?

H. V. Schreiber, of the Augusta Railway & Electric Company, Augusta, Ga.—We have tried the type of cup just mentioned and found after using it for some time that we could not adjust it. It is arranged with notches, and the idea is to turn the notches to regulate the supply of oil, but we found if we turn the nut one notch the oil would all flow out, or if we turned the nut back one notch the oil would stop flowing entirely. We have made experiments with a number of different kinds of oilers; but at the first, when we dispensed with grease, we simply took the grease cup already on the motor, and put waste in it, packed it good and hard with wool waste and poured oil on top of the waste, and that passed through the waste and made a good, cheap oiler, but it had the same trouble which has been mentioned here to-day, the oil would go down through the bearings and make the streets greasy. We tried some oil cups. We had a screw which pinched a wick similar to some of those described here. I looked up the matter of lubrication on steam railroads and found they are oiling cars for about one-tenth of what it costs us. We also tried successfully the oiler shown on page 77 of the Question Box. That has a great advantage in that it uses the same oil over and over again and keeps everything tight so that no dirt comes in. That is an oiler I think we will adopt; though a little expensive at first sight, it is really cheaper than some others and, although it looks complicated at first, it serves the purpose very well.

Mr. Danforth—I am sorry to say I am not supplied with any figures, and can only say generally that the cost of lubrication has been about the same as it was when we used grease, although our bearings are running two and three times longer than they did. We have been experimenting with a large number of trucks, using high-priced oils, and we consider the first thing necessary to stop hot boxes is to find the right kind of oil, and the next thing is to find the cup that will feed the oil economically. We finally got down to a cup that is somewhat of a compromise. It contains a loose-fitting piston, held down by a spring pressure resting on a thin piece of felt which acts as a filter. The vibration of the cup during the motion of the car moves the piston sufficiently to allow the oil to flow down onto the piece of felt, when it is filtered through onto the bearing. We are now working to obtain a cup which will practically stop the flow of oil when the car is at rest. I am of the opinion that, generally speaking, this will have to be accomplished by using a rod with dense oil which will flow slowly, if at all, at low temperatures. This means you can change the oil, which up to the present day we have not felt warranted in doing. I will say, however, we use two grades, summer and winter, and have tried some cheaper oils, with very good results.

Mr. Du Boise—I will say that in our oil cups which we are using we have four different feeds in the cup, which we can regulate to a certain extent. We cannot stop the flow entirely when the car stops. By changing the feed of these oilers according to the weather, hot and cold, and also by changing the grade of oil, we get along very economically with it, but cannot stop it entirely. Our experience has been that we effect a saving of about 25 per cent in the cost of lubrication by oil over the cost of lubrication by grease, and I should say we have effected nearly double that saving in the wear of bearings.

Mr. Collins—In regard to the matter of roller bearings, which Mr. Du Boise spoke of, I am not quite clear as to whether that refers to armature or axle bearings or journal-box bearings.

Mr. Johnson—I referred to all the bearings. Mr. Du Boise spoke of the ball bearings he was trying in an experimental state, and I gathered it referred only to the journal bearings of the car. I would like to know if it refers to the axle bearings and motor bearings as well?

Mr. Du Boise—I referred to the journal bearings only when I spoke of the roller bearing. In regard to the oil question, we have stopped the hot-box problem by the use of oil.

Mr. Harrington—I believe that the grease question is a thing of the past. We have been working on the oil question for some time, and there is no doubt that the use of oil has supplanted the use of grease. The great trouble is that the oil lies in pools around the car house and on the street. In so far as the cost is concerned, we made a contract about four months ago with a company on the basis of furnishing the lubrication for the entire system, so much per thousand car-miles. The oil company was to allow us credit for the oil and grease we had in stock. Since that time up to the last report I had, the oil company still owed us money.

Mr. Collins—There is another point which enters largely into this question, and that is the matter of armature repairs, due to armatures getting down on the pole pieces and stripping. Since we began using oil for lubricating we have practically eliminated that trouble, while prior to the use of oil as a lubricant we often had the bearings go down and we lost a good many armatures. At the present time we have overcome that difficulty almost entirely.

Mr. Du Boise—Since we have used oil for lubricating we practically have no armatures on the pole pieces whatever, and we get at least three times more life out of our bearings with the use of oil than we did when we used grease.

Mr. Harvie—I would like to ask how often these gentlemen find it necessary to thoroughly clean the oil cups, emptying out the old oil and cleaning them out thoroughly, to prevent clogging with the wick-feed cup?

Mr. Collins—We go over our machines, such as blowing out the motors and doing work like that, and in addition to that we make it a point once a month to clean out all the oil cups. I think the secret of success of lubricating with oil lies largely in the attention given to the matter of cleaning the oil cups.

Mr. Leavitt—In connection with the question of the use of oil, I think that grease and oil should both be used, especially on long lines. In such cases, where there is any bearing trouble, the grease will tide the bearing over and enable you to get the car into the depot. It would be necessary to clean out the bearing as soon as you found the grease had started, but having a motor of ample capacity, the grease does not start to any extent unless the bearing warms up—that is, it does not run to any extent in the natural heat of the motor.

We have used very little grease, but have used it as an extra precaution. Of course, if the grease starts, the felt and wicking is clogged up and is useless for oil, and has to be changed and cleaned out.

Mr Baukat—I do not agree with Mr. Leavitt. I say throw the grease out and keep it out. After you once get the grease in the bearing, you will have a hard job to get the bearing clean, and it means quite a little money to clean the bearing. After you have it once cleaned, keep it clean. The main thing we should aim at is to get a cup that will not feed when the car is not running. The whole question does not lie in the cost of oil by any means. If you have a cup that will lubricate your bearings at a fair price and you have no armature trouble, etc., I think you should be all satisfied. I would not advise using grease. I would not do it.

Mr. Fairchild—If there are no more questions or answers on this subject, we will pass to the wheel question, which is an old one, and yet it is always new. The matter relating to wheels is found on page 81 of the Question Box, and following pages. The subject is divided as follows: Give your ideas and experience with respect to the following: (a) Life and cost (per 1000 wheel-miles) of cast-iron wheels? (b) Life and cost (per 1000 wheel-miles) of steel-tired wheels? (c) Life and cost (per 1000 wheel-miles) of rolled-steel wheels? Is there anyone here who can give us late data on this subject? Have any of you been carrying out comparative records lately? There is a great demand for comparative wheel records. Everyone realizes that wheel records are only valuable up to a certain extent, because the conditions governing the information and also the method of keeping mileage records have not yet been standardized, and wheel records, even when they are given out, have to be taken with considerable explanation, but it might be well to give a few moments to this wheel question and see if we cannot add to the information on the subject.

Mr. Collins—I have expressed my opinion somewhat in the answers in the printed Question Box. We find in our experience, which is taken from a careful record of mileage—and it is an average record taken from 300 or 400 wheels—that the average life of our cast-iron wheels is about 30,000 miles and the cost per 1000 wheel-miles is 20 cents. That includes the cost of wheels used in city and suburban, and some interurban service. The average life of our steel-tired wheels is 150,000 miles and the cost per 1000 wheel-miles is about 13.5 cents. That price is based on the cost of tires only. I consider, in the matter of making comparisons between steel-tired wheels and cast-iron wheels, we should not take into account the wheel center, because that is a common feature of the truck. If the wheel center is designed correctly we can use that indefinitely. I find that the cost of turning the tires on one steel-tired wheel during its lifetime is practically the same as for boring and fitting five cast-iron wheels, which we would have to use to make the same mileage. The value of scrap returned is slightly in favor of the cast-iron wheel, which would reduce the cost of the cast-iron wheel per 1000 wheel-miles to 17.4 cents, as compared with 13.5 cents for the steel-tired wheel. That is merely looking at the question from the economical standpoint.

I believe we should look at the question in another light. I think the factor of safety should be the determining factor in the question of the use of wheels. I am very strongly of the opinion, and I have been convinced for some time, that in all interurban cars we should use steel-tired wheels. The question in my mind is, What is the best type of steel wheel? We have been using the built-up wheels, with cast-iron and cast-steel centers, with a Mansell retaining ring, which is practically nothing else than steam railroad practice. We have used that wheel with excellent results. There has been brought out lately a rolled wheel which seems to me to be admirably adapted for interurban service. We now have two of the largest cars equipped with that type of wheel, but they have not attained sufficient mileage to enable us to make a comparison. We have run something like 20,000 miles with that type of wheel, and from present indications they will be highly successful. The cost as compared with the built-up wheel will be slightly in favor of the built-up wheel in the long run. The first cost will be in favor of the rolled wheel, but in using the same wheel center over and over again indefinitely, the eventual cost will be slightly in favor of the built-up wheel. There is one element which should be considered. If you have an integral wheel, you eliminate largely the question of loose tires, or the wheel coming apart, or anything of that sort. It seems to me that the rolled wheel is the coming wheel for interurban service.

Mr. Johnson—Our experience is practically the same as that of the gentleman who has just spoken. I believe the rolled-steel wheel is the coming wheel for high-speed roads. I think it is going to be a little more expensive in maintenance, but the factor of safety is going to outweigh that. As far as the city service is concerned, I think the chilled wheel will hold sway and give us plenty of safety.

Mr. Carver—I do not know that I have much to say on the wheel question at this time. I am trying to watch developments in the wheel matter, trying to do that very closely. I think the steel-tired wheel will compete with the cast-iron wheel, for city service, on a cost basis. I do not believe that a cast-iron wheel is suitable for high-speed service. I have known of some cast-iron wheels which have burst in city service, but that was due to high speed, the motor running away on a down grade. The wheel burst as the result of the speed; that was the only solution we could discover for it. I do not want to advertise anyone's goods, but I am watching this pressed wheel very closely, and think it is going to win out.

J. H. Pardee, of Canandaigua—Last year our chief engineer applied some cast-iron wheels. They were specially designed, but have proven unsatisfactory, and we went back to steel wheels. We are experimenting with the built-up wheel and using that wheel, and also a solid wheel.

T. W. Wilson, of Buffalo—I believe for interurban practice regarding the question of wheels, we can, as in other things, follow the example which the steam roads have set us. I do not believe a cast wheel is fit to be run under an interurban car. As to the type of steel wheel, I rather agree with the gentlemen who have preceded me, in thinking that the rolled wheel is the best type. For city service, I think the only reason which would lead us to adopt a steel wheel is the one which Mr. Carver suggested, the initial cost. I think the cast wheel is satisfactory for city service. If the cost can be brought down to the same, or possibly a little more, as the cost of the cast wheel, I think we should adopt the steel wheel for city service. We get about 40,000 miles out of our steel-tired wheels on the Lockport line, and a little less on the Buffalo & Niagara Falls line, on account of the numerous curves. I think the life of a steel-tired wheel can be set at about 150,000 miles. Our cast wheel make about 40,000 miles and costs us about 22 cents per 1000 car-miles.

W. J. Harvie, of Utica—We have no rolled-steel wheels on our road. We are using two types of steel-tired wheels which are giving us very good results. I was rather interested in what Mr. Pardee said in regard to the special cast wheel which he had made for his road. We are using some of the same kind, although not for high-speed service. It has a reinforced flange, which seems to be a good feature.

Mr. Baukat—I would like to say something in regard to wheels. The life of the wheel can be increased to a considerable extent if your special work is taken care of so as to favor the wheel. The life of the flange determines the life of the wheel. I think, in order to favor the wheels, the track department should co-operate closely with the mechanical department

in regard to wheels. If that is taken into consideration, the cost of wheels can be decreased considerably.

Mr. Wilson—There is one addition I would like to make. In turning down steel-tired wheels we reduce the diameter, and last winter on our Buffalo & Niagara Falls line we found the mechanism under the car was closer to the roadbed than ever before, giving us considerable trouble from the motors driving on the snow and ice. Would it not be well to make a wheel with a little larger diameter than 33 ins. to take care of that trouble? I would like to ask some of the master mechanics if they have had any trouble on that account?

Mr. Collins—We ran into about the same trouble as Mr. Wilson describes. We have been using a 28½-in. wheel center, with a 2½-in. tire, and in order to overcome the trouble Mr. Wilson speaks of, we are increasing our tire to 3½ ins., and I think that will compensate for the reduction in the diameter of the wheel, owing to the turning down.

Mr. Baukat—In reference to what Mr. Wilson said, we ran up against the same trouble last winter, and on our new cars we are adopting a 36-in. wheel. We went further. We found our old special work was pounded out, was made wider than it was originally, and we are ordering our new special work wide enough to permit us to use a 1⅛-in. flange. I would like to hear an expression from the members in regard to a 36-in. wheel.

Mr. Leavitt—We are using a 34-in. wheel which, after it is turned down twice and runs three times, gets down below 33 ins. We have kept records of several sets of wheels on two cars. One car ran 218,000 miles with two turns, with one pair of steel-tired wheels with spoke hubs, that ran on the first wear 116,000 miles. We had a good deal of trouble with these turned wheels last winter, letting the motors down into the snow and ice in the streets, due to their smaller diameter.

Mr. Baukat—I would ask what kind of a wheel this gentleman used, because the mileage is certainly excessive.

Mr. Leavitt—The one that ran 218,000 miles was a steel-tired fused wheel. The one that ran 116,000 miles on the first run was a Midvale steel-tired wheel, with a Gibson ring fastened on the hubs. That wheel perhaps ran too long; 100,000 miles would perhaps have been a better figure at which to have changed it over.

Mr. Harrington—In the use of cast wheels, the ordinary road of the ordinary size sends its wheels to the wheel manufacturer to have the wheels renewed, thus avoiding the necessity of supplying the equipment necessary to change the wheels. I think this one feature alone has been one of the chief reasons why steel wheels have not been more generally adopted throughout the United States on the smaller roads, as they have not had the equipment to change and turn down the steel wheels. The advantages, I think, are quite strongly in favor of steel wheels if they can be properly handled—promptly handled, in that you avoid flats to a very great extent, so much so that you may consider you entirely avoid flats.

As to the matter of the relative safety between steel wheels and cast wheels, we hear continually that the steel wheels are almost an absolute necessity on high-speed roads. I would like to know how many railroad managers have had experience in which their cast wheels have caused derailments, such as have been referred to. I personally have yet to find out any experience that would indicate this. It seems more, from my point of view, to be a bugaboo—that we are looking for a certain thing that we think may happen. I should like information on that point. There is one other feature, however, in connection with the use of the steel wheel which gives it an advantage over the cast wheel, in that the wheels are not in the house for renewal so often, and therefore you can get more life out of your equipment, with the minimum amount of housing.

Mr. Johnson—I wish to say for the information of Mr. Harrington that less than two weeks ago we had a serious accident due to the breaking of a wheel. It was a case where a car ran at probably a little higher speed than it should have done, struck the curve and ripped off the flange; the car left the track and some people were injured.

Mr. Baukat—You mean a cast-iron wheel?

Mr. Johnson—This was a cast-steel wheel.

The President—I will say, in the winter of 1902-03, we had a 24-ton interurban car running at the rate of 45 m.p.h., equipped with 690-lb. chilled-iron wheels, and we had a portion of one wheel, consisting of the spoke and about one-third of the rim, weighing about 150 lbs., come up through the floor of the car and crush the foot of a passenger, so that he will be a cripple for life. The bursting of the wheel cleared the cable and a portion of the air equipment and the brake chain and everything that was on the car in the way of the wheel. That was the thing that drove us from the use of cast-iron wheels and compelled us to adopt the steel wheels.

Our experience with the steel wheel has been that there is no economy in the steel wheel; but we do not keep wondering when the wheel is going to break.

Mr. Pardee—The type of cast-iron wheel which we used is that with the reinforced flange, which Mr. Harvie spoke of. Since we have used this wheel we have not had a case where the flange has broken off sufficiently to allow the derailment of the car, but in running the wheels over side tracks and special work, the flanges became chipped and it was necessary to replace the wheels. We do not worry so much about derailments as we do about cost. We do not get enough mileage out of the wheels.

Mr. Collins—I would like to corroborate the experience of President Allen somewhat. We recently, within the past three months, had two 28-ton cars equipped with cast-iron wheels, and the flanges of these wheels were broken; in each case the wheels were comparatively new. In one case the car had run something like 6000 miles, and in the other case about 10,000 miles. In one case we lost about 11 ins. of the flange, and in the other case about 6 ins. In both cases, fortunately, this happened while the car was in the city streets. You can imagine what would have happened if it had occurred on some of our interurban lines on which we have some very heavy grades and bad curves.

In reference to the cost of the steel wheel as compared with the cast-iron wheel, I ask the president if his lack of facilities for taking care of the steel-tired wheels does not bring about, in a large measure, the increased cost?

The President—It does. A road equipped with steel-tired wheels should have the facilities in its own shops for taking care of these wheels. We are handicapped in this matter, in that we not only have to truck our wheels, but ship them to the Rome Locomotive Works, where they have facilities for turning down the tires. It costs $3 per pair of wheels for the turning down alone, plus the cost of transporting the wheels from our shops to Rome and returning the wheels to Utica.

Mr. Baukat—The steel-tired wheel certainly costs more; but in case of an accident what show would we stand, if anyone was injured, due to using cast-iron wheels, with the jury? I would like to hear Mr. Carr speak in reference to that point.

James O. Carr, Counsel for the Schenectady Railway Company—I do not think the question of the kind of wheel would have much effect on the Jury, from what I have seen in most of these cases. The one point which would appeal to me particularly in this question is this: If it has been demonstrated that the steel-tired wheel is the only safe and proper wheel to use on interurban service, where the cars are operated at high speed, and a railway company was using at the time of an accident a chilled wheel or cast-iron wheel, in that event I believe the railway would be considered negligent for not having used a steel-tired wheel. However, there are usually other

things than wheels that have a bearing on the question, and I think all men here familiar with the operation of street railways understand that better than I do. It is usually the man who operates the car who causes the accident, rather than the equipment on the car; but from what I have seen in the use of wheels, I know, so far as the Schenectady Railway is concerned, we have found that the only feasible wheel for the interurban service, such as we operate, is a steel-tired wheel—that is, what is known to you as a steel-tired wheel, as distinct from the open cast-iron wheel.

Mr. Fairchild—Reference has been made to the matter of taking care of steel wheels in shops. I call attention to the wheel-turning lathe in the shops of the International Railway Company, of Buffalo, described on page 82 and following pages of the Question Box. This is said to have cost but $350 to get into shape. It was made out of an old lathe and is rather an interesting suggestion. Has anyone else anything of the same nature in his shop for taking care of steel wheels? It may be interesting to know at what stage it will become economical to put in something for taking care of these wheels. I ask President Allen when he thinks it would pay him to put in a lathe to do his own work in the shop?

The President—Mr. Harvie, have you any idea when it would become economic to put in a lathe for turning our wheels?

Mr. Harvie—We have fifteen equipments of steel-tired wheels, and I thoroughly believe we should by no means be without a tire-turning lathe. How much below that a person can go in the equipment of steel-tired wheels, and still find it economical to have a tire-turning lathe, I cannot say; but I know we are seriously handicapped at the present in the matter of the cost of the wheels by the absence of a tire-turning lathe.

Mr. Fairchild—Is there anything more to be said on this wheel question? If not, we will pass on to the subject of brake-shoes, Questions 25 to 30. The brake-shoe question is intimately related to the wheel question, and is a subject which has not received perhaps full attention at past conventions. Mr. Baukat, you said you found your men were taking off the brake-shoes before they had worn down to a dangerously low limit—that is, they were wasting them. Have you stopped that and found it advantageous to let the shoes stay on a little while longer?

Mr. Baukat—That was entirely due to the fact that the brake rigging was not right. It was up too high. It was no fault of the shoe. In regard to the brake-shoe, local conditions govern that entirely.

Mr. Johnson—I believe local conditions govern the use of brake-shoes entirely. When cars are run on interurban lines, with high mileage, and are not frequently returned to the car house for attention, you cannot be too careful in avoiding too close a limit for the wearing of the shoe; but where cars are running on city service and go into the shop frequently, you can get a pretty wide limit on shoes. The question of the hardness of the shoe is one of the things which may also vary according to local conditions. We are using two different makes of shoes—a softer shoe on the heavier equipment for better braking qualities and a harder shoe on smaller equipment for better mileage. I think that practice, however, is general.

Mr. Du Boise—I am looking for information on this question. I have used a soft cast-iron shoe, with a wrought-iron insert, which gives me as good service as anything I have found. It makes a tough wearing shoe, of good braking quality.

Mr. Collins—I do not think I have anything to add to this discussion, any more than to say I believe on the heavy cars we should not use too hard a brake-shoe, because, in my opinion, it impairs the braking quality, and in order to get the greatest amount of braking efficiency we should use a shoe adapted to service. We can use a harder shoe in the city service, where the conditions vary. We have experimented with different makes of brake-shoes and finally adopted a standard of our own, which we make in our own foundry, and get as good results as we have ever had from any we have ever tried.

Mr. Fairchild—Before closing the Question Box this morning I want to refer to some of the shop devices described in the Question Box, and make request if there is anyone here who can suggest other devices for use along the line of labor-saving devices for the shop, we will appreciate having them for the published discussions. Under this heading are described arrangements for washing cars; stands for varnishing sash; racks for holding freshly varnished sash and doors; an ingenious method for testing motors; methods of handling armatures, etc. This covers quite a range of subjects, and there is a good deal of interest in schemes of this kind. If anyone can suggest to the editor of the Question Box anything additional to be put under the heading of shop devices, we will appreciate the information.

The President—We have concluded the papers which were prepared for discussion and we have devoted upward of two hours' time this morning to the Question Box. I desire at this time, while there are many street railway men present, to conclude with the miscellaneous business of this convention, and we will take up the report of the committee on rules, Edgar S. Fassett, chairman.

Mr. Fassett presented the following report:

The standard rules committee would respectfully report that at a meeting, held in Albany on June 16, it was resolved that a circular letter be mailed to the members of the association, asking if they had adopted the code of rules which the State association adopted in September, 1904, and if so, whether they had followed the rules exactly, or if they had modified same, whether these modifications were in the nature of general rules or specific to the locality.

This circular letter was mailed to forty-three roads in the State, and answers were received from eighteen. Of these ten had adopted the rules, using only such modifications as were necessary for the special locality. Two roads have adopted the city rules, but have not adopted the rules for interurban service. Four of the roads have not yet adopted the standard rules, but two of them wrote that they intended to do so within the next year. Three of the interurban roads have adopted the standard steam rules.

These replies seem to indicate that the rules adopted for the city service are being generally accepted. The rules for interurban service, however, seem to need further modification, and we would respectfully suggest to the new rules committee for the ensuing year that changes should be made in the interurban rules to bring them nearer to the standard steam code of rules.

The President—Gentlemen, you have heard the report of the committee on rules. What will you do with it?

H. A. Robinson, of New York—I move that the report be received and placed on file, and that the rules committee be continued for another year, with the same powers.

The motion was seconded and carried.

The President—I desire to say that Mr. Fassett, as chairman of the committee on rules, has only had the opportunity of calling his committee together once. You will all appreciate that in the annals of the New York State Street Railway Association the year just about to close is a short year, our annual meeting usually having been held in September, and this has deprived the committee of the opportunity of doing the work they would have done if the year had been longer. We will now have the report of the committee on nominations.

Mr. Robinson then presented the list of officers for the ensuing year, and the report was unanimously adopted. (For list of these officers see the last issue of the Street Railway Journal.)

The President—What is the pleasure of the association as to the place and date of the next meeting? As you are all aware, the executive committee last year was empowered to change the time and to name the place of meeting. As to whether this convention has been a success, each one must be the judge.

I feel there never has been such interesting discussion of interest to the mechanical and operating men at any convention that I have attended heretofore. If there is no discussion as to the next place of meeting, it will be in order to empower the executive committee to name the next place of meeting.

H. J. Clark—I move that the executive committee be empowered to select the next place of meeting. Motion seconded and carried.

Mr. Robinson—Mr. Chairman, permit me to offer the following resolution: "Resolved, That the thanks of the assocition be tendered to the Hudson Valley Railway Company, and its eminent president, A. B. Colvin, for his kindness and attention in making the entertainment of the ladies at this convention as delightful as it has been." Motion seconded and carried.

The President—The next thing I wish to bring before the convention at this time is in reference to changes to the by-laws. Section 2 of the by-laws provides at present that the executive committee shall consist of the president and four others. The practice of the association has been to elect two vice-presidents, and your executive committee, at its first meeting after the twenty-second annual convention, discussed this matter and recommended that the two vice-presidents should be made members of the executive committee. We have prepared and have ready to submit to this convention the following change in by-law II.:

"The officers shall consist of a president, two vice-presidents, a secretary and treasurer. The officers and members of the executive committee shall be elected by ballot, at each regular meeting of the association, and shall hold office until their successors shall be elected. The executive committee shall consist of the president, vice-presidents and four others, and shall have the entire charge and management of the affairs of the association."

Mr. Robinson—I think the suggestion is a very excellent one. We always have men of ability as our vice-presidents, and I do not see why the association should be deprived of their services on the executive committee. It seems to me most desirable that they should be made members of the executive committee. I move the adoption of the amendment to the by-laws. Motion seconded and carried.

Mr. Wilson—Before we adjourn I think the members of this convention should express, by means of a vote of thanks, their appreciation of the services of C. Loomis Allen as president during the past year.

Secretary Cole put the question, which was duly carried.

President Allen—Gentlemen, I wish to thank you for your kind resolution. I do not know that it is necessary for me to say very much. I know that I could not have accomplished anything alone. I have had the benefit of the advice and the hard work of the members of the executive committee and officers of the association, and if there be any glory or credit to be given to anyone for the work of the association during the past year, its officers and its executive committee are properly entitled to be given that glory.

We have another amendment to the by-laws, which is in reference to the time of meetings. The by-laws at present in force provide that the meetings of the association shall be held on the second Tuesday in September. At the convention of 1896, held in Binghamton, which was the last single-day meeting held by the association, it was voted at that time that the next year we should try holding our conventions for two days, Tuesday and Wednesday, and since 1897 the meetings have been held two days, but the by-laws of the association have never been amended, and your executive committee recommend the adoption of the following amendment:

BY-LAWS—MEETINGS—ARTICLE VII.

"The regular meetings of the association shall be held on the fourth Tuesday and Wednesday in June, and at such hour and place as shall be designated by the executive committee. Special meetings shall be held upon the order of the executive committee, and notice of every meeting shall be given by the secretary to each member. Ten members shall constitute a quorum of any meeting."

The President—The change involved is that from the second Tuesday in September to the fourth Tuesday and Wednesday in June, and also the hour and place to be approved by the executive committee. There is much that can be said upon this question. It is difficult for me to tell whether this convention has been a success or not. Each one of you must know whether it has been successful or not. To bring this matter before you, to decide whether we desire to hold a spring or fall meeting, I think this amendment should be moved and discussion follow.

J. N. Shannahan—I move that the resolution be adopted. Motion seconded.

H. A. Robinson—I desire to make a suggestion in reference to this resolution. It may be difficult, in moving around the State, to find a hotel in which to hold a convention meeting on the particular days stated in the amendment to the constitution. I offer the suggestion that some power to change the days be given to the executive committee when in their judgment it is proper to make a change. I do not know that it will always be possible for the executive committee to get the quarters we want in the particular week in June which has been specified. This is not intended, however, to differentiate between a spring and fall meeting.

The President—As stated in the address of the president, in order that the delegates, guests and supply men shall be accommodated in one hotel, it is necessary that this association shall hold its meetings at the time when some of the large summer resorts are open. We were at sea for a long while as to the best place to hold this present meeting. We desired at first to hold the meeting in the first week in June, and it was not possible for us to find a hotel which would be open at that time which could accommodate us. The new Fort William Henry Hotel, in which we are holding this convention, was opened one week earlier to care for this meeting. It seems as if it is not practicable to hold the annual meeting of this association in the fall of the year. There are many who attend our meetings who are desirous of attending the meetings of the American Street Railway Association, and it is not an easy matter to have street railway men leaving their properties twice in one month to attend conventions. That is the principal reason for changing the time of our meeting from the fall to the spring of the year. Is there anyone else who has anything to say on this question?

H. J. Clark—It has been suggested, owing to the fact that the master mechanics have their meetings in the second and third week in June, it might be inconvenient for them. I refer to the American Railway Master Mechanics' Association.

The President—Mr. Danforth, you have the burden of the affairs of the association during the coming year. What have you to say on this question?

R. E. Danforth—I ask for a freer expression of opinion from the delegates present upon the advisability of holding the annual meeting in June. If we hold the meeting in the fourth week of June, that is very close to the Fourth of July. Many of our operating men are very busy at this time preparing for the business on the Fourth of July, and to my mind it is a question whether the advantage gained in having the meeting in June is not offset by the disadvantage of losing the attendance of some of our transportation men.

T. W. Wilson—It seems to me that inasmuch as the national association has its convention in September, that it is most advisable for us to select another month. The big summer rush does not start until July, and it continues through July and

August; those are the two biggest months, so that unless we have the meeting in the same month as the meeting of the national association, I do not see any other month to put it in except June. It might be possible to make the date a little earlier in the month, in order to meet the objection of Mr. Danforth. Mr. Ely, will you give us the benefit of your judgment on this question?

W. Caryl Ely—The objection to having the conventions coming within a few days of each other is very well taken. The convention of the American Street Railway Association is held in the last week in September, or the first or second week in October each year, and there are many who desire to attend each, both the New York State and the national conventions. It is a serious thing to consider absences recurring so close to each other, and while this is somewhat of a departure from the established practice in this association, it strikes me very favorably indeed. I should say that a better attendance at our meetings and a better representation at the meetings of the American Street Railway Association could be secured by separating them in this way. Certainly it is very desirable, it seems to me, that there should be a large representation from the different companies at these meetings, and the great value of the meetings of the New York State Street Railway Association has been enforced upon my attention during the past few years. When one comes in contact with the laws of this State governing the construction and operation of street railways and compares them with the laws of other States, one is at once struck by the very great advance we have made in our statutes governing these things. In some States the electric railways, notwithstanding their importance, do not possess at this time the right of condemnation or the power of eminent domain. In other States twenty-five-year franchises are in vogue and many other things of like character. I do not believe, personally, that any such advance could have been made as has been made in this State had it not been for this association and its work. Its benefits and advantages are enforced upon my mind more and more, and I hear from all parts of the country most experienced and prominent men refer to this association as a leading example of organizations of this character.

It has fallen to my lot to undertake, with the assistance of others, the reformation and reorganization of the American Street Railway Association in an attempt to conduct it along higher and better lines, and in that work I have come in contact with the best men in our business throughout the country, and the appreciation expressed of the work done in New York State is very general.

I am very much pleased with this convention and the very serious and dignified way in which the work is being conducted, and I think the value of the association is bound to increase from year to year, and that anything which you may be able to do, with reference to the time and manner of holding conventions that will insure the greatest possible attendance ought to be done, and it seems to me this is a step in that direction.

J. N. Shannahan—I desire to offer an amendment to the original resolution which I moved for adoption, in that the date be fixed in the month of June, but the exact days be left to the discretion of the executive committee.

The President—The motion made by Mr. Shannahan is in substance that Article VII. be amended as follows:

"The regular meetings of the association shall be held in the month of June, in each year, and at such hour and place as shall be designated by the executive committee, etc."

The amendment, as proposed by Mr. Shannahan, was adopted.

The President—Before taking up the next order of business I will call upon Albert L. Judson, accountant of the New York State Board of Railroad Commissioners, to give us a little talk on some changes in the standard system of accounting which it has occurred to me would be wise and proper to make.

Mr. Judson—I am very glad of this opportunity, first, to thank you for your kind invitation to be your guest at this convention. I do so heartily.

So far as the accounting matter is concerned, at the last meeting of the Street Railway Accountants' Association of America, held at St. Louis last fall, the question of standardizing, so far as is possible, the accounts of electric and steam railroads, so that they might be compared with each other, particularly interurban roads, was taken up and discussed very thoroughly. The result of that discussion was the appointment of a committee by the National Association of Railway Commissioners, consisting of two Railroad Commissioners, one from Connecticut and one from Pennsylvania, a member of the Interstate Commerce Commission, a representative of the American Street Railway Accountants' Association and myself. We met with the committee of the Street Railway Accountants' Association in New York a short time ago and the matter was thoroughly discussed. The fact was admitted that in many respects the system of operation of interurban electric railroads was almost the same as that in use by the steam railroads. How to bring about a classification of operating accounts which might be based on the same idea, to be used by both steam and electric railroads, was a question. This matter has finally been left to a committee consisting of H. M. Kochersperger, third vice-president of the New York, New Haven & Hartford Railroad; G. N. Wilson, general auditor of the Lehigh Valley Railroad; C. N. Duffy, secretary and auditor of the Chicago City Railway Company, and W. F. Ham, treasurer and comptroller of the Washington Railway & Electric Company. It is expected that this sub-committee will be able to get out something which will meet the situation in two or three years.

As a matter of fact, a comparison between the accounts of electric railroads doing the same style of business as steam railroads is absolutely impossible at present, with the present classification. Street railway accountants think they have devised a system which is superior. The steam railroads have had their system in use so long that they do not like to change, so that it is probable that both sides will have to give way a little in order to arrive at a system of accounting which will be applicable to both systems. For instance, to illustrate one of the differences, where you have "Damages" under "General Expenses," the steam railroads have it as a "Conducting Transportation" item. The question of wages of station agents, the help in the various stations along the interurban roads, is not provided for directly in the street railway classification, but the committee which devised that system think that it covers in a general way all the accounts that are necessary for the purpose of making reports to official bodies, such as Railroad Commissioners, etc. For your own personal uses, of course, the system may be amplified to cover any local conditions. The classification of the construction accounts has not changed in any particular, neither have the operating expense accounts, so far as that is concerned. The principal change made by the Street Railway Accountants was in treatment of the income account.

Hereafter, beginning with this year, the State of New York will probably require as a part of the gross earnings the direct earnings of the property, including its electric light and power portion, and anything else which is the direct result of the operation of the property itself. Heretofore, as you will recall, advertising, sale of power and similar items have been given as "Income from other sources." This year, with the beginning of July, they are to be a part of the gross earnings. This system of classification and accounting has grown in use in the United States to such an extent that I believe all of the

Central and Middle States, and the New England States, with the exception of Massachusetts, have adopted it. It is expected that Massachusetts will fall in line some day, but of all the States in the East, I believe Massachusetts is the only one which has not finally adopted this system.

I would be very glad indeed to answer any questions I can or receive any suggestions which will aid the New York State Railroad Commission in publishing each year comprehensive information that will be of value to the public as well as the street railway companies; to the stockholders, bondholders and others.

James O. Carr, Counsel Schenectady Railway Company—I will ask Mr. Judson one question. You state that where a railway is operating an electric light plant, or possibly a gas plant, it is to report as part of the gross earnings the earnings of the electric light and gas plant. Is it also the intention of the Railroad Commissioners that these earnings shall be reported for the purposes of taxation as well? That is to say, the railways pay a tax of 1 per cent on the gross earnings. Are they also to pay that 1 per cent on the electric light and gas earnings?

Mr. Judson—I believe they do that now.

Mr. Carr—I think not.

Mr. Judson—From the standpoint of the State, I cannot strike off any taxation. (Laughter.) I will say that when the income account was originally arranged, it was arranged by some railroad men to put in the different items under "Income from other sources." Advertising is undoubtedly a part of the gross earnings of a company, and it would appear as if it might have been put in as a separate item for the purpose of escaping taxation—taken out of gross earnings and added somewhere else, but the man who makes the tax rolls at the Comptroller's office gets it in the right place.

Mr. Carr—If an electric railway company owns an electric light plant, and the electric light property is a separate corporation, if you include the lighting earnings, it pays twice, because as an electric light company it pays taxes on its earnings.

Mr. Judson—If it is separate corporation it pays taxes only once.

Mr. Carr—If you require these earnings to be stated as part of the gross earnings of the railroad company, would it not operate as a tax of 1 per cent in addition to the present tax of one-half of 1 per cent?

Mr. Judson—We are not looking at the proposition from the standpoint of taxation, but as an accounting proposition. Some of the companies, however, have found it almost impossible to divide the operating expenses of a corporation which distributes electricity and does other business with its own plant. It is almost impossible to take out of the operating expenses what applies strictly to the railroad proposition, and nothing else. In some instances the gross earnings from operation are required—the gross earnings of the railroad—and in the operating expenses the electric light plant is included, which produces a deficit from operation. Then when in the income from other sources sale of electric power is taken in, that makes the gross income show a nice profit. Where the stock and bonds of a corporation cover all these different things, it is almost impossible to arrive at correct statistics of percentage of earnings, unless the gross earnings include the gross earnings of all of the property.

Other miscellaneous business was transacted and the meeting adjourned.

The Boston & Worcester Street Railway Company, by arrangement with the Nahant Steamboat Line, is offering its patrons a round-trip ticket covering a trolley ride each way between Worcester and Boston and a steamboat ride to Nahant and back. The combination makes an excellent day's outing. It is the first time the experiment has been tried on this road.

FIRE PROTECTION IN GRAND RAPIDS

The Grand Rapids Street Railway Company has a comprehensive fire protection system, which has been built up within the last three years by special inspector, or fire warden, John Larmer. Inspector Larmer's duties consist in building up and maintaining safeguards against fire at the three car houses of the company and at Ramona, the company's amusement park.

It is at Ramona that the company's system for fire protection is most elaborate. About the grounds are located electric alarm boxes, each connected with a big gong in the pavilion. The alarm is given by pushing a button in the box a number of times, corresponding to the number on the box. On either side of the pavilion on the park lawns are located hose houses, in each of which are long lines of hose of the regulation 2½-in. and 1½-in. size. The hose is all racked up and ready to run out. One end is attached to the hydrant covered by the house, and to the other is attached a nozzle. The hydrant is never closed, and it is only necessary to open a valve to turn the water into the hose. In the basement underneath the pavilion is kept a hose cart with additional lengths of hose, which are hauled out as soon as an alarm is sounded. Other lines of hose are racked up on the roof of the pavilion veranda on either side. This hose is also attached to hydrants and with the nozzles on. Lengths of hose are kept stacked in the theater, attached to the hydrants. Each of the park concessions has its own hose equipment, also attached and ready for use.

Three electrically-driven pumps in a pump house near the pavilion grounds pump the water supply from the lake into a 1000-barrel tank located on a tower. When an alarm is sounded, the water is turned off from the tank and forced directly into the mains. With but two lines of hose a pressure of 72 lbs. is secured, and with seven lines of hose a pressure of 65 lbs. to the square inch is obtained from the pumps. A sprinkler system is used to protect the stage.

Two nights each week a fire drill is carried out. The firemen are fourteen in number, seven of them motormen and conductors, who, during the evenings and Sundays, act as special police at the park; the others are seven picked employees of the concessionaires.

When the alarm is given by the big gong in the pavilion, two of the firemen rush into the basement of the theater after the hose cart. Others drag the hose from the hose houses and turn on the water. Still others climb to the roof of the pavilion, each having his own particular post of duty. One man runs directly to the pump house and another to the tank. A private telephone system connects these places with the pavilion and other points about the grounds. When word is received by the telephone, the water is shut off from the tank and the pumps started. At each drill the exterior sprinkler of the stage is turned on. The sides and roof of the pavilion are deluged. When the drill is over, the hose is returned to its place and the men resume their duties. The department has run out the hose, started the pumps and thrown water within a minute and a half after the alarm is sounded. Besides the water protection, chemical extinguishers are placed about the park, fifty dry powder extinguishers and thirty liquid extinguishers being used. Ramona Athletic Park also has a line of hose and will soon have a hose house.

The car houses of the company are equipped with hose lines and fire extinguishers, and in one of the car houses an automatic sprinkler is installed. Fireproof paint is used at Ramona, and will be used at all of the car houses. Mr. Larmer makes his rounds of the car houses between 1 and 6 o'clock in the morning. He inspects the stoves in the cars, sees that no rubbish is allowed to accumulate, looks after the car houses and buildings and conducts the semi-weekly drill at Ramona. He also inspects the park concessions to see that they are kept free from inflammable material.

TABLE OF INCOME AND OPERATING EXPENSES PER CAR MILE

The accompanying table was compiled by H. M. Beardsley, secretary and treasurer of the Elmira Water, Light & Railroad Company, and was presented at the Lake George Convention of the Street Railway Association of the State of New York. It gives the various income and operating expenses for the year ending June 30, 1904, worked out on a car-mile basis, for all the member companies of the New York State Association. The comparative data offer much food for thought.

Income and Operating Expenses Per Car Mile of Roads Which Are Members of the New York State Association.

Year Ending June 30, 1904.

Compiled by H. M. Beardsley, Elmira.

City	ALBANY		AUBURN		BINGHAMTON		BROOKLYN *	
Company	United Traction Co.		Auburn & Syracuse Elec. R. R. Co.		Binghamton Railway Co.		Brooklyn Heights Railroad Co.	
	Amount	Per Car Mile	Amount	Per Car Mile	Amount	Per Car Mile	Amount	Per Car Mile
Car miles	8,297,632		904,822		1,210,622		53,891,975	
Income from operation	$1,690,204 64	20 37	$238,829 57	26 39	$239,225 32	19 76	$13,603,409 11	25 24
1. Maintenance track and roadway	64,147 77	.77	14,258 36	1 58	1,859 98	.15	296,389 25	.55
2. " electric line	19,820 19	.24	9,308 67	1.03	2,132 27	.18	151,375 14	.28
3. " buildings	8,427 69	.10	660 08	.07	462 17	.04	133,024 92	.24
4. " steam plant *	3,878 26	.05	1,637 93	.18	1,529 97	.13	124,694 14	.23
5. " electric plant	945 58	.01	347 89	.03	210 73	.02	52,670 28	.10
6. " cars	29,006 38	.35	5,621 84	.62	8,727 44	.72	381,810 54	.71
7. " electrical equipment of cars	29,326 90	.35	5,561 16	.62	7,851 69	.65	373,040 72	.70
8. " miscellaneous equipment	2,092 93	.03	423 18	.05	343 78	.03	81,066 92	.15
9. Miscellaneous shop expenses	5,914 52	.07	429 23	.05	1,153 69	.09	147,986 97	.27
Total Maintenance.	163,555 56	1 97	38,248 28	4.23	24,271 72	2 01	1,742,058 38	3 23
10. Power plant wages	18,287 36	.22	15,477 42	1 71	5,817 77	.48	337,520 08	.63
11. Fuel	18,837 54	.23	17,032 12	1 88	15,613 77	1 29	863,175 36	1 60
12. Water	2,291 42	.03	193 35	.02			100,712 26	.19
13. Oil and waste	2,226 78	.03	926 11	.10	843 45	.07	17,137 04	.03
14. Miscellaneous expenses of power plant	2,061 60	.02	75 38	.01	306 36	.02	49,520 59	.09
15. Hired power	99,920 25	1.20					51,785 28	.10
16. Supt. of transportation	47,029 19	.59	835 00	.09	1,511 00	.11	195,114 99	.36
17. Wages of conductors	209,704 67	2.53	15,293 98	1 69	27,186 01	2 25	1,255,193 15	2 32
18. Wages of Motormen	209,704 01	2.53	15,293 93	1 69	27,675 65	2 29	1,229,136 00	2 28
19. Wages other car service employees	27,777 54	.34	784 96	.09	2,270 56	.19	497,298 72	.92
20. Wages car house employees	23,947 03	.29	7,228 87	.80	4,152 24	.34	131,355 32	.24
21. Car service supplies	7,715 11	.09	1,315 63	.15	1,007 70	.08	33,509 74	.06
22. Miscellaneous car service expenses	14,565 85	.18	2,207 75	.24	93 80	.01	116,651 16	.22
22a. Hired equipment	28,233 58	.34						
23. Cleaning and sanding track	18,302 38	.20	92 40	.01	547 55	.05	20,419 77	.04
24. Removal of snow and ice	11,871 75	.14	4,745 66	.52	1,236 87	.10	84,859 56	.16
Total Operating.	747,676 28	9.00	81,532 66	9 00	88,166 73	7.28	4,981,495 82	9 24
25. Salaries of general officers	18,687 23	.22	5,303 63	.59	4,500 00	.37	44,531 07	.08
26. " clerks	18,374 81	.22	2,840 98	.31	2,071 48	.17	8,596 93	.14
27. Printing and stationery	3,663 13	.05	389 67	.04	330 81	.02	1,455 17	.02
28. Miscellaneous expenses	6,357 57	.08	1,859 83	.21	357 93	.03	23,955 35	.04
29. Store room expenses	2,527 27	.03					18,372 35	.03
30. Stable expenses	6,851 88	.08	636 02	.07				
31. Advertising and attractions	373 50	.01	2,608 10	.29	4,539 54	.37	3,730 76	.01
32. Miscellaneous general expenses	7,920 04	.10	3,820 94	.42	1,539 75	.13	34,907 96	.06
33. Damages	45,840 11	.55			2,049 95	.18	667,381 65	1 24
34. Legal expenses in connection with damages	11,504 95	.13					228,105 76	.43
35. Other legal expenses	4,233 73	.05			350 00	.03	17,689 41	.03
36. Rent of land and building	684 32	.01	2,347 25	.26			8,818 38	.01
37. " track and terminals	44,599 01	.54	11,505 42	1 27			20,926 72	.04
38. Insurance	19,687 63	.23	1,662 00	.18	2,250 00	.18	143,587 48	.27
39. Express							20,693 23	.04
Total General.	190,630 18	2.30	40,104 24	4 43	18,447 75	1 52	1,382,441 06	2.56
Total Operating Expenses.	1,101,861 82	13 27	159,875 18	17 66	130,887 20	10.81	8,105,995 26	15 03

City	BROOKLYN		BUFFALO		CANANDAIGUA		CORTLAND	
Company	Coney Is. & Brooklyn R. R. Co.		International Railway Co.		Rochester & Eastern Rapid Ry. Co.		Cortland County Traction Co.	
	Amount	Per Car Mile	Amount	Per Car Mile	Amount	Per Car Mile	Amount	Per Car Mile
Car miles	6,391,140		15,153,937		270,548		218,871	
Income from operation	$1,643,767 69	25.72	$3,470,450 09	22 90	$72,978 26	26 97	$47,393 02	21 65
1. Maintenance track and roadway	42,869 83	.67	137,302 25	.91	4,800 13	1 78	4,408 11	2 02
2. " electric line	14,727 43	.23	27,158 96	.18	821 38	.30	390 55	.18
3. " buildings	5,012 88	.08	9,450 97	.06	163 01	.06	158 58	.07
4. " steam plant *	25,269 07	.39	5,916 99	.04	447 59	.17	474 98	.22
5. " electric plant	1,944 90	.03	3,416 63	.03	67 67	.02	32 16	.01
6. " cars	27,770 19	.43	89,006 18	.58	3,332 66	1 23	1,635 64	.75
7. " electrical equipment of cars	57,939 30	.91	70,704 01	.47	1,285 92	.48	1,410 60	.64
8. " miscellaneous equipment	2,580 19	.04	5,614 08	.04	161 45	.06	25 20	.01
9. Miscellaneous shop expenses	364 16	.01	10,196 56	.07	820 50	.30	210 59	.10
Total Maintenance.	178,477 75	2 79	360,775 63	2.38	11,900 20	4 40	8,754 41	4 00
10. Power plant wages	42,069 79	.66	32,834 98	.21	5,280 37	1 95	1,323 67	.60
11. Fuel	160,597 78	2 51	40,394 85	.26	13,371 73	4 94	4,058 54	1 85
12. Water	10,136 70	.16	663 23	.01	122 06	.05		
13. Oil and waste	4,966 46	.08	1,624 10	.01	679 50	.25	150 92	.07
14. Miscellaneous expenses of power plant	6,968 19	.11	1,064 75	.01	146 07	.05	195 83	.09
15. Hired power	26,065 68	.41	248,182 57	1 64				
16. Supt. of transportation	19,375 73	.30	38,423 26	.25	1,315 99	.49	600 00	.28
17. Wages of conductors	168,263 75	2.63	357,179 01	2 35	3,800 22	1 40	4,430 44	2 02
18. Wages of Motormen	168,263 75	2 63	343,763 51	2 27	3,887 51	1 44	4,191 63	1 92
19. Wages other car service employees	18,436 34	.29	71,228 29	.47	58 22	.02	365 38	.17
20. Wages car house employees	16,899 98	.27	70,558 41	.47	1,493 29	.55	1,528 86	.70
21. Car service supplies	2,638 29	.04	14,166 13	.09	661 22	.24	197 62	.09
22. Miscellaneous car service expenses	25,763 18	.40	35,132 51	.23	4,801 91	1 78	1,219 44	.56
22a. Hired equipment			744 37	.01				
23. Cleaning and sanding track	4,430 18	.07	15,094 86	.10	85 78	.03	130 40	.06
24. Removal of snow and ice	6,055 82	.10	40,661 67	.27	1,129 66	.42	918 73	.42
Total Operating.	681,552 62	10 66	1,314,531 84	8 67	36,841 55	13 61	17,784 42	8.12
25. Salaries of general officers	16,800 00	.26	41,775 04	.27	2,096 04	.77	2,916 67	[illegible]
26. " clerks	8,596 93	.14	24,408 19	.16	2,003 60	.74	817 83	.37
27. Printing and stationery	1,455 17	.02	6,239 31	.04	1,336 21	.49	131 31	.06
28. Miscellaneous expenses	1,104 19	.02	6,693 23	.04	325 88	.12	828 07	.38
29. Store room expenses	883 17	.01	8,550 11	.06	268 03	.10	237 43	.11
30. Stable expenses	7,376 64	.12	6,991 90	.05			2 44	.01
31. Advertising and attractions			7,233 16	.05	2,482 69	.92	354 10	.16
32. Miscellaneous general expenses	7,551 68	.12	23,789 85	.16	715 39	.26	1,116 25	.51
33. Damages	108,470 01	1.70	235,785 76	1 55	165 98	.06	491 41	.22
34. Legal expenses in connection with damages	2,105 77	.03	9,912 84	.07	12 43	.01	102 20	.05
35. Other legal expenses	2,546 05	.04	10,568 99	.07				
36. Rent of land and building	2,000 00	.03	10,727 55	.07	419 15	.16		
37. " track and terminals	21,001 86	.34			6,579 75	2 44		
38. Insurance	27,561 74	.43	33,856 80	.22	140 00	.05	903 20	.41
39. Express								
Total General.	208,253 41	3 26	426,461 73	2 81	16,545 35	6 12	5,073 84	2 31
Total Operating Expenses.	1,068,283 78	16 71	2,101,769 20	13.86	65,289 08	24 13	31,612 66	14 44

City	ELMIRA		FISHKILL		FREDONIA	
Company	Elmira Water, Light & R. R. Co.		Citizens Ry., Light & Power Co.		Dunkirk & Fredonia Ry. Co.	
	Amount	Per Car Mile	Amount	Per Car Mile	Amount	Per Car Mile
Car miles	1,206,965		179,982		122,935	
Income from operation	$194,044 12	16 08	$44,888 40	24 94	$42,269 03	34 38
1. Maintenance track and roadway	27,167 31	2 16	2,831 99	1.57	816 12	.66
2. " electric line	2,326 67	.19	307 64	.17	399 95	.33
3. " buildings	785 55	.06	545 76	.30	86 12	.07
4. " steam plant *					1,473 97	1 20
5. " electric plant					53 14	.04
6. " cars	7,324 12	.61	5,310 20	2 96	1,670 70	1 36
7. " electrical equipment of cars	6,150 32	.51	1,614 05	.90	1,385 12	1.13
8. " miscellaneous equipment	26 63				225 19	.18
9. Miscellaneous shop expenses	135 91	.01	191 22	.11		
Total Maintenance.	44,014 77	3 64	10,801 07	6 01	6,118 93	4 97
10. Power plant wages					1,686 84	1 37
11. Fuel					11,011 54	8 96
12. Water					140 00	.11
13. Oil and waste					241 35	.20
14. Miscellaneous expenses of power plant					164 89	.14
15. Hired power	25,125 48	2 10			1,120 00	.91
16. Supt. of transportation	1,426 65	.12	5,758 00	3 20		
17. Wages of conductors	25,019 42	2 09	3,705 00	2 06	2,661 12	2 17
18. Wages of Motormen	24,292 61	2 01	4,524 82	2 51	2,400 00	1 95
19. Wages other car service employees	1,160 70	.10				
20. Wages car house employees	1,579 86	.13	637 75	.35	175 59	.14
21. Car service supplies	1,489 13	.12	514 59	.29		
22. Miscellaneous car service expenses	1,109 44	.09			175 59	.14
22a. Hired equipment						
23. Cleaning and sanding track	1,482 84	.12	155 40	.08	20 90	.01
24. Removal of snow and ice	855 40	.07	192 76	.11	1,174 32	.95
Total Operating.	86,456 57	7 17	15,483 32	8 60	20,973 04	17 06
25. Salaries of general officers	3,360 00	.28	1,960 89	1 09	200 00	.16
26. " clerks	1,124 73	.09			431 79	.35
27. Printing and stationery	295 05	.02	34 50	.02	22 50	.01
28. Miscellaneous expenses	858 07	.07	325 06	.18	277 59	.23
29. Store room expenses	199 12	.02	24 16	.01		
30. Stable expenses						
31. Advertising and attractions	1,253 36	.10	301 98	.17		
32. Miscellaneous general expenses	755 30	.06	27 98	.01	1,734 31	1 41
33. Damages	3,907 60	.32			98 82	.08
34. Legal expenses in connection with damages						
35. Other legal expenses	375 00	.03				
36. Rent of land and building	297 52	.02			20 50	.02
37. " track and terminals	529 92	.05				
38. Insurance	1,435 94	.12	1,200 00	.67	275 64	.23
39. Express						
Total General.	14,354 61	1 18	3,874 57	2 15	3,061 15	2 50
Total Operating Expenses.	144,825 95	11 99	30,163 96	16 76	30,153 12	24 53

* Cable plant included with steam plant. Maintenance of locomotives included with maintenance of misc. equipment. Wages of trainmen (elevated) included with motormen.

City.	GARDENVILLE		GLENS FALLS		HORNELLSVILLE		ITHACA	
Company.	Buff. Gar. & Eb. Ry.		Hudson Valley Ry. Co.		Hornellsville Elec. Ry.		Ithaca Street Ry. Co.	
	Amount.	Per C. M.	Amount	Per C. M.	Amount	Per C. M.	Amount	Per C. M.
Car miles	97,614		2,265,130		181,440		375,492	
Income from Operation	$ 14,006 07	14 35	$ 465,218 75	20 54	$ 15 854 16	8 74	$87 653 86	23 34
1. Maintenance track and roadway	2,905 47	2 98	33,210 64	1 47	1,905 06	1 05	2 131 14	57
2. " electric line	113 00	.11	11,496 46	51	168 32	09	606 36	.16
3. " buildings			2,952 66	13	-350 02	.19	168 92	04
4. " steam plant			6,611 11	.29				
5. " electric plant			3,855 19	17			9 75	
6. " cars	416 07	.43	15,066 55	66	894 10	.49	2,936 86	78
7. " electrical equipment of cars	221 38	.23	19,872 06	.88	999 26	56	2 510 96	67
8. " miscellaneous equipment			1,121 14	05			31 17	01
9. Miscellaneous shop expenses	70 98	07	2,230 97	10			340 73	09
Total Maintenance.	3,725 90	3 82	96,414 67	4 26	4 316 76	2 38	8 734 89	2 32
10. Power plant wages			17,338 53	.77			3,513 63	93
11. Fuel			27,969 08	1 23			19,007 09	5.06
12. Water			425 97	02				
13. Oil and waste	24 20	02	1,269 58	05				
14. Miscellaneous expenses of power plant			948 06	04			108 98	03
15. Hired power	3,600 00	3 69	31,513 16	1 39	3 223 83	1 77		
16. Supt. of transportation			10,164 25	46			834 50	22
17. Wages of conductors	1,446 17	1 48	37,208 99	1 64	3 051 20	1 68	9 272 39	2 47
18. Wages of motormen	1,451 46	1 48	37,333 86	1 65	3 010 00	1 68	8,900 59	2 37
19. Wages other car service employees			4,757 76	21			6 15	
20. Wages car house employees	174 40	.18	7,101 37	32	349 12	19	1,167 89	31
21. Car service supplies	380 90	39	3,407 22	15			427 06	11
22. Miscellaneous car service expenses			7,700 65	34			11 76	
22a. Hired equipment								
23. Cleaning and sanding track			716 42	03			744 69	20
24. Removal of snow and ice	238 94	25	7,485 03	33	184 18	10	258 39	07
Total Operating.	7,316 07	7 49	196 339 93	8 62	9,818 33	5 42	44 253 01	11 77
25. Salaries of general officers	225 00	23	6 224 96	.28	797 07	44	2 980 88	79
26. Salaries of clerks	301 50	20	8,328 16	37				
27. Printing and stationery	34 76	04	991 48	04			60 27	02
28. Miscellaneous expenses	41 88	05	945 12	04	27 85	01	12 09	
29. Store room expenses			922 16	04				
30. Stable expenses			285 34	01			67 37	02
31. Advertising and attractions	149 00	15	1 598 49	07			3 078 88	82
32. Miscellaneous general expenses	28 90	03	3 624 04	16	379 72	21	1,307 16	35
33. Damages			14 147 17	62	16 00	01		
34. Legal expenses in connection with damages	7 70	.01	2,627 39	12			2 350 00	63
35. Other legal expenses			2 343 74	11	210 00	12		
36. Rent of land and building			2,495 00	11				
37. Rent of track and terminals			19 403 19	85				
38. Insurance	15 00	01	7,200 00	.32	85 00	04	788 52	21
39. Express			12,186 53	53				
Total General.	703 74	72	83,221 69	3 67	1 614 61	83	16 645 17	2 84
Total Operating Expenses	11 744 71	12 03	374 976 29	16 55	15 649 72	8 63	63 633 07	16 93

City.	KINGSTON		MONTOUR FALLS		NEWBURGH		NEW YORK	
Company.	King Con. R. R. Co.		Elmira & Sen. L. Ry.		Orange Co. Trac. Co.		New York City Ry. Co.	
	Amount	Per C. M.	Amount	Per C. M.	Amount	Per C. M.	Amount	Per C. M.
Car miles	493,599		201,721		528,302		45,383,254	
Income from Operation	$123 037 51	24 93	$ 39,237 33	19 45	$112 760 02	21 34	$15 133 600 70	33 35
1. Maintenance track and roadway	6 648 06	1 14	6 685 94	3 31	9 506 16	1 80	280 807 66	62
2. " electric line	782 58	16	42 35	.02	1 401 96	27	207 251 57	46
3. " buildings	154 37	.03	93 83	05	524 75	10	42 388 98	09
4. " steam plant	259 84	05	1,094 83	54	185 02	03	44 633 99	10
5. " electric plant	96 90	02	16 80	.01	412 25	08	50,709 05	11
6. " cars	4,483 78	91	616 77	31	4,643 63	88	385,909 20	85
7. " electrical equipment of cars	3,134 06	64	917 67	45	4 567 00	86	427,170 73	94
8. " miscellaneous equipment	265 90	05	301 24	15	477 29	09	1 429 03	
9. Miscellaneous shop expenses	1,953 88	40	78 [illegible]	04	151 77	03		
Total Maintenance.	16 779 37	3 40	9 846 56	4 88	21 869 83	4 14	1 439 933 39	3 17
10. Power plant wages	3,416 37	69	2 468 73	1 22	3,221 71	61	125 749 43	28
11. Fuel	7,722 90	1 56	7 028 78	3 49	9,692 13	1 84	385 369 14	85
12. Water					200 04	04	42,608 73	10
13. Oil and waste	595 09	12	111 22	06	275 27	05		
14. Miscellaneous expenses of power plant	181 88	04	323 30	16	186 39	03	26 760 91	06
15. Hired power							76 547 05	17
16. Supt. of transportation			1 200 00	59			327,737 75	74
17. Wages of conductors	11,860 08	2 41	2 951 31	1 46	11 215 14	2 12	1,465 409 05	3 23
18. Wages of motormen	13 536 33	2 74	2 951 31	1 46	13 399 91	2 53	1,465,409 05	3 23
19. Wages other car service employees					1 663 34	29		
20. Wages car house employees	1,714 11	35	1 404 64	70	1 993 08	38	247,439 67	54
21. Car service supplies	290 93	06	193 86	09	778 16	15	80 471 67	18
22. Miscellaneous car service expenses	364 42	.07	266 10	13	488 51	09	28,718 40	06
22a. Hired equipment							459 363 99	1 01
23. Cleaning and sanding track	1,100 45	22	118 03	06	519 04	10	9 501 14	02
24. Removal of snow and ice	495 18	10	880 19	44	335 23	07	93 067 12	20
Total Operating.	41 276 74	8 36	19 897 47	9 86	43 867 95	8 30	4 843 153 10	10 67
25. Salaries of general officers	5 100 00	1 03	1 778 46	88	3,845 04	73	126 792 17	28
26. Salaries of clerks	1,210 66	24	716 16	35	2,669 35	50		
27. Printing and stationery	214 00	04	63 83	03	339 05	06		
28. Miscellaneous expenses	85 15	02	130 30	07	297 03	05	65 663 94	15
29. Store room expenses					73 84	02		
30. Stable expenses	315 29	06						
31. Advertising and attractions	2 806 69	57	59 00	03	3 591 15	68		
32. Miscellaneous general expenses	529 94	11	161 51	08	1,708 40	32	11 362 21	02
33. Damages	1 058 66	22	30 00	02	6,529 36	1 05	757 301 68	1 67
34. Legal expenses in connection with damages	1 433 91	29					461 850 81	1 01
35. Other legal expenses	349 33	07			561 85	11	41 234 65	.09
36. Rent of land and building	1 00		296 30	15	648 00	10	26,925 91	06
37. Rent of track and terminals			3,233 40	1 60			103 503 62	23
38. Insurance	1 523 74	31	410 99	20	1 618 80	31	86,869 65	19
39. Express								
Total General.	14 626 29	2 96	6 880 61	3 41	20 781 86	3 93	1 681 564 64	3 70
Total Operating Expenses	72 684 40	14 72	36 624 [illegible]	18 15	86 519 64	16 37	7 464 558 13	17 54

City.	OGDENSBURG		ONEIDA		ONEONTA	
Company.	Ogdensburg St. Ry. Co.		Oneida Ry. Co.		O. C. & R. S. Ry. Co.	
	Amount	Per C. M.	Amount	Per C. M.	Amount	Per C. M.
Car miles	314,160		147,349		574 360	
Income from Operation	$ 27 862 15	8 87	$ 12,404 84	8 42	$ 77,703 83	13 53
1. Maintenance track and roadway	591 29	19	9 79	01	6,064 10	1 06
2. " electric line	93 18	03	5 87		2,637 24	46
3. " buildings	64		2 16		311 60	05
4. " steam plant	137 09	04			448 93	08
5. " electric plant	175 63	06	106 75	07	392 40	07
6. " cars	3,652 15	1 16	855 14	58	6,652 48	1 16
7. " electrical equipment of cars	64 80	02	482 95	33	5 749 19	1 00
8. " miscellaneous equipment			65 48	05	56 30	01
9. Miscellaneous shop expenses			188 33	13	347 50	06
Total Maintenance.	4 714 78	1 50	1 716 46	1 17	22 661 71	3.95
10. Power plant wages	1 274 00	41			6 580 29	1 15
11. Fuel	287 25	09			21 361 83	3 72
12. Water						
13. Oil and waste	40 78	01	1 60		725 65	13
14. Miscellaneous expenses of power plant	561 65	18	12 49	01	200 33	03
15. Hired power			4 193 59	2 84		
16. Supt. of transportation					1 759 79	31
17. Wages of conductors	4,478 07	1 42	2 529 96	1 72	5 909 38	1 03
18. Wages of motormen	5 445 48	1 73	2,493 11	1 70	6 952 47	1 21
19. Wages other car service employees	1,139 98	36	80 85	05	1,794 02	31
20. Wages car house employees	1,130 89	36	623 47	37	1,274 31	22
21. Car service supplies	212 93	07	67 31	04	570 20	10
22. Miscellaneous car service expenses			253 96	17	606 89	10
22a. Hired equipment						
23. Cleaning and sanding track			97 66	07	28 06	01
24. Removal of snow and ice	513 92	16	284 30	19	1,662 85	29
Total Operating.	15 075 95	4 79	10 541 00	7 16	49 446 06	8 61
25. Salaries of general officers	1 166 66	37			1 300 00	22
26. Salaries of clerks	512 21	16	266 40	18	5 916 26	1.03
27. Printing and stationery	10 36		91 73	06		
28. Miscellaneous expenses	200 00	07	115 48	08	1,485 95	26
29. Store room expenses					215 91	04
30. Stable expenses					413 19	07
31. Advertising and attractions	325 60	11			16 96	
32. Miscellaneous general expenses	360 92	12	145 39	10	40 45	01
33. Damages			372 11	25	1 487 68	26
34. Legal expenses in connection with damages	255 99	08			97 85	02
35. Other legal expenses	255 99	08				
36. Rent of land and building			65 00	04	133 06	.02
37. Rent of track and terminals					645 00	11
38. Insurance	234 75	07	648 00	.45	2 420 94	42
39. Express						
Total General.	1 321 88	1 06	1 704 14	1 16	14 172 29	2 46
Total Operating Expenses	23 112 61	7 35	13 961 60	9 49	86 273 06	15 02

City.	PEEKSKILL		PLATTSBURG		PORTCHESTER		POUGHKEEPSIE		ROCHESTER	
Company.	Peeks'll L. & R. R. Co.		Plattsburg Trac. Co		N. Y. & Stamford Ry.		P. C. & W. F. E. Ry. Co		Rochester Railway Co.	
	Amount	Per C. M.	Amount	Per C. M.	Amount	Per C. M.	Amount	Per C. M.	Amount	Per C. M.
Car miles	293 398		132,573		764,196		464 781		6 138 030	
Income from Operation	$ 50,015 77	17 05	$ 21,004 26	15 84	$121 674 70	16 92	$ 98 408 30	21 17	$1,487,181 81	24 23
1. Maintenance track and roadway	1,276 15	.44	773 62	58	1,689 49	.22	3 073 27	66	15,980 10	26
2. " electric line	184 66	06	260 24	19	2,014 29	26	4 694 04	1.01	21,134 39	34
3. " buildings	122 00	04	38 95	03	509 65	07	45 85	01	4 161 62	07
4. " steam plant					193 68	03	1,439 61	31	10,735 34	17
5. " electric plant	699 47	24			2 66		156 50	03	5 589 87	09
6. " cars	1,184 29	40	622 41	47	3 232 76	42	3 913 77	84	47 392 00	77
7. " electrical equipment of cars	597 65	20	199 01	15	1,941 67	25	5,157 06	1 11	47 584 92	78
8. " miscellaneous equipment	Red 16 92				157 32	02			3,122 17	05
9. Miscellaneous shop expenses			33 73	03	89 10	01	23 63	01	7 148 00	12
Total Maintenance.	4,047 20	1 38	1 927 96	1 45	9 830 61	1 28	18,503 73	3 98	162 848 31	2 65
10. Power plant wages					3 804 23	49			25 420 43	41
11. Fuel					10,260 76	1 34	10 999 16	2 37	74,786 76	1 22
12. Water					1 082 76	14			2,103 93	03
13. Oil and waste					163 45	02	1 021 65	22	1,661 33	03
14. Miscellaneous expenses of power plant					259 71	03	42 62	01	1 585 02	02
15. Hired power	7,856 07	2 68	1,888 69	1 50					68 159 17	1 11
16. Supt. of transportation	916 00	31	574 86	43	1 217 08	16			12 861 46	21
17. Wages of conductors	6,235 66	2 13	1 861 43	1 40	15 247 76	2 00	33 426 41	7 19	152,059 34	2 48
18. Wages of motormen	6 238 06	2 13	1 856 64	1 40	15 247 76	2 00			151 381 62	2 46
19. Wages other car service employees			270 75	20	312 41	04			8 491 59	14
20. Wages car house employees	1 026 21	35	464 38	35	2 589 68	33			13 001 16	21
21. Car service supplies	157 50	05	206 45	16	149 90	02	36 01	01	13 072 64	21
22. Miscellaneous car service expenses	158 98	05	170 81	13	1 344 66	18	53 25	01	20 691 55	34
22a. Hired equipment										
23. Cleaning and sanding track	82 39	03	43 10	03	707 77	09			3,300 77	05
24. Removal of snow and ice	165 97	05	196 53	15	402 65	05	484 67	10	20 305 09	33
Total Operating.	22 826 84	7 78	7,632 44	5 75	53 090 66	6 92	46 063 67	9 91	668 792 55	[illegible]
25. Salaries of general officers	1 375 00	47	1 500 00	1 13	2 523 84	33	5,460 00	1 16	15 416 65	25
26. Salaries of clerks	904 00	.31			1 434 64	19			14 798 98	24
27. Printing and stationery	91 64	03	112 55	08	153 76	02	71 18	.02	1,967 10	03
28. Miscellaneous expenses	61 65	02	265 35	20	274 04	04	220 77	05	3 407 32	06
29. Store room expenses									2 140 60	04
30. Stable expenses							1 768 24	38	1 846 03	03
31. Advertising and attractions	506 05	17	385 00	29	5,646 39	71			8 686 17	14
32. Miscellaneous general expenses	344 76	12	179 55	29	1,628 49	21	1 649 20	33	10 426 47	.17
33. Damages	90 00	03	742 76	56	1,286 07	17	145 00	03	43 588 61	71
34. Legal expenses in connection with damages					7 412 64	97	100 00	02	4,200 00	07
35. Other legal expenses									1 977 88	03
36. Rent of land and building			83 37	.06	236 01	02			996 00	01
37. Rent of track and terminals									829 31	01
38. Insurance	4 032 78	1 37	169 68	13	2 415 39	32	1,485 75	31	7,247 68	12
39. Express										
Total General.	7 405 76	2 52	3 648 21	2 74	23 011 17	3 01	10 686 14	2 30	119 107 20	1 94
Total Operating Expenses.	34 278 80	11 68	13,108 61	9 94	85 932 44	11 21	76 263 64	16 41	860 748 06	13 88

City.	SCHENECTADY		SYRACUSE		SYRACUSE		SYRACUSE		UTICA	
Company.	Schenectady Ry. Co.		Syracuse, L. & Bald.		Syracuse Rapid Transit		Syracuse and Suburban		Utica & Mohawk Val.	
	Amount	Per C. M.	Amount	Per C. M.	Amount	Per C. M.	Amount	Per C. M.	Amount	Per C. M.
Car miles	2 755 036		226 967		3 869,887		438,492		3,394 271	
Income from Operation	$660,202 58	23 96	$ 50 988 69	22 46	$834 561 74	21 56	$ 83 613 54	19 05	$724 938 09	21 36
1. Maintenance track and roadway	19,810 91	72	1 742 89	77	$ 16 229 82	41	5,255 94	1 20	24,841 83	73
2. " electric line	7 358 09	26	618 20	.27	9,431 50	24	616 68	14	9,273 71	27
3. " buildings	4,362 77	16	27 73	01	1,452 69	04	560 08	13	947 72	03
4. " steam plant	740 15	03	154 81	07	13 205 51	34	111 88	03	1 555 32	05
5. " electric plant	1 468 52	05	636 67	28	8 431 72	21	207 75	05	751 32	02
6. " cars	37 392 01	1 36	1 216 80	54	26 409 05	68	1 902 43	43	19,150 49	56
7. " electrical equipment of cars	22 710 47	82	2 513 21	1 11	19,646 00	50	2 357 20	54	20 379 48	60
8. " miscellaneous equipment	1,539 88	06	96 97	04	498 56	11			4,217 30	12
9. Miscellaneous shop expenses	4,671 09	18	35 77	01	2,401 00	06	762 48	.17	5 944 70	18
Total Maintenance.	99 943 89	3 63	7,05[illegible] 30	3 10	97 604 84	2 52	11,775 44	2 69	87 001 87	2 57
10. Power plant wages	7,368 22	26	2 224 84	98	10 784 23	28	2 030 52	46	10 041 40	30
11. Fuel			5,426 72	2 41	65 [illegible] 52	1 69	1 048 73	24	961 59	03
12. Water					316 71	01			12 35	
13. Oil and waste	122 87	01	244 14	11	2,010 34	05	123 27	03	210 37	01
14. Miscellaneous expenses of power plant	1 067 97	04	237 80	10	732 40	02	66 10	01	781 10	02
15. Hired power	69 946 64	2 54	582 90	26	1,189 47	03			128 992 76	3 80
16. Supt. of transportation	12 591 56	46	19 30	01	1 557 88	04			3 610 06	11
17. Wages of conductors	60 349 41	2 19	2 798 48	1 23	86 428 52	2 23	7 068 05	1 60	59 692 11	1 75
18. Wages of motormen	61 948 80	2 25	2,732 17	1 20	89 754 00	2 31	7 516 62	1 72	59 713 67	1 76
19. Wages other car service employees	7 129 57	26	99 15	05	5,154 69	13			5 080 68	15
20. Wages car house employees	22 801 41	83	[illegible]		8,640 94	22	4 294 67	98	15 623 41	46
21. Car service supplies	5,303 31	19	105 86		2 832 74	08	447 41	10	6 615 17	20
22. Miscellaneous car service expenses	22 102 50	80	382 77	16	4 292 10	11	307 43	07	8 787 19	25
22a. Hired equipment										
23. Cleaning and sanding track	4,768 66	18	57 25	02	3 824 67	10	281 36	06	2 183 77	06
24. Removal of snow and ice	5 308 17	19	28 67	01	8,189 60	21	1 196 36	12	16 815 02	47
Total Operating.	280 817 20	10 19	15,733 66	6 93	294 156 71	7 57	24 521 11	5 59	318 134 74	9 37
25. Salaries of general officers	3 661 08	13	2 277 92	1 00	11 718 36	30	3 610 00	81	10 253 39	30
26. Salaries of clerks	10,717 47	39	1 143 32	50	5,269 49	14	1 480 50	34	5 666 67	17
27. Printing and stationery	1,807 10	07	89 07	04	722 69	02	115 85	03	1,274 21	04
28. Miscellaneous expenses	2,138 96	08	109 27	05	116 77	01	1,966 36	45	1 149 18	03
29. Store room expenses	2 727 63	10			375 00	01			784 89	02
30. Stable expenses	5 604 78	20			2,752 41	07	193 80	05	2 263 56	07
31. Advertising and attractions	3 618 43	13	175 65	08	4 086 38	13	976 62	22	2 788 65	08
32. Miscellaneous general expenses	7 431 19	27	943 66	42	5 765 86	15	4 881 00	1 11	6 620 38	20
33. Damages	24 861 69	91	227 00	10	50 4[illegible]2 89	1 30	516 60	12	21 718 12	64
34. Legal expenses in connection with damages	84 22		228 13	10	4 627 32	11	213 85	05	2,080 11	06
35. Other legal expenses	586 83	02	1 175 96	52	4 673 63	12	721 93	16	1 798 73	05
36. Rent of land and building	861 72	03			1 520 14	04	970 08	22	769 08	02
37. Rent of track and terminals	46,030 65	1 67							70 37	
38. Insurance	5 734 68	21	300 00	13	4,800 00	12	16 00	01	8,332 96	25
39. Express									22 177 24	65
Total General.	115 656 52	4 20	6 668 87	2 94	99 666 84	2 58	16 602 65	3 56	87,866 73	2 58
Total Operating Expenses.	496,417 70	18.02	29 455 63	12 97	490 105 19	[illegible]	61 899 10	14 84	492 81[illegible]	[illegible]

6 mos. only

MEETING OF THE OHIO INTERURBAN RAILWAY ASSOCIATION

The Ohio Interurban Railway Association held its last meeting of the season at Cedar Point, near Sandusky, last week. This is a most attractive summer resort, and is popularly called the Atlantic City of the Great Lakes. It is a point of land ¼ mile wide and extending 10 miles into Lake Erie, and accessible only by steamer from Sandusky, and it is of tremendous importance to the Lake Shore Electric Railway, whose interurban cars run directly to the boat landing. The meeting was largely of a social nature, nearly all of the members bringing their families, who greatly enjoyed the boat ride, bathing and other attractions of the place. About 150 sat down to a noonday luncheon of excellent quality, in which lake fish was the leading feature. A toast was offered to E. C. Spring, the absent president, who is still confined to his home near Dayton, as the result of a six weeks' illness.

The short morning session was devoted to the discussion of the subject, "Freight vs. Express." It was a very one-sided discussion, owing to the absence of some of the strongest advocates of the freight business.

Vice-President Warren Bicknell, who presided, invited F. D. Carpenter, of the Western Ohio, to open the discussion in the absence of Harrie P. Clegg, of the Dayton & Troy. He said Mr. Carpenter had had experience with both classes of business, his road having recently changed from express to freight, and he asked Mr. Carpenter to explain why.

Mr. Carpenter said it was an important question, and that he was willing to have it understood that the present freight business on his road was in direct opposition to his views. The connecting roads both north and south of him handled freight and wanted to try to develop through business, so he reluctantly consented to a trial, but as a matter of fact they had not dropped the company's local express business, and were handling it on the same cars with the freight. He thought that not one in ten interurban roads were built to handle freight. They usually have a single track going through the centers of towns. To operate any large number of freight cars would mean an interference with the operation of passenger cars, which is the companies' chief business. He said that while his company had one of the largest power stations on an interurban road and had plenty of excess power, he did not think either his road nor the majority of roads had sufficient excess power to handle the varying loads caused by the operation of freight trains at irregular intervals. If they interlined with steam roads as some of the electric lines professed a desire to do, they would have to take whatever was offered to them, and at times this would mean heavy trains that could not possibly be moved. He referred to one electric line which had started with the plan of hauling trains by an electric locomotive, and he understood this company had been obliged to abandon this locomotive and buy steam locomotives. The parallel steam roads had let go of the local passenger traffic with reluctance, and it would be waving a red flag at them to attempt to take the freight business, particularly the through freight. Altogether, he had no faith in the proposition of the present forms of electric roads handling freight. On the contrary, he said, they had worked up a nice little package express business at express rates, and he proposed to hang on to it and develop it.

I. L. Oppenheimer, of the Ohio River Electric Railway & Power Company, said his company handled both classes. They are situated differently from the majority of roads. They connect at Middleport with the Hocking Valley Railway (steam), and handle its cars for Pomeroy and Racine, the latter 12 miles from the junction. Cars are handled at night by electric locomotive, and they receive from $2 to $5 per car, switching charges; empties returned free. They haul four cars at once, the plan being to get between them on account of heavy grades. It is a profitable business, and they are a feeder to, rather than in competition with, steam roads. They expect to buy a heavier locomotive and 100 coal cars with which they will serve a coal mine on their line, and will interchange with the steam road on a per diem basis. Their power station runs all night for lighting, and as the interurban cars are then off, the freight about balances the load. In their express service they handle packages at 10 cents and 25 cents, selling tickets which are rung up as cash fares. They have a wholesale shipper's rate of 10 cents per cwt. to any point on the line, not less than 50 lbs. accepted. He said that during a recent month it cost 10.86 cents per car-mile to operate freight cars, and the earnings per car-mile were considerably more than for passenger cars.

F. W. Coen, of the Lake Shore Electric Railway, thought the advisability of handling freight or express hinged upon the geographical position of a road. Roads having no steam competition like the Eastern Ohio and Toledo & Western could probably work up considerable freight business and make money on it, but he did not think freight was profitable on a line closely paralleling a steam road. On the Toledo-Norwalk division of their road they formerly handled freight. For the year previous to the change to express, the earnings per car-mile were 12 cents to 14 cents. They ran three cars each way a day and had plenty of business; in fact, it was 33⅓ per cent of the entire Toledo Union Station business, where five of the other roads did similar business. In September, 1903, the Electric Package Company took over the business and rates were almost quadrupled. People complained and the quantity of business dropped off, but at present their earnings from the Electric Package Company are about 27 cents per car-mile, this being after deliveries and terminal station expenses were deducted, but including power maintenance and wages of train crew. Their cost of operating is about 10 cents per car-mile. He explained that the Electric Package Company was an association, and that it had no capital account, all expenses being charged to operation. New equipment is charged to the various roads; in 1903 they paid $4,000 for horses, wagons, etc., and there has been nothing since. Their net from freight in 1903 was $5,000, while the net from the Electric Package Company in 1904 was $17,000, which convinces them that express is a much better proposition for a road of their class.

J. R. Harrigan, of the Columbus, Newark & Zanesville, said their rates were between freight and express, and because the name sounds better they class it as express. Cars make two round trips a day between Columbus and Zanesville, the service having just been started on the Zanesville extension. They are handicapped by poor terminal facilities in both terminal cities. It was out of the question for them to handle carload freight, and he agreed with Mr. Carpenter as to the practicability of handling standard freight cars. They have discontinued wagon service as unprofitable. They get the business because their rates are lower than express, and they give practically express service.

Theodore Stebbins, of the Appleyard system, said his business was the same as that of Mr. Harrigan's, only they called it freight. He thought about 90 per cent of it was freight at rates between steam freight and express, and the balance was delivered express at rates slightly higher than steam express. Their freight cars earn 32 cents to 35 cents per car-mile, which is more than the passenger cars earn. He thought the success of the business was largely dependent upon keeping the cars full. Get as much high-priced matter as possible and then fill the cars with cheap stuff at standard freight rates if necessary to get it. He thought a good manager should be able to accomplish this and at the same time not have the cars loaded with a lot of bulky, cumbersome freight that was unprofitable.

In answer to a question, George S. Davis, of the Street Railway Journal, said that the Ohio roads were about evenly divided on the question of freight and express; if anything,

more roads handled freight at slightly higher than steam freight rates. As an example of a road handling carload freight at freight rates in close competition with steam roads, he spoke of the Toledo & Indiana. They are within a stone's throw of the Lake Shore & Michigan Southern (steam) over the entire route. They have a number of standard freight cars and handle trains of a number of cars by electric locomotive, being limited only by the amount of business they can get. They have laid sidings into a number of factories and get considerable business on account of prompt deliveries, and because they load and unload goods right in the towns. They claim to be earning 50 cents to 60 cents per car-mile on freight business. He agreed with Mr. Stebbins that much depended upon keeping the cars full. He spoke of two roads in Eastern New York that distinguish between freight and express only in the matter of immediate shipment and deliveries. They agree to handle bulky stuff any time within a specified period, and they keep their cars filled by having a considerable amount of this class of goods in their warehouses ready for shipment. He thought some of the roads doing purely an express business could increase their receipts without increasing their car mileage by moving farm produce at freight rates. At present some of them cannot touch this class because their rates are too high.

W. H. Abbott, of the Roberts & Abbott Company, said that on all new propositions they were considering carefully the freight prospects, and that nearly all new roads were being built with few curves and grades with this in view. He thought the majority of old roads were in no condition to handle carload freight, both from the standpoint of track and power stations. He thought that where only one or two cars were handled it was foolish to attempt to do business at steam freight rates. If you can get business enough for trains of cars, it was doubtless profitable, but this means extra equipment in the power station, at least 600 kw extra for each freight train to be handled, and more feeders and sub-stations closer together.

F. T. Pomeroy, of the Cleveland & Southwestern, thought there was money in securing switching charges for transferring carload freight, but could see no money in it in competition with steam roads. He thought the profits shown by some of the freight-carrying electric roads were largely a matter of bookkeeping; that they did not know what it cost to operate.

F. J. Stout, of the Lake Shore Electric Railway, said their main business was passenger business and that freight cars were a disturbing element to good service. They have a single-track line and give half-hourly headway much of the time, in addition to five limited trains each way, and their chief concern was to keep the cars on time and carry people safely. Freight cars necessarily run slower, and he thought that even if they had double track all the way that an increase of freight business would interfere with the passenger business.

W. H. Abbott, of the Roberts & Abbott Company, agreed that a road having business enough to warrant half-hourly headway had better let the carload freight business alone.

C. N. Wilcoxson, of the Cleveland & Southwestern, said he knew of some roads that had taken contracts for moving brick, stone and building material in competition with steam roads. He figured they lost more than they earned, besides straining their power-station equipment. He thought if a road advertised that it would haul freight, it would be obliged to take anything that was offered or run the risk of having its charter forfeited. He thought that even with business enough for two-car or three-car trains, it was not profitable to handle it at steam road rates.

J. H. Merrill, chairman of the transportation committee, stated that the agreement on the Ohio interchangeable coupon books would expire Aug. 19, and he asked the various parties to the agreement to sign up the new contracts that would be sent to them. He stated that the plan was proving very popular among the traveling public, and that about 2800 books were in use at that time. He announced that the Indiana Union Traction Company had signed the agreement and would accept the books on its lines, making them available on something over 1500 miles of roads at the present time, with additional contracts expected in the near future.

A NOVEL A. C. BLOCK SIGNALING SYSTEM

BY CHARLES E. BENNETT.

There is now in successful operation on the electric tramways at San Juan, Porto Rico, a block signal system that embodies features believed to be somewhat out of the ordinary. In brief, the source of energy for operating the signal lamps is

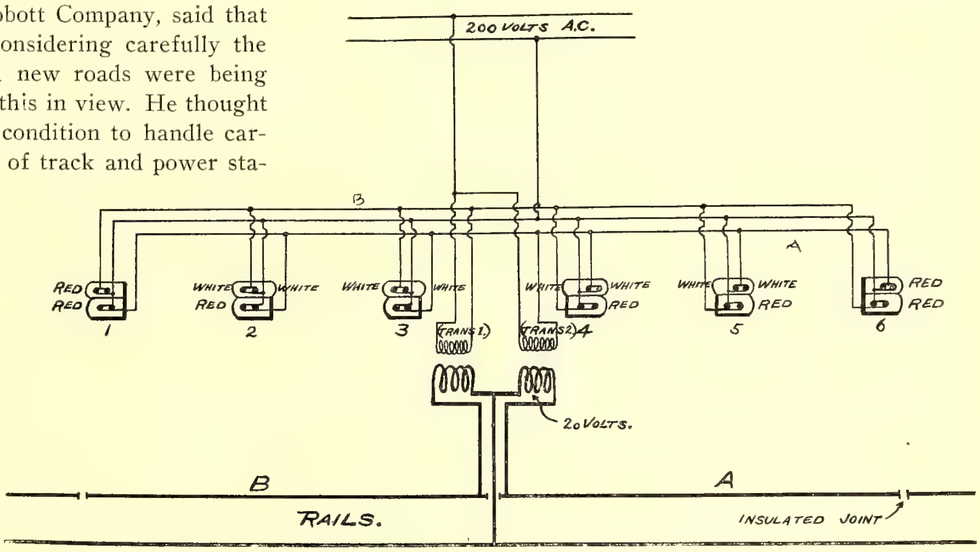


FIG. 1.—WIRING DIAGRAM FOR SIGNAL SYSTEM, SAN JUAN

a 220-volt alternating current main, the current from which is stepped down to 20 volts by means of two special 2-kw transformers placed near the center of each block. The signal lamps are connected in series with the primary side of these transformers. One of the track rails throughout the system is insulated from ground and is divided at the center of each block into insulated sections. One secondary lead of one transformer is connected to the insulated rail going in one direction, and one secondary lead of the other transformer is connected to the insulated rail going in the other direction. The remaining secondary leads of the two transformers for each block are connected together and are tapped to the second track rail, which is not insulated, and acts as a common return for the alternating current of the signal system and the direct current of the trolley circuit. The number and candle power of the signal lamps in the primary circuit of each set of transformers are so selected with respect to the voltage of the energizing current as to give a choking effect or reactance of sufficient density so that the current normally flowing in the primary circuit will not cause the lamps to light. It will now be understood, by reference to Fig. 1, that when a car enters the block the car axle will bridge the two track rails, causing a short circuit on the secondary side of the transformers, thereby breaking down the resistance and permitting sufficient current to

flow in the primary circuits to cause all the lamps to burn brightly.

The number of signal lamps to be used is a matter for determination, depending upon the voltage of the lamps and the length of the block. The lamps will be required to work upon a rather variable voltage, varying approximately from 85 to 120 volts, inasmuch as the resistance in the secondary circuits will change as the car approaches the extreme ends of the section. It will be evident that under these conditions better regulation will be secured by having a greater number of lamps of low candle-power rather than fewer lamps of higher voltage. By experimenting, the writer found that lamps of about 120 volts were best adapted to the system, and in Fig. 1 is shown the layout of a block equipped with six signal boxes, each box including two sets of lenses. Two lamps are provided for each lens, one lamp placed directly back of the other, so that if one should burn out the other will still give the proper indication through the lens. The signal boxes may be located at different points along the section, and the signals will be given simultaneously at all the boxes. This introduces a very important additional element of safety, inasmuch as the lights at the various points serve as a constant check on the train crews, and in the event of a crew running past a red signal at the entrance to the block, they will still be confronted with warning lights at frequent intervals along the block. Moreover, the crew of an opposing car moving in the same block will be warned that the crew of the approaching car has disobeyed the signals, and they will be able to take suitable steps to prevent disaster.

The complete working of the system will be understood by reference to Fig. 1. It will be seen that a car entering at B will

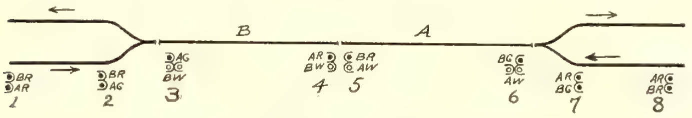


FIG. 2.—LOCATION OF SIGNAL BOXES

cause a red signal to light up in boxes 1, 4, 5 and 6, thereby protecting itself at extreme ends of the block as well as at the intermediate points in the block. White lights will appear in boxes 2 and 3, these white lights serving the one purpose of indicating whether or not the signal system is working normally. Failure to get a white light signifies that something is out of order. As the car moves beyond the middle of the block into section A, red lights appear in boxes 1, 2, 3 and 6. The red lights in boxes 1 and 6, however, are changed from the upper to the lower lens, thus showing the waiting car that the one in the block is approaching. Should two cars enter from opposite ends of the block at the same instant, all lamps will light up. This will cause red signals to be shown against the entering cars. Should one of the transformers feeding either section of the block become crippled, the car entering will fail to get a white light, showing at once that the signal is out of order.

It will be evident that the system requires five wires, two for the 220-volt alternating-current main and three for the lamp circuits. As installed at San Juan, the system required the giving up of one track rail for the signal system, but it will not be a difficult matter to devise some form of induction bond or reactance choke coil so that this rail may be used for the trolley return, while at the same time carrying the alternating current of the signal circuit.

It is a comparatively simple matter to arrange the signal system so that two or more cars may run through the block in the same direction. With the wiring, as shown in Fig. 1, it is possible to do this, providing there is an understanding that such arrangement of cars shall pass as a unit. Or it can be done as shown in Fig. 2. In this case A and B represent the two divisions of the block between the turnouts. It will be necessary to use three colors of lenses, W, G and R, as shown on the diagram, indicating respectively white, green and red lenses; that is, for example, A G represents a green signal, operated from the transformer connected to the section A, and is illuminated only when a car is on that section.

To illustrate, assume two cars entering from the right. The leading car enters upon section A, immediately throwing a red light in box No. 7 A R, holding the second car at that point. The first car continues on to section B, setting signals B R in boxes 5 and 8, and B G in boxes 6 and 7. The second car upon receiving green signals in boxes 6 and 7 will follow into section A, but can only go as far as box 5 until the first car leaves section B, for the reason that, as long as the car is in section B, danger signals are illuminated in all B R boxes. This feature of the system is advantageous, because cars are kept safely apart while running in the same direction. Should two cars enter the block from opposite ends simultaneously, green lights will be displayed in boxes 3 and 6 against both of them. Both the motormen, knowing in the first place that they are not following cars, will anticipate trouble, and one of the cars will have to back out, giving the other the right of way. This perhaps is not a perfect arrangement, but no accident could occur, for the reason that they would both face danger signals in the middle of the block. White signals are installed in boxes 3, 4, 5 and 6, and are used to indicate merely that the system is operating normally.

This method is also applicable to a double-track road using overlaps, it being necessary to install one transformer in each overlap and five wires for the lamp circuits and alternating-current mains.

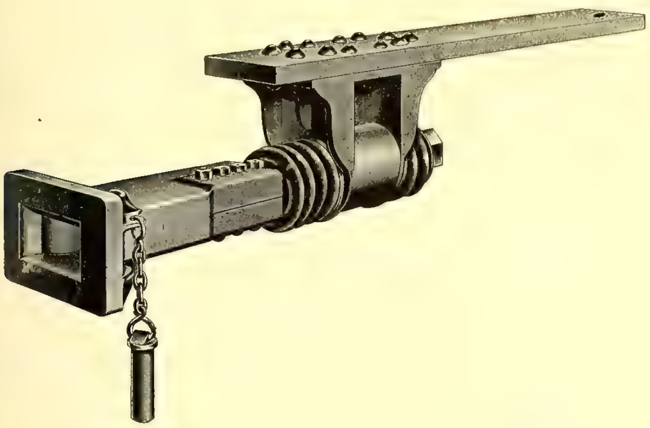
THE ELECTRIC RAILWAY AS AN AUTOMOBILE AMBULANCE

General Superintendent F. J. Stout, of the Lake Shore Electric Railway, has hit upon a scheme for bringing a little extra revenue to his road from an extraordinary source. The road closely parallels the main east and west highway all the way from Cleveland to Toledo, which is used a great deal by automobile tourists, and needless to say the cars frequently puncture or break down. Time and again Superintendent Stout had passed a smile at the sight of a farmer with his team dragging a disabled automobile to the nearest repair shop, when recently an idea struck him. He bought a couple of block and tackle outfits and some good, stout planks, and caused it to be known that his company would furnish automobile ambulances on short notice at any time of day or night. He uses an ordinary flat car, propelled by a work car, freight car or anything that is handy, and arriving at the scene, the damaged auto is pulled aboard in short order. The new service comes rather high, but it is a great convenience to automobile owners, and is much less embarrassing than having to resort to the horse to get back to town. For $15 an automobile will be hauled 15 miles, or for $25 it will be carried 50 miles, with greater distances at 50 cents a mile. It looks like a very good idea, four autos having been rescued within the last ten days.

The Sandusky, Norwalk & Mansfield Railway has been placed in operation between Norwalk and Plymouth. The work of installing the overhead was done last week by John Mann, chief electrician of the Lake Shore Electric Railway, who adopted the rather novel method of stringing live wire. A reel of wire was placed on the front end of the car and furnished with power from the Lake Shore Electric power station, and the car simply pushed its way to the end, unreeling and stringing the trolley as it went. The task was carried through without accident, and 26 miles of trolley wire strung in two days. Some little difficulty was experienced in getting a start out of Norwalk, owing to the number of telephone and electric light wires which, of course, had to be elevated, but once out of town it was smooth sailing.

NEW TYPE OF DRAW-BAR

W. T. Van Dorn, of the W. T. Van Dorn Company, of Chicago, has recently brought out an improved draw-bar for heavy service which presents several radical improvements over former draw-bars manufactured by him. The feature of the draw-bar, which is entitled No. 19, is the use of a round pin instead of one having an elliptical or elongated section. The coupling pin used on this type of bar is 1 11-16 ins. in



NEW DRAW-BAR WITH ROUND COUPLING PIN

diameter, and it is designed to drop in either at the center of the link or at one side of the mouth of the bar, as in the other forms of Van Dorn bars. The advantage of the round pin in distributing the wear is self-evident. Every time that it is used it presents a different surface to the wear of the link; at the same time the round pin is found to deflect the link at the time of coupling just as easily as the former type. The No. 19 draw-bar is made with a tail bolt, as shown in the illustration, and the No. 20 draw-bar, which also used the round pin, employs an 80-lb. rail instead of a tail-bolt.

SEMI-CONVERTIBLE CARS FOR FREDERICK & MIDDLETOWN RAILWAY, MD.

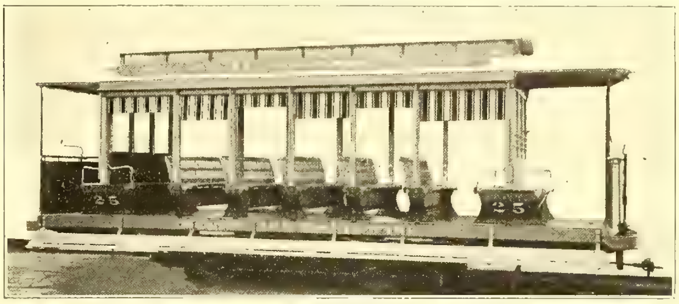
The semi-convertible type of car illustrated has recently been delivered to the Frederick (Md.) & Middletown Railway Company, by the J. G. Brill Company, to be operated on the lines connecting Frederick, Middletown and Myersville. The railway company is well acquainted with the semi-convertible window system, the Brill Company having previously furnished it with this type. The illustration shows some of the windows held at different heights and others raised entirely into the roof pockets, and also the neat arm rests provided on the low sills.

The cars measure 30 ft. 8 ins. over the end panels, and are 8 ft. 2 ins. wide over all. They are seated for forty-two passengers. An interesting arrangement is that of the longitudinal seats at one end, occupying the space of two windows. Baggage will be carried in this end of the car, and the seats are arranged to drop with the cane against the side of the car, thus providing extra space without any liability of injury to the seats. The transverse seats are of spring cane and are 36 ins. long, leaving a 22-in. aisle. Ash in natural color and birch ceilings neatly decorated constitute the interior finish. The trucks are of the No. 27-G type for fast and heavy city and suburban service. The length over the vestibules is 40 ft. 8 ins., and from the panel over the crown piece and the vestibule, 5 ft. The width over the sills is 7 ft. 10½ ins. The sweep of the posts is 1¾ ins.; the distance between the centers of the posts is 2 ft. 8 ins. The side sills are 4 ins. x 7¾ ins., and the end sills are 5¼ ins. x 6⅞ ins. The sill plates are 12 ins. x ⅜ in. The thickness of the corner posts is 3⅝ ins., and of the side posts, 3¼ ins. The furnishings include angle-iron bumpers, "Dedenda" gongs, "Dumpit" sand boxes, etc.

ONE OF THE FREDERICK & MIDDLETOWN RAILWAY COMPANY'S DOUBLE VESTIBULE, SEMI-CONVERTIBLE CARS

SUMMER EQUIPMENT FOR MADISON, WIS.

The Madison (Wis.) Traction Company has recently added to its equipment the nine-bench type of open car illustrated, intended for service in the city and suburbs of Madison, where the company operates about thirty-five cars. The length over the bulkheads is 18 ft. 10 ins., and the width over the seat ends is 7 ft. ½ in. The seats are reversible, with the exception of the two seats at each end of car, and are of ash slats, with a double row of spindles in the backs. The seat arms are of bronze. The sashes in the bulkheads are arranged to drop



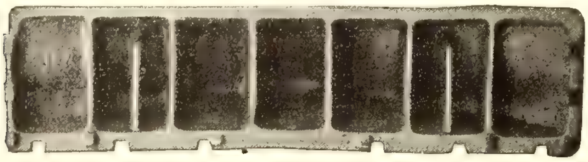
NINE-BENCH, SINGLE-TRUCK CAR FOR THE MADISON TRACTION COMPANY

into pockets between the seats. The curtains may be drawn to the floor, the Brill round-corner seat-end panels which are used being so arranged in connection with the grooves in the posts as to permit the curtains to come down over the post outside of the panels, a continuation of the grooves of the posts being formed in the exterior surface of the panel. The panel also provides for an easy entrance, as there are no sharp projecting corners, and increases the safety of passengers compelled to stand on the running board. The interior finish is of ash, with decorated quartered oak ceiling.

The length of this car over the crown pieces is 27 ft. 6 ins., and the width over the sills, including the facing, is 6 ft. 3 ins. The sweep of the posts is 5 ins. The distance between the centers of the posts is 2 ft. 9 ins. The side sill size is 4½ ins. x 7 ins.; the sill plates are 7 ins. x ½ in.; the thickness of corner posts is 3⅝ ins., and of the side posts, 2¾ ins. The height of the steps is 17 ins., and of the risers, 16 ins. Angle-iron bumpers, radial draw-bars, gongs, sand boxes, ratchet brake handles, etc., of Brill manufacture are also included.

A NEW CAR REPLACER

The Buda Foundry & Manufacturing Company, of Chicago, has recently put on the market a car replacer which is illustrated herewith. One of the important features of this device is the groove that protects the flange by allowing the tread of the wheel to first engage the replacer preparatory to mounting. This construction makes it possible for the tread, and not the flange of the wheel, to first grip the replacer. The increase in the friction thus secured, over what would be possible if the flange only were presented, is readily apparent, and the great



UNDER SIDE OF CAR REPLACER

force and shock to the equipment that is ordinarily made necessary is obviated, and thus the injury which so often occurs to the flange, equipment or to the replacer while rerailing a car is avoided. Again, there are overcome the tendency to shove the replacers out of position, and also the spinning of wheels in the attempt to secure, on the flange alone, sufficient friction to start the ascent, especially in the case of very heavy equipment. Another desirable point in the replacer, and one which will doubtless meet with considerable favor, is the reduction of the pronounced and abrupt arch at the ends. Reference again to the illustration will show how thin the approach has been made, at the same time this method of construction has been accomplished without decreasing the strength required at the points mentioned.

The inner replacer shows for itself more plainly than could be told by description how the wheel is forced toward the rail. Repeated experiments have shown that it is not possible for

CAR REPLACER IN POSITION

the wheel to travel over the top of the replacer and drop on the opposite side—the deflection has been proved positive and absolutely complete in each instance. During the entire rerailing operation there is no shock whatever, and the resultant saving to the equipment, as well as the economy in the time required, leads the manufacturers to feel that they have a replacer which will meet with great success.

The demand for strength has also been met, and tests made by the Hunt Bureau of Tests have demonstrated that the Buda replacer will sustain a load more than two and one-half times as heavy as any locomotive now in use. This is accomplished by the proper distribution of metal and not by any undue amount. A cut is shown of the under side of a replacer which illustrates its construction. Convenient carrying handles are provided, which are shown near the end. Another style has center handles. The replacers come in two sizes, the No. 1, for 60-lb. rail, weighing 150 lbs. a pair; the No. 2, for 100-lb. rail, weighing 200 lbs. a pair.

PREPARATIONS FOR THE PHILADELPHIA CONVENTION

A meeting of the executive committee of the American Street Railway Manufacturers' Association was held in New York, July 7, and a number of important preliminaries in connection with the Philadelphia convention next September were arranged. There were present at the meeting Chairman Brady and Messrs. Carlton, Heulings, McGraw, Martin, Pierce, Randall, Wharton and Baker and President Ely, of the American Street Railway Association.

The resignation of Committeeman W. H. Whiteside, of the Allis-Chalmers Company, was received, and Frank C. Randall, manager of the New York office of the company, was elected in his place. E. H. Baker, of the Galena Signal Oil Company, was appointed to fill the vacancy caused by the resignation of Mr. Randall, as representative of the National Electric Company.

It was decided to provide admission to the exhibition hall by means of tickets, which will be distributed under the direction of the executive committee.

Mr. Wharton, as chairman of the local committee, confirmed the agreement made with the executive committee of the American Street Railway Association, selecting the Philadelphia Museum as the place of meeting, and also the hall for holding the exhibits. He also announced that arrangements had been made with a well-known caterer in Philadelphia for supplying a lunch at the convention hall, at which moderate prices will be charged; also that arrangements had been made for coaches for conveying attendants between the convention hall and the Walnut Street cars.

THE WHEEL QUESTION

In the article on this subject by C. G. Bacon, Jr., in the last issue of this paper, a paragraph read: "And why is it not possible * * * as did the wheel shown in Fig. 3?" This reference should be to Fig. 4. The following paragraph should also be inserted after the reference to Fig. 3: "Wherein is the wheel itself, or its manufacturers, at fault in the showing as per Fig. 3? Yet this was the condition of two wheels on the same axle under a car in street railway service, in a recent test, after 13,416 miles of service."

SIGHT-SEEING IN SAN FRANCISCO

In connection with its "Seeing San Francisco" service, the United Railroads of San Francisco publishes an interesting folder containing illustrations and descriptions of the city's noted buildings, monuments, street and harbor scenes, etc., together with a list of statistical items about the Golden Gate metropolis. The sight-seers' car, which is accompanied by a lecturer, takes over two hours to make its rounds, and half a dollar is charged for the complete trip.

One advantage of this attractive sight-seeing service, both in San Francisco and other cities, is that even the city residents are led to indulge in similar trips, especially on holidays.

FINANCIAL INTELLIGENCE

WALL STREET, July 12, 1905.

The Money Market

Some improvement was noted in the local money market this week. The demand for accommodation was larger than in the preceding week, and rates for fixed periods ruled slightly above those recently quoted. Money on call was in abundant supply at rates ranging at from 2¼ to 3 per cent, with most of the business transacted at 2½ to 2¾ per cent. In the time loan department, brokers reported a fair increase in the inquiry for funds, especially for the long maturities, as a result of the increased activity in the securities market. Early in the week the demand was supplied largely by out-of-town lenders, who placed moderate amounts of six months' funds at 3¾ per cent, but as soon as this supply was exhausted the rate rose to 4 per cent, with very little money obtainable under that figure. Local institutions were not disposed to offer with any degree of freedom, owing to the preparations making for payment of the remaining 25 per cent of Government deposits, due on July 15, and the expectations of heavy subscriptions to the new Japanese 4½ per cent loan to be offered to investors this week. Mercantile paper continued in good demand, but the supply was not materially larger. Rates were unchanged on the basis of 3¾ per cent for choice names. Sterling exchange was weak, prime demand sterling declining about 25 points to 4.86 75, which is considerably below the gold export rate. The decline in sterling was attributed to the placing of sterling loans. The foreign markets ruled easy and practically unchanged. At London the discount rate was 1⅞ per cent; at Berlin, 2⅛ per cent, and at Paris, 1 13-16 per cent. The bank statement published last Saturday was rather disappointing. Loans decreased $4,410,500 and deposits decreased $7,733,800. Cash decreased $5,634,500 and the surplus reserve decreased $3,701,050 to $7,957,825, as against $36,017,725 in the corresponding week of last year and $8,008,475 in 1903. United States deposits amounted to $10,952,225, as against $14,755,725 in the preceding week.

The Stock Market

Increased activity developed in the stock market this week, but prices continued to show more or less irregularity as a result of profit-taking sales. During the first half of the week the upward movement was resumed, and in many instances new high records were established, but toward the close heavy realizing by the speculative element carried prices off rather sharply. London traded only moderately and at no time was an important factor in the market. Commission houses, however, were more active than in the preceding week, indicating a growing interest in the speculation on the part of the outside public. Reading and Union Pacific were the leaders of the market, both establishing new high records on heavy purchases. Other prominent features of strength were New York Central, Louisville & Nashville, Pennsylvania, St. Paul and Erie. In the specialties, Tennessee Coal & Iron scored a sensational advance. Amalgamated Copper showed early strength, but in the subsequent dealings practically all of the early gain was lost. At the beginning of the present week the upward movement was continued, there being no unfavorable developments over the holiday, but on Tuesday there was considerable selling by the professional element, which carried prices off sharply. Western houses were particularly heavy sellers of Union Pacific. Reading declined sharply, as did New York Central and Pennsylvania, while in other quarters of the market the recession ranged from 1 to 2 per cent. The Steel stocks were in urgent demand throughout and held relatively strong. Baltimore & Ohio was also conspicuously strong at the close. The bond department was moderately active and firm, the feature being the activity and strength in Japanese issues. The closing was soft.

The local traction issues were less active. In the early dealings prices held fairly firm, but at the close there were sharp recessions in sympathy with the decline in other quarters of the market.

Philadelphia

Increased dullness characterized the market for traction stocks this week. Dealings included a fairly large number of issues, but the individual totals were considerably smaller than in the preceding week. The general tone, however, was firm. United Gas & Improvement was especially strong. In the early dealings the price fluctuated between 93¾ and 94, but toward the close there was a sharp rise to 95⅞, from which it reacted only a small fraction. About 2500 shares were dealt in. Philadelphia Traction was practically unchanged, about 800 shares changing hands at 100¼ to 100. Philadelphia Rapid Transit was extremely dull, but firm, practically all transactions taking place at 28¾. Philadelphia Company common sold to the extent of about 1500 shares at from 44 to 43½, while the preferred sold at 47¾ to 48. Other transactions included Rochester Railway & Light preferred at 92¾, United Railways of San Francisco preferred at 87½, Union Traction at 60½ to 60, Fairmount Park Transportation at 17, Union Traction of Pittsburg preferred at 51, American Railways at 51, United Companies of New Jersey at 269½, and Union Passenger Railway at 235.

Chicago

Little interest was manifest in this market. Trading was confined to a few issues, and apart from a sharp rise in Chicago & Oak Park Elevated preferred from 16 to 17¾ on the exchange of less than 600 shares, the dealings were without feature. The common recovered a point to 5 on the purchase of about 400 shares. A small lot of Chicago Union Traction preferred sold at 28. Northwestern Elevated common brought 21⅞ for 125 shares.

It is said that Mayor Dunne has a new traction plan, but before anything is done another attempt will be made to have the traction interests fix a price upon their properties.

Other Traction Securities

The Boston market was fairly active and irregular. Boston & Suburban common sold at 22 and 22½, while the preferred rose from 68½ to 70. Boston & Worcester common declined from 30 to 29 on limited dealings, but subsequently there was an advance to 30¼. The preferred was dealt in to the extent of about 2000 shares at from 76½ to 77, and closed near the highest. West End common moved up a point to 98 on the exchange of a small lot. Boston Elevated sold at 157¾. Massachusetts Electric common sold at 19¾ to 19½, and the preferred at from 63¾ to 63.

At Baltimore, trading was upon an exceedingly small scale, but prices generally held firm. United Railway issues, which have been the market leaders for weeks past, were unusually dull. Odd lots of the stock brought 13. The 4 per cent bonds sold at 93¾ to 94 for about $25,000, while the incomes changed hands at 59½ to 59¾. City & Suburban 5s sold at 113¼. Virginia Railway & Development 5s advanced from 99 to 100. On the New York Curb market, Interborough Rapid Transit ruled quiet but firm, about 700 shares selling at prices ranging from 200½ to 202. New Orleans Railway common sold at 35¾ for 100 shares, while 200 of the preferred brought 79½.

There was little activity at Cincinnati last week. Toledo Railways & Light featured and made a gain of 1 point from 34¼ to 35¼. Cincinnati, Dayton & Toledo stock showed a fractional decline to 23. There were heavy sales in the 5 per cent bonds of this company, with a range of 94⅞ and 95. Southern Ohio 5s, an underlying issue, sold at 98¼. Cincinnati, Newport & Covington preferred and common both showed fractional declines, the former selling at 92¼ and the latter at 32¾. Detroit United sold at 93½, and Cincinnati Street Railway at 147.

Northern Texas again featured in Cleveland, and it made a jump of several points to 66. Aurora, Elgin & Chicago common was firm at 16½ on a number of sales, and the preferred sold at 65¾ for a small lot; the 5 per cent bonds sold at 93 and 93½. Northern Ohio Traction reached a high mark in several years trading of 24. Western Ohio receipts advanced to 14½, on reports that the property would be taken into the Widener-Elkins trans-State project, and there was considerable trading in the bonds of this company at 80 to 80⅜. Cleveland Electric sold at 77½ and 78.

Security Quotations

The following table shows the present bid quotations for the leading traction stocks, and the active bonds, as compared with last week:

	July 5	July 12
American Railways	50½	50
Boston Elevated	a157	157
Brooklyn Rapid Transit	72½	69½
Chicago City	a190	a190
Chicago Union Traction (common)	7	7½
Chicago Union Traction (preferred)	32	32
Cleveland Electric	79½	78
Consolidated Traction of New Jersey	82	82

	July 5	July 12
Consolidated Traction of New Jersey 5s	108½	108½
Detroit United	93¾	93
Interborough Rapid Transit	200⅞	200⅝
International Traction (common)	—	a28
International Traction (preferred) 4s	—	a65
Manhattan Railway	165	164
Massachusetts Electric Cos. (common)	18	a19
Massachusetts Electric Cos. (preferred)	a62	63
Metropolitan Elevated, Chicago (common)	24	23⅞
Metropolitan Elevated, Chicago (preferred)	65	65
Metropolitan Street	129¾	125¾
Metropolitan Securities	84½	81¾
New Orleans Railways (common), W. I	38	38
New Orleans Railways (preferred), W. I	80¾	80¾
New Orleans Railways 4½s	90	90
North American	99¾	98⅝
North Jersey Street Railway	25	25
Philadelphia Company (common)	*43¼	43
Philadelphia Rapid Transit	28⅝	28
Philadelphia Traction	100	100
Public Service Corporation 5 per cent notes	97	97
Public Service Corporation certificates	69	69
South Side Elevated (Chicago)	94½	95
Third Avenue	130	127
Twin City, Minneapolis (common)	113	113⅛
Union Traction (Philadelphia)	60	59½
West End (common)	97	97
West End (preferred)	*114	114

a Asked. W. I., when issued. * Ex-dividend.

Iron and Steel

The monthly statistics collected by the "Iron Age" show that the production of coke and anthracite pig iron fell off from the record of 1,964,000 tons in May, a month of thirty-one days, to 1,793,000 tons in June, a short month. The greater part was due to the restriction of the operations of the steel companies, whose product declined 136,000 tons, while the output of the merchant furnaces fell off only 35,000 tons. The active capacity has undergone a sharp decline, having receded from 443,092 tons on June 1, to 408,617 tons on July 1. The demand for structural material is very active, the pressure being so heavy that orders are reported to have been sent abroad. Premiums are being paid for prompt delivery, and there is a disposition in some quarters to agitate for an advance in the base prices. Additional business is in sight for the steel rail mills, and in the wire trade the first indications of a revival of buying have been noted.

JUNE OUTING OF NEW ENGLAND STREET RAILWAY CLUB

The June outing of the New England Street Railway Club took place Thursday, June 29, at Lake Quinsigamond, Worcester, Mass., with about 200 members in attendance. Through the courtesy of the Boston Elevated Railway Company, the Boston & Worcester Street Railway Company, the Worcester Consolidated Street Railway Company and F. H. Bigelow, manager of the "White City" at Lake Quinsigamond, the party was taken from Boston to Lake Quinsigamond and admitted to the "White City."

One of the features of the occasion was the ride from Boston to Lake Quinsigamond and return, via the Boston & Worcester Street Railway, the party having the pleasure of riding in a special three-car train of electric cars. An excellent dinner was served at the Tatassit Club House on an island in Lake Quinsigamond, and the outing was one of the best in the history of the club.

WIDENER-ELKINS SYNDICATE BUYS INDIANA LINES AND LEASES LIMA TRACTION COMPANY

It is announced that the Indianapolis & Eastern Railway and the Richmond Street & Interurban Railway have been acquired by the Widener-Elkins syndicate and merged, and that Charles Murdock, of Lafayette, has been appointed general manager of the entire property, succeeding J. W. Chipman, of the Indianapolis & Eastern. A new schedule will soon be effective whereby cars will run direct from Indianapolis to Richmond. For some reason not stated the proposed merger of these properties with the Dayton & Western Traction Company has not been effected, although it is asserted negotiations for the property are still pending.

The lease of the Lima (Ohio) Electric Railway & Light Company's property to this syndicate became effective July 1. The syndicate controls the Fort Wayne, Van Wert & Lima Traction Company and the Lima & Toledo Traction Company, which is building a line north from Lima towards Toledo. The securing of the city property is in line with its policy of controlling terminal lines.

NEW ORLEANS RAILWAYS COMPANY SOLD AT PUBLIC AUCTION

The last step preparatory to the transfer of the properties of the New Orleans Railways Company to the New Orleans Railway & Lighting Company was taken July 8, when the properties were sold at public auction and bought in for the New York Security & Trust Company for $3,500,000. The final step will be for the newly-organized company to take over the properties from the trust company. M. C. Buckner, of the reorganization committee, representing the New York Security & Trust Company, bought in the property for the sum mentioned, it being sold by Elwyn C. Foster, one of the receivers, and master of the sale.

The property was sold in four lots. The first consisted of all the realty, which brought $250,000. The second was the right, title and certain indentures in the lease of the New Orleans City Railroad Company. This brought $2,000,000. The third lot was rolling stock, office fixtures, live stock and personalty of the corporation, which brought $750,000. The fourth lot consisted of all the claims, debts, etc., notes, bonds, evidences of indebtedness, which brought $500,000. From now on the speediest possible steps will be taken for the new company to put the properties into good shape.

THE APPLEYARD TRACTION TANGLE

M. H. Wilson and J. G. Schmidlapp, receivers for the Appleyard properties, have received the reports of experts appointed to make investigation as to the condition of the various properties. They decline to say anything as to the details of the report before it is filed with the courts, other than to say that the affairs of all the individual companies are badly tangled, and that the report is unsatisfactory, due to the inability to secure the books of the Great Northern Construction Company, which built the various roads. It is stated that it will probably be a long time before anything can be done toward the reorganization of the companies.

BIG CONSOLIDATION IN INDIANA

Under the name of the South Bend, Laporte & Michigan City Railway Company (capital stock $1,000,000), the Laporte & Michigan City Traction Company, which was composed of the bondholders of the Chicago & South Shore Railway Company, and which bought that road at receivers' sale, and the South Bend Western Railway Company, which is constructing an interurban line between Laporte and Michigan City, have been merged. The Indiana Railway Company, which owns and operates a system of interurban lines in Northern Indiana and Southern Michigan, owns a controlling interest in the consolidated company which is authorized to issue 5 per cent forty-year gold bonds to the amount of $1,100,000. The intention is to merge the new corporation and the Indiana Railway Company, which then will have more than 200 miles of main track, and to connect with line running into Northern Ohio on the east and Chicago on the west.

STATUS OF THE PROPOSED CANADA MIDDLESEX RAILWAY

The Middlesex Railway Company, which has attracted considerable attention recently, is a subsidiary enterprise of the Niagara Welland Power Company, which company has been absorbed by the Electric Development & Securities Company, of New York City, with the Canadian name of the International Electric Securities Company. The Niagara Welland Power Company holds a sweeping charter for the development of water power from the Niagara River by means of a canal, which follows a route affording a very much greater fall than can be obtained at Niagara Falls proper. A recent amendment to the charter grants an extension of time until 1913 for the completion of the work, and at the same time the privilege to the power company to build a tramway on its own right of way. The right of way, covering 272 miles, from Niagara Falls to Toronto, has been located with a view of utilizing it for railway purposes, particularly between Niagara Falls and London, where the company is contemplating building a high-speed line.

The president of the Niagara Welland Power Company is Harry Symons, K. C., of Toronto; vice-president, Charles Hesson, of St. Catharines; secretary, John S. Campbell, barrister and solicitor, of St. Catharines. The executive committee of the Electric Development & Securities Company is composed of Mr. Symons, of Toronto, and James B. Sheehan, of New York. Since the New York interests took hold of the project last October about $10,000 have been spent by the engineering department in surveys and computation work, which have been carried out under the direction of John MacCunn, M. Can. Soc. C. B., the resident engineer.

MAYOR DUNNE'S LATEST TRACTION OFFERINGS

Probably Chicago must count that day lost which does not bring forth some new scheme of solving its woful traction problem. The latest suggestions, which comes from Mayor Dunne, seem to show that he is beginning to realize "immediate municipal ownership" is practically impossible. On July 6 he placed two plans before the City Council, the substance of the same being as follows:

The first and preferred plan provides that a company composed of five men having the confidence of the people for business integrity and sympathy for municipal ownership, shall construct and operate a municipal system. This company is to be authorized to issue capital stock limited to the actual cost of the construction, and all earnings in excess of the cost of maintenance, operation and all earnings in excess of the cost of maintenance, operation and 6 per cent dividends are to be placed in a sinking fund for the purthe sinking fund, or apply the proceeds of both to purchase the property. The company is to receive a twenty-year franchise, but the city is to have the right of purchase at any time at a price and upon terms to be agreed upon.

The alternate plan provides for constructing a municipal system by the city on plans prepared by its engineers on a contract for construction and acquisition let to lowest bidder; issuing Mueller law certificates for the payment of the cost of construction; submitting ordinance to voters for approval, and testing the validity of the Mueller law certificates.

The contract plan now advocated by Mayor Dunne is the subject of much criticism on the part of the municipal ownership radicals, who call attention to his ante-election pledges. In defending his stand Mr. Dunne said: "My plan does not conflict in spirit with the third referendum proposition that no franchise should be granted to any company, though apparently in conflict with its letter. The company I propose will act in the interest of the city. It will be the city's company, not a private corporation. The corporation itself will make no profit except the 6 per cent dividends it will receive on its stock. During the campaign I supposed that only the streets of the Adams Street line would be available for a municipal system and that we would need more streets. I now find we already have 100 miles of streets, and that during the two years of construction 140 miles more will be at our disposal. My plan is strictly in accordance with the Democratic platform. We are going ahead to acquire a system in the quickest way possible. I do not think it is advisable to condemn any lines while we have so much of the streets available at once."

Mayor Dunne declared that he had not considered the appointment of the directors of the company. He said that question would be taken up when the local transportation committee was preparing the ordinance.

At least one knot in the traction tangle has been untied by Judge Julian W. Mack, of the Circuit Court, who has decided that the leases by which the Union Traction Company is in control of the street car lines of underlying corporations are valid. He denied a motion for an injunction to prevent the company from continuing in control. The decision ends a year of litigation between the Union Traction Company and David A. Kohn and J. J. Townsend, who sought to prevent the company from reducing rentals paid under the leases. The fight hinged on the right of the Illinois Trust & Savings Bank to vote stock held in trust. Judge Mack held that the bank had right to vote the stock.

BROOKLYN RAPID TRANSIT PREPARES TO MOVE INTO ITS NEW OFFICES

Work on the Brooklyn Rapid Transit Company's new building, at Clinton and Remsen Streets, Brooklyn, has practically been completed, and the company has made arrangements to move into its new quarters on July 22. The new building, which is ten stories in height, adjoins the company's old building at Clinton and Montague Streets. The company will continue to use the latter building, which is now undergoing extensive improvements. With its new and old buildings the Brooklyn Rapid Transit Company will occupy the entire block on Clinton Street, between Remsen and Montague Streets, having a frontage of 184 ft.

The new building represents the most up-to-date type of fireproof construction in office buildings. Instead of using a concrete flooring, however, a German fireproofing material, called asbestolith, is employed.

The new structure, in conjunction with the old building, the company's officials believe, will afford ample room for housing every department of the company for many years to come. Beside its ten stories, the building has a basement and sub-basement. In the sub-basement will be the heating plant and three large vaults, one 45 ft. in length. The building contains a large number of these vaults, running from the sub-basement to the fifth story, all fireproof, and many of them burglar-proof. In these vaults will be kept the company's records.

A novel feature of the new building to be occupied by the Brooklyn Rapid Transit Company is an automatic telephone system by which persons in all parts of the building may talk to one another without having first to secure communication through the medium of a switchboard.

Another feature of the Brooklyn Rapid Transit Company's new home is that it does not contain a single gas pipe, as it will be lighted entirely by electricity.

The front of the building is done in brick and terra cotta. The style is that of the Renaissance. Four immense water tanks have been placed on the roof.

The arrangement of the offices in the new building is as follows: Basement, receivers' room, where money is counted, local postoffice, application and examining surgeon's offices for the employment bureau. First floor, secretary and treasurer's department, main office of employment and inspection departments, chief ticket agent's office. Second floor, general superintendent and his operating staff, including telegraph office of chief train despatcher for elevated system; general freight agent, superintendent of American Railway Traffic Company. Third floor, general attorney and claim agents. Fourth floor, comptroller and auditors. Fifth floor, attorneys and extra auditors' room. Sixth floor, president and vice-president and general manager. Seventh floor, purchasing agent, Brooklyn City Railroad offices, telephone operating room. Eighth floor, mechanical engineer, superintendent of power and assistants. Ninth floor, electrical engineer, department of reinforcement and repairs. Tenth floor, chief engineer. Eleventh floor, roof house, blueprint room. The Bell telephone switchboard used by the company requires six operators.

NEW YORK SUBWAY NOW COMPLETE FROM BATTERY TO WEST FARMS

Two important additions to the New York subway system were opened formally to traffic at 12:01 o'clock on the morning of July 10. One was the section of the tunnel from Fulton Street to the Battery, and the other the section running from 145th Street and Lenox Avenue under the Harlem River to the "L" extension running to West Farms. It is estimated that the running time from the Battery to 180th Street, West Farms, will be 50 minutes.

EFFECT OF ABSENCE OF WORLD'S FAIR TRAFFIC ON ST. LOUIS EARNINGS

Loss of the World's Fair traffic shows in the earnings of the United Railways, of St. Louis, for June, 1905, when compared with the earnings of the transit company for the same month last year. The decrease is $135,000, the largest for any month so far this year. This is fairly well balanced, however, by an increase of $93,000 over June, 1903, which gives a comparison with a normal period. The figures for the three periods are as follows: Gross earnings for the month of June, 1905 and 1904, June, 1905, $742,104.25; June, 1904, $927,732.82. Decrease, $185,628.57. Gross earnings for the month of June, 1905 and 1903, June, 1905, $742,104.25; June, 1903, $648,745.92; increase, $93,358.33.

ELECTRIFIED DIVISION OF LONG ISLAND RAILROAD READY FOR SERVICE

The first practical application of electricity as a motive power for the suburban divisions of steam railroads in the East will be made this week, when operation under the new system of the western lines of the Long Island Railroad will be inaugurated, and electric passenger trains will be run from the Flatbush Avenue terminal over the Rockaway Beach division. Though the first trains this week will be run on the Rockaway Beach division, 70 miles of third rail have been laid, and a corresponding length of track is ready for the electric operation. The zone practically completed includes the road from Flatbush Avenue to Belmont Park, and from Jamaica past the Metropolitan race track to Springfield Junction, and the Far Rockaway branch, via Valley Stream, as far as Hammel's. In addition to the electrification already completed, it is planned to electrify the Manhattan Beach line and the North Shore branch to Whitestone and Port Washington.

SPECIFICATIONS FOR CAST-IRON CAR WHEELS

At the convention at Atlantic City, June 29, 30 and July 1, of the American Society for Testing Materials, the following specifications were tentatively decided upon, and copies were sent to the members of the society for a letter ballot.

PROPOSED STANDARD SPECIFICATIONS FOR CAST-IRON CAR WHEELS

The wheels furnished under this specification must be made from the best materials, and in accordance with the best foundry methods. The following pattern analysis is given for information, as representing the chemistry of a good cast-iron wheel. Successful wheels, varying in some of the constituents quite considerably from the figures given, may be made:

	Per Cent
Total carbon	3.50
Graphite carbon	2.90
Combined carbon	0.60
Silicon	0.70
Manganese	0.40
Phosphorus	0.50
Sulphur	0.08

1. Wheels will be inspected and tested at the place of manufacture.

2. All wheels must conform in general design and in measurements to drawings, which will be furnished, and any departure from the standard drawing must be by special permission in writing, and manufacturers wishing to deviate from the standard dimensions must submit duplicate drawings showing the proposed changes, which must be approved.

3. The following table gives data as to weight and tests of various kinds of wheels for different kinds of cars and service:

Wheel	33-inch diameter Frgt. and Pass. cars.			36-inch diameter.	
Kind of service	60,000 lbs capacity and less.	70,000 lbs. capacity.	100,000 lbs. capacity.	Passenger Cars.	Locomotive Tenders.
Number	1	2	3	4	5
Weight Desired	600	650	700	700 lbs.	750 lbs.
Weight Variation	Two per cent either way.				
Height of drop, ft.	9	12	12	12	12
Number of blows	10	10	12	12	14

4. Each wheel must have plainly cast on the outside plate the name of the maker and place of manufacture. Each wheel must also have cast on the inside double plate the date of casting and a serial foundry number. The manufacturer must also provide for the guarantee mark, if so required by the contract. No wheel bearing a duplicate number, or a number which has once been passed upon, will be considered. Numbers of wheels once rejected will remain unfilled. No wheel bearing an indistinct number or date, or any evidence of an altered or defaced number will be considered.

5. All wheels offered for inspection must have been measured with a standard tape measure, and must have the shrinkage number stenciled in plain figures on the inside of the wheel. The standard tape measure must correspond in form and construction to the "Wheel Circumference Measure" established by the Master Car Builders' Association in 1900. The nomenclature of that measure need not, however, be followed, it being sufficient if the graduating marks indicating tape sizes are one-eighth of an inch apart. Any convenient method of showing the shrinkage or stencil number may be employed. Experience shows that standard tape measures elongate a little with use, and it is essential to have them frequently compared and rectified. When ready for inspection, the wheels must be arranged in rows according to shrinkage numbers, all wheels of the same date being grouped together. Wheels bearing dates more than thirty days prior to the date of inspection will not be accepted for test, except by permission. For any single inspection and test, only wheels having three consecutive shrinkage or stencil numbers will be considered. The manufacturer will, of course, decide what three shrinkage or stencil numbers he will submit in any given lot of 103 wheels offered, and the same three shrinkage or stencil numbers need not be offered each time.

6. The body of the wheels must be smooth and free from slag and blowholes, and the hubs must be solid. Wheels will not be rejected because of drawing around the center core. The tread and throat of the wheels must be smooth, free from deep and irregular wrinkles, slag, sand wash, chill cracks or swollen rims, and be free from any evidence of hollow rims, and the throat and thread must be practically free from sweat.

7. Wheels tested must show soft, clean, gray iron, free from defects, such as holes containing slag or dirt more than ¼ in. in diameter, or clusters of such holes, honey-combing of iron in the hub, white iron in the plates or hub, or clear white iron around the anchors of chaplets at a greater distance than ½ in. in any direction. The depth of the clear white iron must not exceed ⅞ in. at the throat, and 1 in. at the middle of the tread, nor must it be less than ⅜ in. at the throat or any part of the tread. The blending of the white iron with the gray iron behind must be without any distinct line of demarcation, and the iron must not have a mottled appearance in any part of the wheel at a greater distance than 1⅝ ins. from the tread or throat. The depth of chill will be determined by inspection of the three test wheels described below, all test wheels being broken for this purpose, if necessary. If one only of the three test wheels fails in limits of chill, all the lot under test of the same shrinkage or stencil number will be rejected and the test will be regarded as finished so far as this lot of 103 wheels is concerned. The manufacturer may, however, offer the wheels of the other two shrinkage or stencil numbers, provided they are acceptable in other respects, as constituents of another 103 wheels for a subsequent test. If two of the three test wheels fail in limits of chill, the wheels in the lot of 103 of the same shrinkage or stencil number as these two wheels will be rejected, and, as before, the test will be regarded as finished so far as this lot of 103 wheels is concerned. The manufacturer may, however, offer the wheels of the third shrinkage or stencil number, provided they are acceptable in other respects, as constituents of another 103 wheels for a subsequent test. If all three test wheels fail in limits of chill, of course the whole hundred will be rejected.

8. The manufacturer must notify when he is ready to ship not less than 100 wheels; must await the arrival of the inspector; must have a car, or cars, ready to be loaded with the wheels, and must furnish facilities and labor to enable the inspector to inspect, test, load and ship the wheels promptly. Wheels offered for inspection must not be covered with any substance which will hide defects.

9. A hundred or more wheels being ready for test, the inspector will make a list of the wheel numbers, at the same time examining each wheel for defects. Any wheels which fail to conform to specifications by reason of defects must be laid aside, and such wheels will not be accepted for shipment. As individual wheels are rejected, others of the proper shrinkage, or stencil number, may be offered to keep the number good.

10. The inspector will retape not less than 10 per cent of the wheels offered for test, and if he finds any showing wrong tape-marking, he will tape the whole lot and require them to be restenciled, at the same time having the old stencil marks obliterated. He will weigh and make check measurements of at least 10 per cent of the wheels offered for test, and if any of these wheels fail to conform to the specification, he will weigh and measure the whole lot, refusing to accept for shipment any wheels which fail in these respects.

11. Experience indicates that wheels with higher shrinkage or lower stencil numbers are more apt to fail on thermal test; more apt to fail on drop test, and more apt to exceed the maximum allowable chill than those with higher stencil or lower shrinkage numbers; while, on the other hand, wheels with higher stencil or lower shrinkage numbers are more apt to be deficient in chill. For each 103 wheels apparently acceptable, the inspector will select three wheels for test—one from each of the three shrinkage or stencil numbers offered. One of these wheels chosen for this purpose by the inspector must be tested by drop test as follows: The wheel must be placed flange downward in an anvil block weighing not less than 1700 lbs., set on rubble masonry 2 ft. deep and having three supports not more than 5 ins. wide for the flange of the wheel to rest on. It must be struck centrally upon the hub by a weight rof 200 lbs., falling from a height as shown in the previous table. The end of the falling weight must be flat, so as to strike fairly on the hub, and when by wear the bottom of the weight assumes a round or conical form, it must be replaced. The machine for making this test is shown on drawings which will be furnished. Should the wheels stand without breaking in two or more pieces the number of blow shown in the above table, the one hundred wheels represented by it will be considered satisfactory as to this test. Should it fail, the whole hundred will be rejected.

12. The other two test wheels must be tested as follows: The wheels must be laid flange down in the sand, and a channelway 1½ ins. in width at the center of the tread and 4 ins. deep must be molded with green sand around the wheel. The clean tread of the wheel must form one side of this channelway, and the clean flange must form as much of the bottom as its width will cover. The channelway must then be filled to the top from one ladle with molten cast iron, which must be poured directly into the channelway without previous cooling or stirring, and this iron must be so hot, when poured, that the ring which is formed when the metal is cold shall be solid or free from wrinkles or layers. Iron at this temperature will usually cut a hole at the point of impact with the flange. In order to avoid spitting during the pouring, the tread and inside of the flange during the thermal test should be covered with a coat of shellac; wheels which are wet or which have been

exposed to snow or frost may be warmed sufficiently to dry them or remove the frost before testing, but under no circumstances must the thermal test be applied to a wheel that in any part feels warm to the hand. The time when pouring ceases must be noted, and two minutes later an examination of the wheel under test must be made. If the wheel is found broken in pieces, or if any crack in the plates extends through or into the tread, the test wheel will be regarded as having failed. If both wheels stand, the whole hundred will be accepted as to this test. If both fail, the whole hundred will be rejected. If one only of the thermal test wheels fails, all of the lot under test of the same shrinkage or stencil number will be rejected, and the test will be regarded as finished, so far as this lot of wheels is concerned. The manufacturer may, however, offer the wheels of the other two shrinkage or stencil numbers, provided they are acceptable in other respects, as constituents of another 103 wheels for a subsequent test.

13. All wheels which pass inspection and test will be regarded as accepted, and may be either shipped or stored for future shipment, as arranged. It is desired that shipments should be, as far as possible, in lots of 100 wheels. In all cases the inspector must witness the shipment, and he must give, in his report, the numbers of all wheel inspected, and the disposition made of them.

14. Individual wheels will be considered to have failed and will not be accepted or further considered, which,

(1) Do not conform to standard design and measurement.

(2) Are under or over weight.

(3) Have the physical defects described in Section 6.

15. Each 103 wheels submitted for test will be considered to have failed and will not be accepted or considered further, if,

(1) The test wheels do not conform to Section 7, especially as to limits of white iron in the throat and tread and around chaplets.

(2) One of the test wheels does not stand the drop test as described in Section 11.

(3) Both of the two test wheels do not stand the thermal test as described in Section 12.

NEW YORK BOARD OF ESTIMATE AND APPORTIONMENT PERMITTED TO CONSIDER TRANSIT PLANS AND SPECIFICATIONS

That the New York Board of Estimate and Apportionment may consider plans and specifications submitted by the Rapid Transit Commission, but may not grant franchises, until the Appellate Division has given a decision on the question of the constitutionality of the law passed by the last Legislature taking away from the New York Board of Aldermen the power of granting street railway franchises is the substance of a decision given last week by Justice Gildersleeve in the Supreme Court. His decision was a modification of the stay granted by Justice Truax on June 29, pending appeal by the Aldermen's representative from Justice Blanchard's decision that the law is constitutional. By Justice Truax's decision the Board of Estimate was debarred from taking any action whatever with regard to new rapid transit routes.

In his decision, Justice Gildersleeve said he was satisfied that public interests might be subjected to serious injury if the stay continued in a form "entirely too broad," and he added:

"The stay must be limited to preventing the Board of Estimate and Apportionment from granting any franchises for rapid transit until the constitutionality of the act in question has been passed upon by the Appellate Division."

Assistant Corporation Counsel William P. Burr subsequently had an interview with Justice Gildersleeve, as a result of which Justice Gildersleeve handed down a revised decision, ending as follows:

"The stay must be limited to permit the Board of Estimate and Apportionment to proceed, as the time limit under the Rapid Transit Act expires to-day. There will be ample opportunity to prevent action after such approval, pending appeal, if he (the plaintiff) be so advised."

George Westinghouse has issued a denial of a newspaper statement that the Westinghouse interests were going extensively into the operation of trolley lines in competition with some of the large railroad systems. He said that he deemed it important to at once deny the statement, which he characterized as an attempt of unfriendly interests to prejudice the managers of the railways against the Westinghouse interests. As to the other statements in the article in question, Mr. Westinghouse sees no occasion to comment on them. The "other statements" had it that John F. Wallace, who recently resigned as chief engineer of the Panama Canal to accept a "$65,000 offer" from somebody whose identity is still undisclosed, was going to be identified hereafter with the Westinghouse interests.

CHANGE IN CONTROL OF LEAVENWORTH TRACTION PROPERTIES

Control of the Kansas City-Leavenworth Railroad Company has changed hands entirely. Conway F. Holmes has become president and general manager of the line. The new owners are Robert L. Gregory, Walton H. Holmes, C. F. Holmes, C. F. Hutchings, Kansas City, Kan.; Fisk & Robinson, New York, and C. J. Pack, Cleveland, Ohio. Fisk & Robinson are now completing the work of underwriting the reorganization bonds of the company, and have raised $1,500,000. Of this sum $400,000 is to be expended in straightening and improving the right of way, buying new equipment and otherwise bettering the service. The Gregory-Holmes syndicate has also acquired ownership of all the street railways in Leavenworth, extending as far as the fort. It is understood from those who are now in the field that the intention of the new owners is to lose no time in building to Atchison, and afterwards to go on to St. Joseph. The first thing to be undertaken, however, is to make it possible to shorten considerably the time between Kansas City and the present north terminus.

Thirty-eight cars are now in operation, and twelve up-to-date interurban cars have been ordered by President Holmes. These are to be rushed to completion as fast as possible.

A car is also to be purchased for express business. It is to run into Kansas City. The company has a contract which will permit it to cross the Sixth Street viaduct, when that structure is completed, and under the terms of the Metropolitan Street Railway Company's franchise it can send its cars as far as the commission houses on the Market Square without its having to lay more than two blocks of track in the city. This car, it is expected, will be operated for the benefit of the green market.

Several former Metropolitan Street Railway officers have rejoined the Holmes brothers in their new enterprise. Daniel Bontecum, formerly chief engineer of the Metropolitan Street Railway, of Kansas City, and at one time holding the same appointment with the Memphis Railway, is chief engineer of the trolley line under the reorganization company. Charles Grover, formerly with the Metropolitan, is the chief electrician of the reorganized company.

ELECTRIC RAILWAY EXHIBITS AT THE MILAN EXPOSITION NEXT YEAR

One of the main features of the Milan International Exposition, to be held in the summer of 1906, by way of celebrating the opening of the new Simplon tunnel through the Alps, will be the division of Carriage by Land, in which the exhibits will be devoted largely to electrical vehicles of all classes. The Italians have made such advances in this line of work, and are so seriously preparing to enter other fields than their own, that this part of the exposition will undoubtedly be very elaborate.

In the division will be included all branches of electric railway work. Thus, one section will be given up to generating plants, and will be devoted to plans and designs, models of water-power and steam plants, and of central stations, designs for direct-current generators, alternators and transformers in types specially suited for electric traction, and stationary accumulators for traction service.

In the equipment section there will be exhibits of poles, supports, insulators, systems for suspending wires and general attachments. A special feature which is invited for exhibit is displays of conductors for long-distance transmission and for service lines. The committee in charge is specially anxious to get exhibits of conductors and insulators for third rail, and overhead construction for heavy electric traction. Block signaling apparatus, telegraph and telephone apparatus for despatching and service on electric lines, and safety appliances are included in the programme for this section, and large exhibits will be made by the principal European firms.

In rolling stock, a branch of the business in which the Italians have not only excelled but have produced some very clever types, special designs for electric traction, cars and parts of cars, electric locomotives, controllers and the various styles of fenders will have an important place. The systems for taking current from the third rail, of particular interest in Europe at this time, will be given a special display in this section. The exposition will also offer a favorable opportunity to exhibitors of automotor cars for city service, trail cars and the trackless trolley cars. Several of these systems have proved successful in Europe for both summer and winter traffic.

SUBWAY CRITICS ANSWERED

In the STREET RAILWAY JOURNAL for June 24 was published a letter that appeared in the "New York Sun" from Nikola Tesla in regard to certain alleged defects in the New York subway. In this connection it is a pleasure to print the following letter by L. B. Stillwell, written to the editor of the "Sun" in answer to Mr. Tesla's criticisms:

In a letter printed in your issue of June 16, Nikola Tesla points out what he says he considers a source of danger in the subway and reiterates an opinion which he has previously expressed in your columns to the effect that a mistake was made in not adopting what he calls "my alternating system of distribution, popularly known as the 'two, three, multi, or polyphase.'" It is probable that some of your readers who have read some of Mr. Tesla's prophetic essays, which have appeared from time to time during the last ten or fifteen years in the daily press, may attach weight to his opinions, and as the public is greatly interested in the subway and its operation, statement of a few facts seems pertinent and proper.

It will be recalled, perhaps, by your readers that in your issue of Nov. 1, 1904, a letter from Mr. Tesla was published, in which *inter alia* he expressed the opinion that polyphase induction motors should have been adopted instead of continuous-current motors. Incidentally he remarked also that the distributing mains ought to be insulated artificially by refrigeration, that he recently perfected inventions which, "abolishing all barriers to electrical development, will soon sweep the world with irresistible force," that he approved Mr. Belmont's private car, that he had not seen the tunnel and did not know its location, and was equally ignorant as regards the power house, that the system adopted was of his own invention, but that it represented "the state of the art more than ten years ago," that a mistake had been made in not asking the electric companies to furnish the best instead of the cheapest equipment, and that the Interborough Rapid Transit Company had never asked him for any advice or suggestion.

In a letter, which was printed in your issue of Nov. 11, 1904, I stated that Mr. Belmont and his associate directors had imposed upon their engineering advisers no limit of cost, that if any mistake in the selection of electric equipment had been made it was mine—not Mr. Belmont's—and suggested that if Mr. Tesla would present before the American Institute of Electrical Engineers a paper containing specific and definite criticism of the equipment, I should be glad to meet him for the purpose of a full and frank discussion.

This suggestion, for reasons which were perhaps satisfactory to himself, Mr. Tesla declined to adopt, and in a long letter, which you printed in your issue of Nov. 27, 1904, in declining to appear before the Institute, he referred to a number of alleged accidents in the subway—the majority of which never happened—and again stated that the system adopted was one which he had "devised many years ago," that its adoption in this instance "was altogether too absurd to dignify it with any serious comment," that polyphase induction motors should have been used, and that he believed in advertising.

In his latest letter (that of the 16th inst.) he reiterates some of the statments contained in previous letters, and calls attention in the following words to a new danger which he has discovered: "The danger to which I refer lies in the possibility of generating an explosive mixture by electrolytic decomposition and thermic disassociation of water through the direct current used in the operation of the cars." His alternating-current polyphase system, as he says, would be free from this danger. Obviously, a charge so serious as this should rest upon a very substantial foundation of fact, and no consideration of self-interest or of personal animosity will excuse its author unless he can prove his charge. And what does Mr. Tesla offer as evidence that electrolytic decomposition of water is taking place in the subway? He says: "It will be recalled that an expert found the percentage of free oxygen in the subway appreciably above that which might reasonably have been expected in such a more or less stagnated channel." In other words, the subway air contains more oxygen than Mr. Tesla expected, and upon this fact he constructs his theory of the production of oxygen and hydrogen gas by electrolysis. He does not offer in his letter a scintilla of evidence that oxygen is thus being set free. No one has alleged that the air in the subway contains more oxygen than uncontaminated and free air. If Mr. Tesla, therefore, is comparing an actual analysis with anything more definite than his own notion of the kind of air that might be expected of the subway, it is for him to make clear his reasoning.

Prof. Charles F. Chandler, who was recently employed by the Health Department of the City of New York to test the condition of the subway from a sanitary standpoint with especial reference to the purity of the air, says:

"According to the best authorities, as, for example, Dr. John S. Billings, in his work, 'Ventilation and Heating,' the chemical composition of the atmosphere when uncontaminated is as follows:

Oxygen	20.80
Nitrogen	70.20
Carbon dioxide	0.03 or 0.04

"The composition is not absolutely constant, the oxygen being sometimes a little higher and sometimes a little lower than the percentage given above.

"Thus far, fifty samples of subway air have been carefully analyzed, and the percentage of oxygen determined, the result being a maximum of 20.80 and a minimum of 20.30—average 20.55. At the same time, nine samples of surface air were examined, showing a maximum of 20.90 and a minimum of 20.60—average 20.76."

It will be noted that the percentage of oxygen in subway air, as determined by Dr. Chandler, is a little less than that of normal uncontaminated air; there is, therefore, no excess of oxygen to be accounted for.

Among all that Mr. Tesla has said upon the subject, three charges besides that relating to alleged excess of oxygen perhaps call for reply in order that any part of the public which may have been disturbed by his statements may be reassured. These charges are: (1) That a mistake was made in not adopting polyphase induction motors, (2) that "not a single electrician of the General Electric or Westinghouse Companies was consulted, and (3) that a mistake was made in not asking the electric companies to furnish the best instead of the cheapest equipment."

The last of these charges I answered in my letter of Nov. 11, 1904. It is absolutely without the slightest foundation of fact. The management of the company aimed to secure the best system available, and no limitation in respect to cost was imposed upon its engineers. Apparently, Mr. Tesla seeks to convey the impression that the polyphase induction motor system is more expensive than that adopted. As a matter of fact, the reverse is the case, the chief claim of the induction system residing in the fact that it is less expensive than the system which the Interborough Company has adopted. Several years ago, when tenders were submitted by manufacturers to the Metropolitan and District Underground Railways in London, the induction motor system was proposed by Ganz & Company, of Buda-Pesth, and the price asked was approximately two-thirds the average price of the competing tenders which were based upon the system which has since been adopted for the New York subway.

The responsibility for decision in respect to the system adopted rests primarily upon me, but the plans were duly examined and approved by Messrs. Duncan and Hutchinson, consulting electrical engineers to the Rapid Transit Commission. As regards consultation with electricians and engineers of the General Electric and Westinghouse Companies, I have been in touch with the leading representatives of both companies from the outstart of this work up to the present time. Many of these gentlemen have contributed largely to the success of the installation and operation of the electrical equipment, and, so far as I am aware, are unanimous in believing that the best system available was adopted.

In support of his contention that a mistake was made in adopting the system which is in use, Mr. Tesla has offered simply an expression of his personal opinion. The polyphase motor system, as developed by Ganz & Company, of Buda-Pesth, undoubtedly has very strong points to commend it under certain conditions, and for what Mr. Tesla did in the early days of its inception the engineering world is under obligation, which in America has been fully recognized. Since certain United States patents were issued to him in 1888, however, he has done little, if anything, toward perfecting the motors and still less toward the development of the multitude of other devices which in the aggregate constitute an electric traction system. Scott, Lamme, Steinmetz, Berg and others in Pittsburg and Schenectady have developed and improved the induction motor so that it is now extensively used in stationary work, but it has never been used in America for traction purposes upon any scale which would have justified its adoption by the Interborough Company. In Europe, within the last five or six years, the engineers of Ganz & Company have developed it for traction purposes, and under certain conditions they have demonstrated its value in this field. Possibly this fact explains Mr. Tesla's recently revived interest in the motor of this type.

In conclusion, I may mention the fact that the system adopted for the operation of the subway and the elevated is identical with that adopted in Paris for the operation of the Metropolitan, in London for the operation of the so-called "Two-Penny Tube," the Metropolitan and the District Railways, in Brooklyn for the operation of the elevated lines; that it has been adopted by the engineers of the Pennsylvania Railroad, the Long Island Railroad and the New York Central & Hudson River Railroad, and is largely used throughout America for the operation of interurban railways.

The induction motor system, as supplied in Europe by Messrs. Ganz & Company, is beyond question an operative and in many respects most excellent system. Hitherto, however, American manufacturers have not placed such a system upon the market. I think I am safe in saying that at the time when Mr. Tesla thinks the induction motor should have been adopted in the subway not a single motor of this type was in use in America for traction purposes. (Signed) L. B. Stillwell.

ACCOUNTANTS' CONVENTION

Elmer M. White, of Hartford, Conn., secretary of the Street Railway Accountants' Association of America, is sending out the following circular:

The ninth annual convention of this association will be held in Philadelphia, Pa., in September. The first meeting will be on the afternoon of Thursday, the 28th, all day on Friday, the 29th, and, if necessary, Saturday, the 30th. Headquarters of this association will be at the Walton.

A convention circular will be issued during August.

The new collection of blanks and forms at the St. Louis convention was so helpful that it seems best to make an effort to bring the collection up to date for the Philadelphia meeting. I will, therefore, ask all the members to send to my address in Hartford a duplicate set of all blanks (four if printed on both sides), that they have adopted since the last meeting. The few members that did not contribute to the 1904 collection are earnestly requested to send a complete collection of all blanks. The blanks are received in so much better condition when sent flat that I will ask you to send them in that way, and not rolled.

As there have been several requests for charts of officials, or organization charts, I will ask any members that have printed copies to send them.

Only a few members have filed copies of annual reports, and as it seems a good practice I will ask all members that have printed reports to mail them as soon as issued.

The members are earnestly requested to make an effort to secure new members at once so that we may go to the next annual meeting with a larger membership than ever before. I regret to say that resignations have been more numerous than applications. This is not as it should be, for the present members can get more out of the association than they pay in dues, if they will only avail themselves of what we have to offer.

If we would only take the trouble to tell the companies that are not members of the advantages of our association we would have many applications.

Let us all take hold of this work with spirit.

RECENT WESTINGHOUSE CONTRACTS

The Westinghouse agents at Paris, which represents the Westinghouse interests in France, Spain, Switzerland, Italy and other countries on the continent of Europe, have been awarded a contract for the installation of the Westinghouse single-phase railway system on the Bergamo-Valle Brembana Railway, Italy. The length of the road will be 20 miles. It will be served by five 30-ton locomotives equipped with four single-phase motors of 75-hp capacity each, with multiple-unit control and pneumatically-operated bow trolleys. The gage of the track will be 4½ ft.

This is the second single-phase railway contract secured by the Westinghouse people in Italy, the first being the Rome-Civita-Castellana Railway. The value of the Bergamo-Valle Brembana contract is about $1,500,000.

Through the New York offices of the Japanese engineering and contracting firm of Takata & Company, a contract has been closed for the installation of a big hydro-electric plant at Kanazawa, to be operated by the Kanazawa Electric Light Company.

Two large domestic contracts are those obtained from the Fort Wayne & Wabash Valley Traction Company, of Fort Wayne, Ind., and the Cincinnati (Ohio) Northern Traction Company. The Fort Wayne contract calls for the entire electrical equipment, comprising both three-phase and two-phase apparatus, the former for the railway and the latter for lighting service. The machinery will be capable of developing 10,000 hp. Steam turbines will be installed. The electrical apparatus will be built by the Westinghouse Electric & Manufacturing Company, while the turbines will be turned out at the Westinghouse Machine Company's shops at East Pittsburg. The Cincinnati Northern Traction Company's contract calls for the equipment of the main generating station and four rotary converter sub-stations. The power house will be located at Hamilton, Ohio. The original installation will be of 5000-kw capacity, with provisions for eventually increasing it to 10,000 kw.

PROGRESS ON THE UNITED ENGINEERING BUILDING

Progress on the United Engineering Building, which is to house the Institutes of Electrical Engineers, Mining Engineers and the Mechanical Engineers, is marked by the award last week, by the committee in charge, of the contract for its construction. The contract was awarded to Wells Brothers Company, of New York, the contract being for the sum of $795,000. This does not include any allowance for the steam heating plant, electric wiring, etc., but relates simply to the general construction of the edifice. The ground is already excavated and the work will begin forthwith. October, 1906, is mentioned as the probable date of completion and readiness.

CONTRACTS GIVEN OUT FOR ELECTRIFYING THE LULU ISLAND ELECTRIC RAILWAY, BRITISH COLUMBIA

The electrification of the Lulu Island Electric Railway, which the British Columbia Electric recently took over, is being pushed ahead as fast as possible. It will cost $150,000 to do the work. The contract for the wire has been given to the firm of Eugene Phillipps & Company, of Montreal, and calls for 106 miles of wire. The contract for the overhead work, insulators, etc., has been let to the Canadian General Electric Company. The single-pole type of construction, with the pole set at one side of the track, will be used. The company is building a number of interurban cars for use on the line. They will be equipped with motors of 2000 hp, provided by the Canadian General Electric Company. The trucks are from the J. G. Brill Company, of Philadelphia. These cars will be equipped with air brakes, supplied by the Canada Foundry Company. In addition they will be equipped with the Sterling-Meaker safety hand-brake as an auxiliary. Each car will be provided with portable telephone instrument, so that any breakdown can be reported at once. Freight cars are also being built for use on the road. A contract has also been awarded to Ironsides, Rannie & Campbell for the construction of a sub-station at Eburne, 50 ft. x 60 ft. in size, and built of brick and concrete.

Mr. Hazlitt, of the British Columbia Electric Railway, is the purchasing agent for the Lulu Island Railway, and Mr. Buntzen is the managing director of both roads, with offices at Vancouver.

IMPROVEMENTS IN BROOKLYN

One of the most important of the improvements being made by the Brooklyn Rapid Transit Company is the construction of a four-track station, a new shop building, inspection pits and sheds and a storage yard for equipment at the old Union station, Fifth Avenue and Thirty-Sixth Street. Actual work on these changes and improvements, which will cost in the neighborhood of $250,000, has just been begun. The traffic to Coney Island and Bay Ridge has become so large in recent years that it became necessary to make some improvements to facilitate the movements and assure the safety of trains at this important point, for it is here that the Bay Ridge line branches off and the Bath Beach, Culver and Sea Beach lines leave the elevated structure for the surface. A new four-track station is being built, with two island platforms, each more than 300 ft. long. The tracks will be connected by underhanging galleries. The tracks and yards will be protected by a new set of electric interlocking switches, operated from a steel tower opposite the station.

In the rear of the station is being built a storage yard and inspection shed, with a capacity of 260 elevated cars. These tracks will be parallel to Thirty-Sixth Street, and will be crossed by a ladder track to carry cars from one track to another, which is to be reached by an incline from the main line. In order to gain space for the storage track the main line tracks are being relocated and are to be carried off to the side of a high hill between Thirty-Seventh Street and Thirty-Eighth Street. The inspection shed, 350 ft. x 110 ft., is to have eight tracks, each with accommodations for a six-car motor train. Under these tracks will be pits of concrete for the inspection of the motors and other equipment. The old station building will be entirely reconstructed. The upper floor will be extended and used for a shop superintendent's office, mill room, locker and lavatory rooms. There will be a mezzanine floor for the train despatcher's office. The lower floor will be extended to Thirty-Seventh Street, making a 200-ft. frontage on a level with Fifth Avenue. Here will be the machine shop, the stock room and elevators for lowering trucks and other equipment from the tracks overhead.

EXPERT BOARD FOR THE MICHIGAN CENTRAL RAILROAD TUNNEL

President Newman, of the Michigan Central Railroad Company, has announced that the construction of the Detroit Tunnel Line from Windsor, Ontario, to West Detroit yard, Michigan, including the electrification thereof, has been placed in charge of an advisory board of engineers, consisting of William J. Wilgus, vice-president of the New York Central & Hudson River Railroad; Howard Carson, consulting engineer, and W. S. Kinnear, chief engineer of the tunnel company.

The chief engineer will be in direct charge of construction, reporting to H. B. Ledyard, chairman of the board of directors, on executive and financial matters, and to the board of advisory engineers as to plans, specifications and methods of doing the work.

WM. K. VANDERBILT, JR., INSPECTS OHIO AND MICHIGAN INTERURBANS

William K. Vanderbilt, Jr., last week made a trip over the Northern Ohio, Lake Shore Electric Railway and the Detroit, Monroe & Toledo Short Line. He went as the guest of Horace Andrews and John J. Stanley, of the Cleveland Electric Railway, in the private car "Josephine." With the party were W. N. Kehrnan, of the Utica & Mohawk Valley Railway, and Warren M. Bicknell, of the Lake Shore Electric. Naturally the daily newspapers placed great significance on the trip, intimating that the roads inspected were to be absorbed by the Vanderbilt-Andrews interests, which are building up an electric railway system in Central New York. It is extremely improbable that any move of this kind is on foot at this time, as the syndicate will have its hands full for a time developing the properties it has already acquired. It was stated that Mr. Vanderbilt made the trip simply to acquaint himself with the operating conditions on some of the Ohio roads, because, as is generally known, he is to take an active interest in the work in Central New York.

An exciting incident occurred on the trip over the Lake Shore Electric. A short distance out of Cleveland the motor leads on the "Josephine" became heated and the floor caught fire. Mr. Stanley wrestled with a fire extinguisher, but could not open it, while the others ran to a neighboring farm house and brought pails of water and soon extinguished the fire. The car was taken to the repair shop, not far distant, and while temporary repairs were being made the whole party turned out and played baseball, Mr. Vanderbilt proving himself a star player. Mr. Vanderbilt was called home unexpectedly, and was unable to inspect several other roads in this district as he had planned.

STREET RAILWAY PATENTS

[This department is conducted by Rosenbaum & Stockbridge, patent attorneys, 140 Nassau Street, New York.]

UNITED STATES PATENTS ISSUED JULY 5, 1905

793,758. Brake-Rod Connection; George A. Woodman, Chicago, Ill. App. filed Aug. 15, 1904. A brake-jaw for car brake-rods having a transverse opening to receive the rod and a keeper adjacent to one end of said opening to secure the end of the rod.

793,763. Car Truck; William P. Bettendorf, Davenport, Ia. App. filed March 21, 1904. Comprises a transom and side frames having journal-boxes made integral therewith of one body of metal, having a transverse opening, the sill of which forms a horizontal support upon which the end portions of the transom rest, and having lugs projecting inward therefrom with which the ends of said transom interlock.

793,764. Car Truck; William P. Bettendorf, Davenport, Ia. App. filed March 25, 1904. Comprises side frames having integral journal-boxes made of one body of metal therewith, and axles journalled in said boxes and movable vertically independent of said boxes.

793,863. Car Seat; Henry F. Vogel, St. Louis, Mo. App. filed March 1, 1905. A hand grip at the upper corner of the seat back and a hand-rod extending along the top thereof.

793,924. Track Cleaner; Benjamin L. Dresser, Uxbridge, Mass. App. filed Dec. 7, 1904. A shaft mounted in advance of the car axle, and driven therefrom is connected at each end through a universal joint with stub shafts carrying brushes, whereby the brushes may operate at an angle to the line of axis of the shaft and to the track rails. A second shaft mounted in advance of the first and driven thereby carries cutter wheels for removing ice, etc., from the rails.

794,020. Trolley Head; Harry I. Jeffers, Tuscaloosa, Ala. App. filed Aug. 20, 1903. When the wheel leaves the wire the wheel will drop down into the harp to the level of a pair of spiral guide rollers, which engage the wire and guide it to the wheel, after which the wheel will again rise to operative position.

793,965. Trolley; William F. Thompson, Coraopolis, Pa. App. filed Dec. 28, 1904. A pair of spring arms mounted on the harp are adapted to overlie the groove of the trolley wheel, and are displaced laterally to pass an obstruction. The trolley wheel is vertically movable in the harp.

794,051. Automatic Switch; William D. Simpson, Columbia, S. C. App. filed April 10, 1905. Details of construction of a shoe for engaging and throwing the switch tongue from a movable car.

794,076. Brake; Thomas F. Brennan and Michael J. Brennan, Scranton, Pa. App. filed Oct. 7, 1904. A brake wheel mounted on the car axle, a band surrounding the same and means for tightening the band.

PERSONAL MENTION

MR. HERBERT M. YOUNG, superintendent of the Milford, Attleboro & Woonsocket (R. I.) Street Railway and of other roads under the same management, has resigned. His place is taken temporarily by Mr. Winthrop B. Nye, assistant superintendent, who is made acting superintendent. Mr. Young had been with the company since 1887, serving it first as driver of a horse car. About fifteen years ago he was made superintendent of the Woonsocket line, and has been put in charge of the various lines as they have been attached to the system.

MR. H. E. REYNOLDS, who has been connected with the Old Colony Street Railway for twenty-one years, has been promoted to the new office of assistant general manager, created by the Boston & Northern and Old Colony Street Railways. Mr. Reynolds has worked his way up gradually from the ranks to his present position, starting with the old Brockton Street Railway Company as a conductor, then acting as cashier, bookkeeper, assistant treasurer and treasurer. At the time of the consolidation of the many street railways south of Boston, into what is now known as the Old Colony Street Railway, he was appointed superintendent of the Quincy and Hyde Park divisions of the company, where he remained until July, 1903, when he was appointed assistant general superintendent of the entire system, with headquarters at Brockton. In 1904 he was tendered the position of purchasing agent of the Old Colony and Boston & Northern Street Railways, which he held until his present appointment. The two companies operate over 850 miles of track north and south of Boston, extending from Nashua, N. H., and along the Merrimac Valley and the North Shore, through the entire State of Massachusetts to Providence and Newport, R. I., serving twenty-two cities and sixty-six towns. Philip M. Reynolds, who has been in the employ of the companies for some time, will succeed Mr. Reynolds as purchasing agent.

H. E. REYNOLDS

MR. SAMUEL A. FRESHNEY, of Muskegon, Mich., general manager of the Muskegon Lighting & Traction Company, has been chosen by the Grand Rapids Board of Public Works for the recently-created position of general manager of the public service department. He will have general supervision of the municipal water works, lighting plant and all public service departments. Mr. Freshney became connected with the Muskegon Traction Company in 1902, when the company was reorganized. Since then the electric light, street railway and the gas department have been rebuilt and enlarged and many other improvements have been made. Mr. Freshney was born in London, Eng. His first electrical work was in Cleveland, Ohio, where he was for a number of years employed in the engineering and sales department of the Brush Electrical Company and Short Electric Railway Company. From 1902 to 1897 he was manager of the old Muskegon Electric Light works, now a part of the Muskegon Traction & Lighting Company. He has been with the Fort Wayne (Ind.) Electric Works as manager of the Cincinnati office, and later in Grand Rapids as manager of their western Michigan office.

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Changes of advertising copy should reach this office by 10 a. m. Monday preceding the date of publication, except the first issue of the month, for which changes of copy should be received two weeks prior to publication date. New advertisements for any issue will be accepted up to noon of Tuesday for the paper dated the following Saturday.

Of this issue of the Street Railway Journal 8000 *copies are printed. Total circulation for* 1905, *to date,* 237,350 *copies, an average of* 8184 *copies per week.*

Unpalatable Good Advice

The result of Mr. Dalrymple's trip from Glasgow to Chicago, at Mayor Dunne's invitation, to advise regarding municipal ownership of street railways, has followed exactly the programme laid down in our editorial of May 13 last on the "Loan of a Conscience." Mr. Dalrymple has returned to Glasgow, and has sent his report to Mayor Dunne, but at present writing the recipient has been scrupulously careful not to let that report get out of his pocket, although it is supposedly a public document. The conclusions as to what the report contained in the way of advice on municipal ownership in Chicago, in the light of all the circumstances, are too evident to need further statement.

But Mayor Dunne is not alone in his disillusion. A neighboring Mayor also had his experience, and has been left, we fear, in a mournful and chastened frame of mind as the result of Mr. Dalrymple's visit, and after attempting to utilize him as the herald of a political boom. The perverse and hard-headed Scot somehow was unable to see how graft and economy could be made to pull in double harness, and when Mayors Dunne and Johnson get together and compare notes on the advice they have received in his report, municipal ownership will hardly seem the land overflowing with milk and honey which their fervid imaginations have pictured. Mr. Dalrymple seems to have acquainted himself very fully and rapidly with the situation in Chicago, and now, after his brief visit to America, probably realizes the true inwardness of the municipal ownership movement here better than he could learn it by a year of reading on his side of the Atlantic. He knows from practical experience the small margin of profit on which street railways have to work, and he sees clearly that unless municipal tramways can be removed completely from control by and for the gang, they can show only sorry deficits in the result of operation. When one stops to think that more than half of each passenger's nickel goes to pay actual operating expenses, without including any proper allowance for general depreciation, the hopelessness of any 3-cent fare proposition is self-evident. Even granting the worst that has been claimed as to over-capitalization of street railway properties, there is no room left between operating expenses and 3 cents for a reasonable argument. And if a street railway gets into the clutches of a political machine, of however guaranteed respectability, its day in the state of solvency will be a very short one. If Mayor Dunne really wanted good advice, let him follow it.

Chicago's "Immediate Municipal Ownership"

While the whole country is waiting breathlessly for the "immediate municipal ownership" of street railways which was promised as a result of the city election of last April in Chicago, there seems to be a hitch in the proceedings, just as everyone knew there would be who had given any study to the complicated traction situation in Chicago. The hitch has certainly not been due to any failure of the traction interests to meet the city half way in the matter of acquiring the street railway lines. Negotiations were soon opened between the city and the companies, and then abruptly closed by Mayor Dunne. The Mayor then brought out several schemes for bringing about municipal ownership, the last of which bore a very strong resemblance to the extension ordinance proposed before his election for the Chicago City Railway Company, with the exceptions that it left out of account many important existing franchises, that it was not comprehensive and that it

did not by any means solve the whole problem for the entire city. It soon became evident that neither the public nor the City Council would stand for the building of 100 miles or 200 miles of municipal railway and leave the problem hanging over the balance of the city for several years. The latest reports are that the city and the companies are again about to talk business. It is the opinion of many street railway men over the country that it would have a most wholesome effect on the present fad for municipal ownership of street railways which is sweeping over the country if Chicago would at once proceed to try it. Even should it prove a moderate success in Chicago, which seems altogether unlikely, the fact that it would be sure not to be the great bonanza that many believe it to be would take off some of the glamor and put an end to the fad.

Just at the present time political conditions in Chicago are not by any means as corrupt as in years past, and are much better than generally supposed by those who have not been recently acquainted with them. Should these conditions continue and improve, the effect of politics in municipal operation would not be as immediately fatal as it would have been in years past, but the final result would undoubtedly be just as disastrous. The history of traction matters in Chicago for the few years during which Chicago has had the "honest majority" in its Council, indicates another very serious danger which exists in all municipal operations, namely, the danger of having too many managers. Not a move has been proposed in Chicago which really offers a solution of the traction problem on a sensible and reasonable basis that the cry of corruption has not been raised in some quarter. The "honest majority" in the Council, although successful in preventing corrupt legislation, appears so far to be unable to agree on good legislation. Thus far the City Council and the Mayor have proved successful as "obstructionists," but they have yet to make a record as successful "constructionists."

Lighting and Power from Railway Circuits

A topic of interest to electric railway companies is the supply of lighting and power from railway circuits. This is a subject which we have touched on recently in these columns and which has been considered in our Question Box, but a further discussion may prove of interest. It should properly be considered not as the mere operation of all classes of service from one system, but as dealing with light and power supply where the railway is the predominating factor in the distribution. In the good old times, before the underwriters set up their beneficent autocracy, motors and lights were run from trolley systems without much hindrance. Everything went, so to speak, and if the lights flickered it was charged up to the depredations of a vagrant ohm, popularly supposed to be a sort of Croton bug infesting electric wires. Now, however, the problem takes on a very different aspect, and practically implies operating an incidental lighting and power load not from the trolley wire, but from the power station and feeders, so as to give what may fairly be considered good, or, at least, tolerable service. All the testimony received on this question has been rather favorable, as was to be expected in the present state of electrical equipments. Granting that the fluctuations of a railway load are such as to forbid lighting directly from alternating feeder circuits, it is still easily possible to get good service by working motor generators on the lighting load. The motor generator, by the way, is just beginning to be appreciated in this country at somewhere nearly its real value. It was for some years pushed almost completely into the background by rotary converters, but however desirable these latter machines may be on certain classes of work, they are inferior to motor generators in preserving constant voltage at the generator end of the outfit. Well-designed motor generators, either d. c. to d. c., or a. c. to d. c., can be made to give excellent operative results, even when the voltage fluctuations of the source are rather severe. They are coming into larger use every year, and we see no reason why many electric railway systems should not make them a source of profitable additional business. Many a road now runs through a country that can hardly support an independent lighting circuit, but which would furnish considerable business if current could be supplied for it. In such cases a motor generator, perhaps merely in the form of a frequency changer, can give current cheaply and easily. It need not require a complicated plant to do the work. In fact, a motor generator of proper design can be made to give excellent service with very little attention of any kind. Every long railway system has scattered sub-stations requiring attendants, and by installing a small motor generator in one of these a very useful lighting service could be worked up. The stations that have tried such a scheme seem to report favorable results, and their experience should encourage others. In fact, in certain cases, the available lighting may well become no inconsiderable item in the gross receipts. The same is true of stationary motor service, which makes much less formidable demands in the matter of close voltage regulation, and is therefore easier to carry on. In this case a good deal of the business does not require motor generators at all, and the effect of the added load on the power station is beneficial.

Apropos of this subject, three very pertinent concrete questions came up to us the other day which, in the interest of railway men in general, deserve a somewhat extended answer. First: Can a railway circuit at 25 cycles give reasonably good service directly from its wires, assuming that the district does not furnish enough business to justify sub-station working? As regards the practicability of lighting from a 25-cycle circuit, there is some difference among authorities. It really depends upon what quality of light the consumer will be satisfied with. If really good lighting is intended, it is the opinion of most engineers who have studied the subject, that 25 cycles is just too low a periodicity for satisfactory service. Some persons fail to recognize the pulsation in the light, but a good many do notice it unpleasantly, and certainly with ordinary incandescent lamps of 16 cp and 110 volts, or thereabouts, it would be inadvisable to try lighting. With 50-volt lamps, particularly if of 20 cp or above, the fluctuations due to the periodicity would be far less troublesome, but those due to variation of voltage from the railway load would still remain, and we do not think the service could be made satisfactory to most consumers. To do commercially good work from such circuits it is necessary to do something to steady the voltage, and the particular thing selected depends somewhat on the nature of the service to be attempted. The main difficulty is that the variations of voltage and speed generally produce a cumulative effect.

Second: Which is preferable in trying lighting from a railway circuit, a motor-generator set with synchronous motor or one with induction motor? The answer depends upon the nature of the service to be attempted, and also upon the sort of fluctuations to be encountered in the supply current. The use of a synchronous motor averts all speed variations in the motor due to variations of voltage in the supply, while in either case the variations due to change of periodicity will remain. At the

end of a long feeder, where the drop is considerable, the former difference may be important. The synchronous motor requires a little the more attention, and has at times given trouble from "pumping." This latter difficulty can readily be avoided, however, and in large sub-stations the synchronous set is probably preferable, provided the frequency can be held reasonably uniform, as it generally can be in a large system. When, however, the amount of lighting to be provided is small and it is necessary to use a motor generator requiring the minimum of attention, the induction motor is altogether preferable. It can be made so as to have a relatively small drop in speed, with moderate variations in the supply voltage, and, as everybody knows, is extraordinarily reliable as a motive power. If it were not necessary to have direct current for the excitation of the generator fields, a motor-generator set with an induction motor could practically be left to itself, save for visits to start and to stop. With a location where current from the trolley wire is available, a generator could probably be given excitation from a storage battery or by special devices from the circuit, so as to be entirely self-acting so far as frequent attention is concerned.

This brings up the third question: Can voltage regulators on the fields of the generator of the motor-generator set be made to give good service in lighting when the frequency of the circuit varies 3 per cent to 5 per cent owing to fluctuating load? That depends on the character of the fluctuations. If they are rather rapid, as often happens on a railway system, no voltage regulator with which we are acquainted will hold the voltage steady. They will do good work, however, for fluctuations that are not too rapid. The trouble comes from the fact that when the speed of the motor falls from dropping frequency it falls sharply and takes down the field of the self-excited generator with it. The voltage regulator has to deal with the summed effect of these drops, and if the fluctuations are rapid the regulator cannot follow them. It serves as a palliative rather than a cure, but may make successful lighting possible in many instances that could hardly be attempted without it. We should certainly advise its use, without, however, guaranteeing a cure. In a station large enough to justify a regular attendant by the help of voltage regulators and judicious care, very good service can be given, even from a pretty badly fluctuating source. The main difficulty comes from working on so small a scale that the apparatus must be practically automatic. The problem of making a small motor generator that will give practically constant potential when supplied from a fluctuating source is one that has not yet been satisfactorily solved. It is an excellent thing for inventors to whet their wits upon, for it is badly needed and is surely within the range of possibility. Work on ordinary sub-station scale is easy enough, and should be tried oftener than it is.

The Size of Power Stations

One of the first questions to be determined in estimating the cost of a new electric road is the size of the power station which will be necessary for its proper operation. While such figures can most accurately be determined by an exhaustive study of the proposed profile and the weight, equipment and schedule of rolling stock suggested, in conjunction with speed-time-current curves derived from published motor characteristics, there is seldom time for such thorough work in the early stages of the game. Round numbers are wanted, instead of close detailed analyses.

Two rapid methods often used in getting the power station capacity needed are worth considering. One of these, and perhaps that which most readly suggests itself as a common-sense proceeding, is to compare the proposition in hand with others of similar design. Granted a close resemblance between the conditions, there could hardly be a better way in which to obtain rough figures of the amount of power required at the station to operate a given service. The trouble is, however, that the conditions seldom are as much alike as is assumed: the topography varies, the feeder system is entirely different in its arrangement, or the rolling stock equipment and the schedules do not agree in important particulars. All these possible variations call for the greatest care in exercising snap judgments based upon what another road is doing, but if such comparisons are made with due appreciation of where the conditions fail to parallel each other, much can be learned by the promoters of the new project from the experience of the older roads. In this connection, the collection of data showing the actual consumption of current at the power stations on many different roads operating various numbers and weights of cars at certain schedule speeds and stops per mile, cannot be begun too soon by those who desire to estimate along the lines just discussed.

The other method, which is certainly good as a check, if not equal to the demands of precise work, consists in estimating the average and maximum demand of current to be expected from a given number of motors of definite rating, assuming that the motors are worked to their full capacity as regards safe temperature rise. Thus, suppose a road is operating 20 cars, each equipped with four 40-hp motors, and that the motors are selected to work close up to the margin of their safe capacity—as motors ordinarily should be selected. It will not be far wrong to assume on this basis that at the cars there will be a continuous demand of about 300 hp, allowing for lighting and heating. Suppose a line and transforming efficiency of 60 per cent—which in many cases ought to be bettered—we need 500 hp constantly at the generators to properly keep the cars moving. Fluctuations must now be considered, and here the problem is most difficult, owing to the absence of exhaustive data upon the relation between the number of cars in service and the ratio between the average and maximum demand upon the power station, momentarily considered. If at any one time five of the cars are accelerating and the other fifteen taking an average amount of power, we shall have frequent momentary fluctuations running up to 750 kw, and sometimes 1000 kw, or even 1200 kw, when half the cars start at once. It would seem that in such a case the power station ought to provide at least 800 kw in normal machinery capacity, and considering the needs of the repair shop, and snow-plows in the winter season, if in a cold climate, 1000 kw would be safe to figure upon in preliminary specifications. It is much better to figure high in preliminaries than to revise during design and construction, and require the bankers to raise additional money.

Power stations are fortunately not often built in too large capacity for the demands of a live electric railway proposition, but the mistake is now and then made of trying to squeeze along with outworn, second-hand machinery for the sake of economy in first cost. Then, again, it is not uncommon to find roads, particularly where land is cheap, tying up too much money in building a larger power-station structure than is needed to house the existing machinery. These things should be figured carefully before vacant engine-room and boiler-house space is allowed to accumulate fixed charges upon the building proper.

NEW CAR SHOPS AND HOUSES FOR THE PUBLIC SERVICE CORPORATION OF NEW JERSEY

BY MARTIN SCHREIBER, M. E.

The officials of the Public Service Corporation of New Jersey have just completed the plans and specifications for one of the most complete and modern railways shop and car-house plants in the country. Work will be commenced immediately, and vigorously pushed to an early completion. The new plant will cost approximately $500,000.

The important repairs of the rolling equipment on this system are now taken care of at two principal points, the Plank Road shop at Newark, and the West Hoboken shop at West Hoboken, N. J., all the minor repairs being done at the individual operating car houses and yards.

The company operates upward of 1700 cars over about 550 miles of track. On account of the rapid growth and improvement of the road, it has become necessary to add more and complete facilities for maintenance and equipment, and it has been decided that in providing the new facilities all the important repair work will be carried out at the Plank Road shops at Newark.

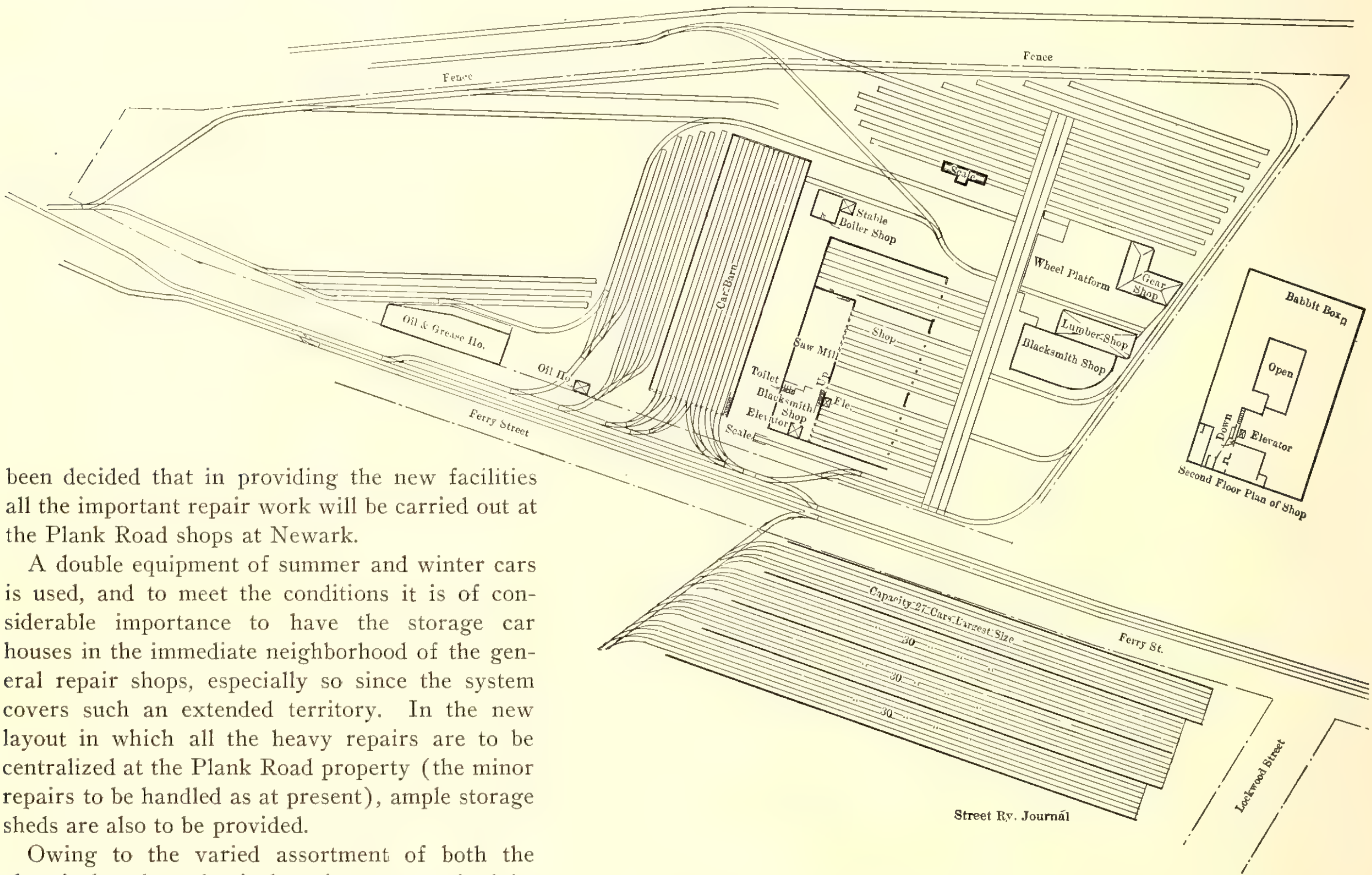
A double equipment of summer and winter cars is used, and to meet the conditions it is of considerable importance to have the storage car houses in the immediate neighborhood of the general repair shops, especially so since the system covers such an extended territory. In the new layout in which all the heavy repairs are to be centralized at the Plank Road property (the minor repairs to be handled as at present), ample storage sheds are also to be provided.

Owing to the varied assortment of both the electrical and mechanical equipment acquired by the merger of many companies, the present problem of the maintenance of the rolling equipment is a most trying one. However, it is intended to gradually standardize the entire apparatus as well as centralize the important repair work, so that a very marked operating saving and a betterment of service will undoubtedly follow.

One of the engravings represents the old property at the Plank Road as it exists, where 60 per cent of the heavy repairs of the rolling equipment is being done under considerable disadvantage. The main building consists of a brick two-story structure 190 ft. x 120 ft., the first floor of which is taken up with the truck shop and mill room, and the second floor used for a machine shop, winding room, etc. Part of the second floor is reserved for a general store room for the entire system, all of which is clearly indicated in the drawing. Then there is a blacksmith shop 90 ft. x 45 ft., a building that has been completed about a year, so that most of the equipment is new. The apparatus in this building consists of six Buffalo Forge down-draught forges, steam hammer, shears, etc. All the rebabbitting of bearings is also done in the blacksmith shop. Formerly the building marked "carpenter shop" was used as an operating car house for the Plank Road Line, which operates between Newark and Jersey City. It is a brick structure 80 ft. x 250 ft., and was recently converted into temporary quarters for the carpenter work.

On the south side of Ferry Street, which may also be seen in the drawing referred to, are new storage car houses that were completed last December. They are built of brick and consist of four bays, each bay containing three tracks 450 ft. long. All the walls are solid, and the roof is of mill construction with a 10-ft. x 10-ft. wire-glass skylight and a 48-in. ventilator every 32 ft. These storage car houses were described in the STREET RAILWAY JOURNAL for Februrary 2, 1905.

The accompanying large plan drawing of the grounds and buildings clearly brings out the new arrangement of the different shops with their separate departments; also the layout of the tracks, etc. This is the final scheme which was decided upon after very careful consideration and study of the existing conditions that were to be met.



OLD LAY-OUT OF PLANK ROAD SHOPS AND CAR HOUSE

It is noted that about 13 acres of additional property has been acquired for the project, this new land being principally intended for the additional storage facilities. It may be of importance to state that the Plank Road property was selected as the particular place of centralizing the shops for the reason that, first, the company already owned the property as shown in the old layout, and second, the location was desirable, as it was near the largest city the company covered and also centrally located for the remaining properties. Moreover, the adjoining property along the south side of the shop site is owned by the Pennsylvania Railroad, which has a spur running parallel to the property line. A connection to the Pennsylvania tracks makes it very convenient for bringing in sup-

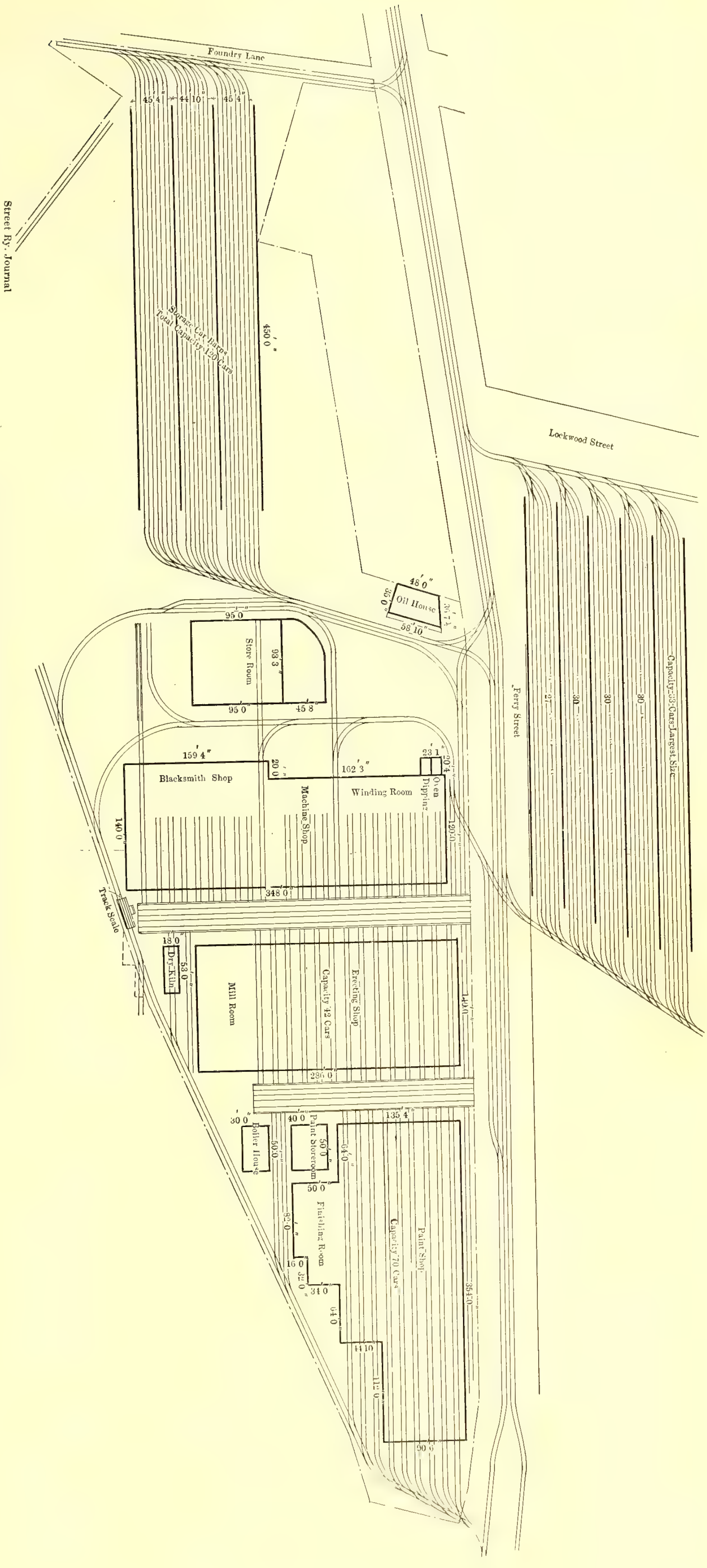
plies by rail, inasmuch as a freight car may be brought directly into the shop yards.

Referring to the new plan, it is noted that the transfer table has been resorted to for shifting and handling the cars; this was considered the best arrangement that could be adopted. It has great advantage over the method of long lead tracks and extensive yard room. Short tracks laid parallel in the buildings render all the space at hand available, and every car is easy of access. Also with this layout a car can be moved without loss of time from one building to another as the various work on that particular body progresses. Moreover, with any other practical arrangement, the progress of the work is often limited by the speed of moving the cars about and not by the number of men at work or the space at hand. With the transfer table arrangement a number of tables may be put into commission, thus greatly reducing all interference with speedy transferring of cars. It is a well-known fact that the capacity of every shop must be overtaxed at times, and it is the facility of responding to this "overload" condition without an excessive cost per car that the transfer table makes a possibility.

For the present, two tables will be built for each transfer run, of which there are two, one between the erecting and machine shops, and one between the paint and erecting shops. The distance between buildings is 60 ft., this being deemed sufficient for handling the company's largest size cars. The transfer table itself is 32 ft. long, and the transfer pit is 32 ft. 1 in. wide.

A transfer table of a substantial but very simple design has been devised and will be built at the company's own shop. From one of the accompanying drawings, showing the principal details of the new table, it will be seen that it is made up of six standard trucks, supporting six twin-bar girders, which carry two 9-in. guard rails. The table is stiffened in the horizontal plane by means of a set of ⅞-in. rods. Power is obtained from a General Electric 800 motor. Each table has a platform arranged for operating a K-10 controller and breaking lever, the brake lever being connected to a 6-in. x ⅛-in. steel band that grips a 21-in. cast-iron split pulley keyed fast to the driving shaft. The transfer table pits are enclosed with concrete walls 5 ft. deep, and the pit is 2 ft. 10 ins. from top of rail in the bottom to top of rail in the building. Three tracks on 12-ft. 3 3-16-in. centers and

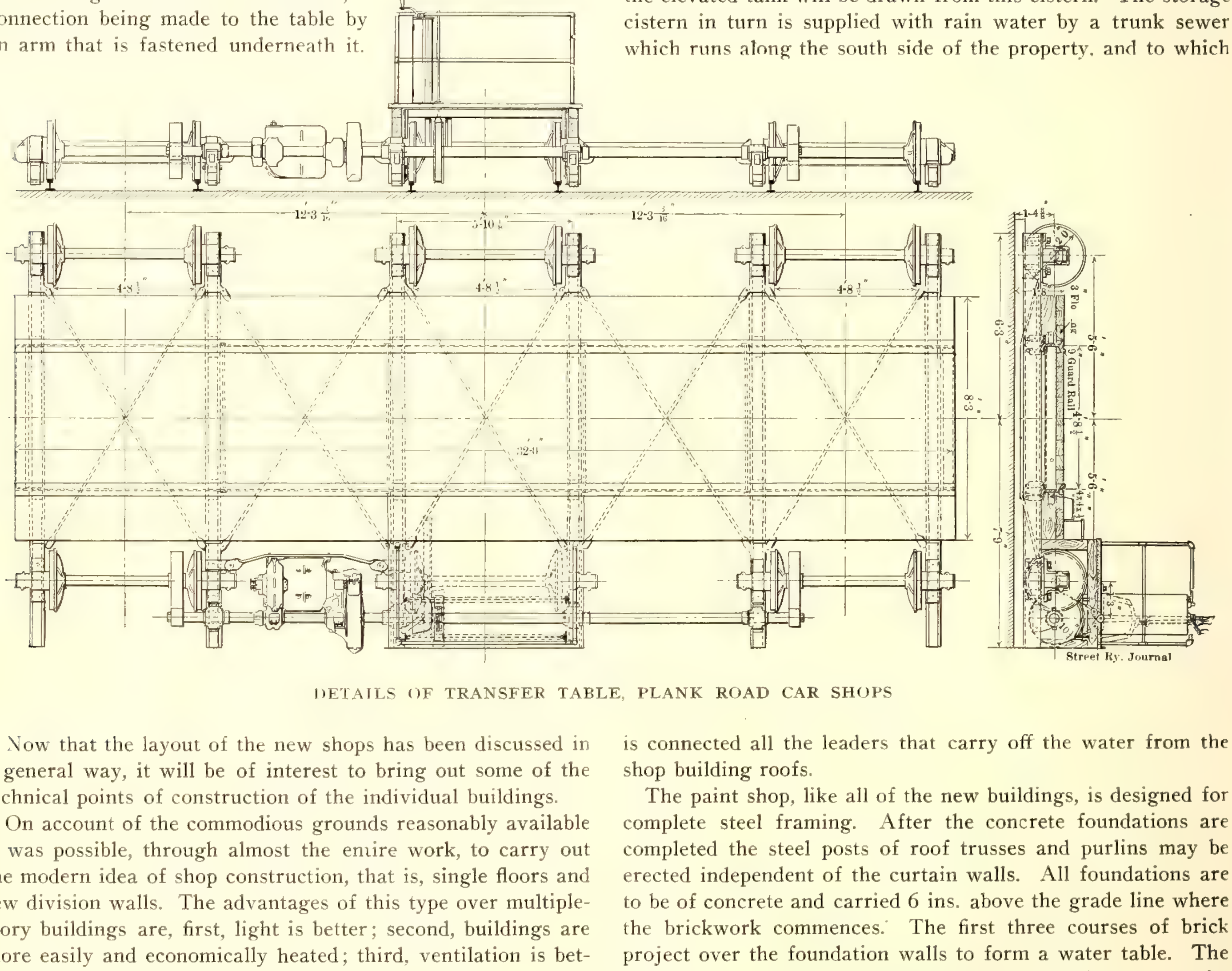
Street Ry. Journal



PROPOSED NEW LAY-OUT OF PLANK ROAD SHOPS AND CAR HOUSES

of standard 4-ft. 8½-in. gage form the runs for the tables.

From the drawing showing the new layout it is plain that cars which are brought from any part of the system may enter the shops from Ferry Street connections and that there is a very elaborate track layout provided to readily accommodate this condition. The out-of-service cars may be placed in storage on the north or south side of Ferry Street. These out-of-season cars will only have to make one trip from any part of the entire system to the Plank Road property for overhauling and for storage, thereby eliminating a great deal of dead mileage now necessary by reason of repairing the cars at one point and storing them at the different operating and storage car houses. Inasmuch as many of the cars will go into the shop "dead," it is probable that no trolley wire will be provided for any of the buildings, but the cars will be moved by a cable on an electrically-operated drum placed at the end of the tracks and on transfer tables. Such a scheme would greatly reduce the fire risk and afford a very marked saving in the insurance rates. The transfer tables are not to be supplied with current from an overhead trolley but by a trolley wire stretched and protected along the inside of table walls, a connection being made to the table by an arm that is fastened underneath it.



DETAILS OF TRANSFER TABLE, PLANK ROAD CAR SHOPS

Now that the layout of the new shops has been discussed in a general way, it will be of interest to bring out some of the technical points of construction of the individual buildings.

On account of the commodious grounds reasonably available it was possible, through almost the entire work, to carry out the modern idea of shop construction, that is, single floors and few division walls. The advantages of this type over multiple-story buildings are, first, light is better; second, buildings are more easily and economically heated; third, ventilation is better; fourth, foundations of machinery are cheaper; fifth, floors cost less; sixth, supervision is easier; seventh, cost of construction is less, and eighth, there is less danger from damage due to fire. Moreover, it was constantly kept in mind in arranging the individual shops to avoid defects in design that would cause inconvenience in handling materials and interference with workmen.

PAINT SHOP

The general design of the paint shop is well shown in one of the drawings. The building proper is 354 ft. x 135 ft., and contains nine tracks capable of housing 70 average size cars operated by the company. The tracks are placed on 14-ft. centers except where the columns come, where the track spacing is increased to 16 ft. A finishing room 82 ft. x 50 ft. is provided on the south side, where small work stripped from the car bodies will be taken care of. Near the southwest corner of the main building is a fireproof paint store room, where all the mixing and storing of paints is to be carried out. At the west end of the building, just within the doors, is a wash stand for every track, so that a car entering the shop on any of the nine tracks may be first cleaned down and washed before proceeding further. On overhead trusses a drop connection to which a hose may be connected is provided over each track and is supplied with soft rain water, which is considered especially adapted for cleaning car bodies. The soft water supply is taken from an elevated tank on the south side of the building. This tank is built of steel and has a capacity of 25,000 gals. It is supported by a structural steel tower of sufficient height to give a water supply at a pressure of 40 lbs. The columns supporting the steel tank rest directly on the walls of a storage cistern built in the ground. This cistern has an inside diameter of 25 ft. and a clear depth of 15 ft., and the water supply for the elevated tank will be drawn from this cistern. The storage cistern in turn is supplied with rain water by a trunk sewer which runs along the south side of the property, and to which is connected all the leaders that carry off the water from the shop building roofs.

The paint shop, like all of the new buildings, is designed for complete steel framing. After the concrete foundations are completed the steel posts of roof trusses and purlins may be erected independent of the curtain walls. All foundations are to be of concrete and carried 6 ins. above the grade line where the brickwork commences. The first three courses of brick project over the foundation walls to form a water table. The roof trusses are placed on 16-ft. centers, and there are 20-in. x 2-ft. pilasters in the outside walls at this spacing, the intermediate or curtain walls being 12 ins. thick. There is 16 ft. clear height under the bottom chord of steel roof trusses and columns are placed between every third track, the columns consisting of four 3½-in. x 2½-in. x ¼-in. angles and a web plate 6 ins. x 5-16 in.

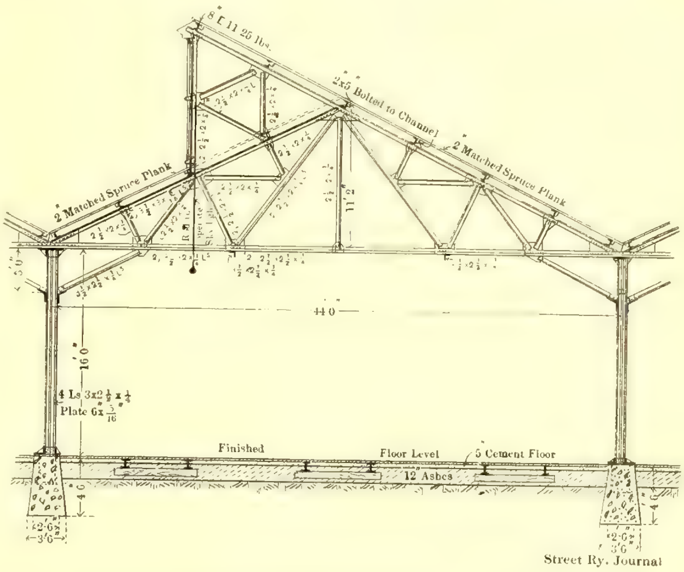
Special attention is to be given to the floor construction, as this is an important feature of a first-class job. First the inside of the building will be excavated to a depth of 17 ins., when the track, which is of 7-in. Trilby rail on wood ties of 2½-ft. centers, is to be placed, ballasted and surfaced to the grade.

The grade of floor line of building, as well as the entire yards, will be of the same level. After the track is placed, drainage provided for, steam ducts, etc., constructed, the floor of building will be filled with 12 ins. of steam ashes, watered and well tamped to a sound footing. Over the ashes 4 ins. of stone concrete is to be placed mixed in the proportion of five parts 1½-in. stone, three parts clean, sharp sand, and one part of Portland cement, and the concrete is to be cut in blocks to prevent cracking. The wearing surface is to be 1 in. thick, marked and colored a light gray. The ingredients of the top finish will consist of one part Portland cement and two parts of sea-washed grit, troweled with pure dry cement to a smooth finish.

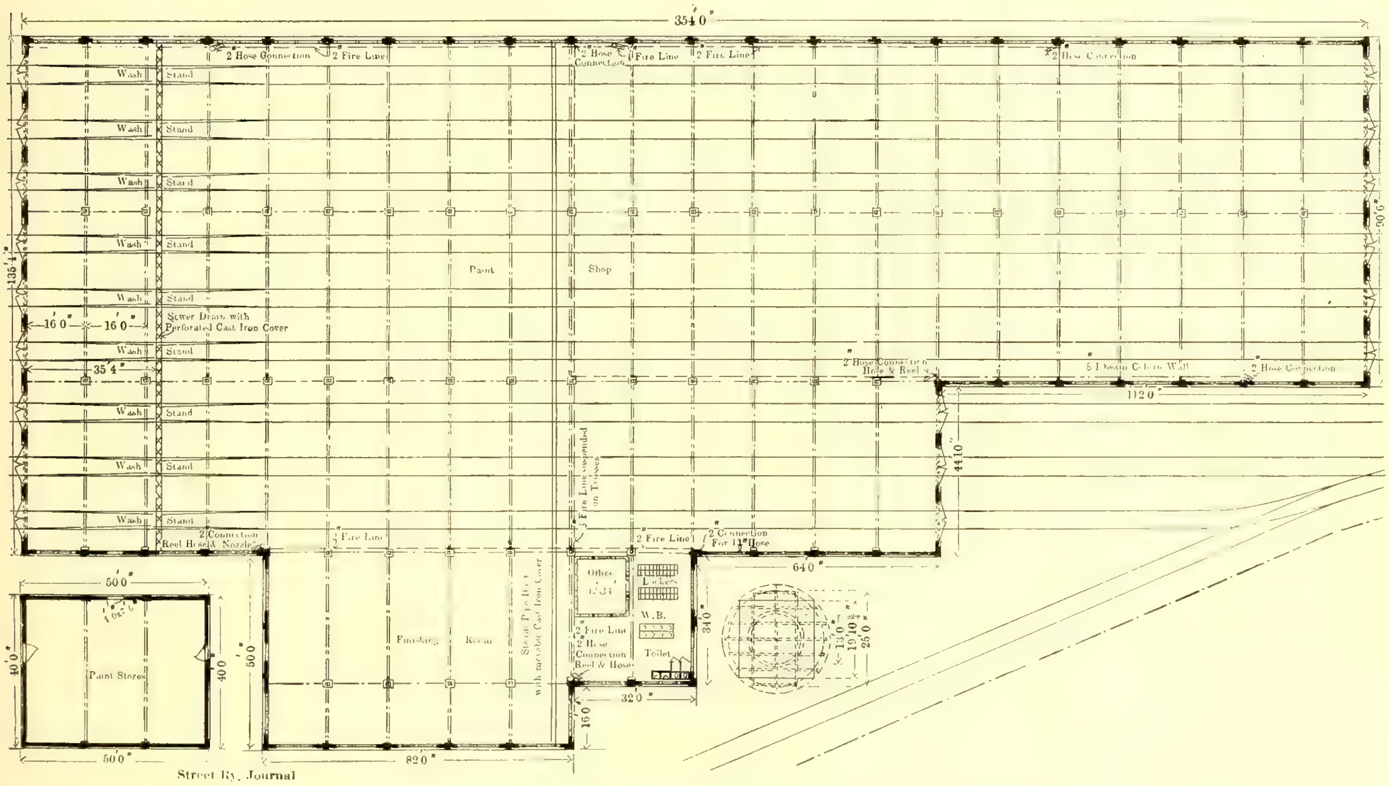
From the elevation drawing of this building it is seen that the outside walls are carried 3 ft. above the finished roof to form a fire wall, with roof gutters on the inside. All the roof leaders are carried down on the interior of the building, so that there will be no freezing or bursting of pipes in cold weather. All the windows on the Ferry Street elevation are constructed singly so that they may be finished with stone caps as well as stone sills. Neat stone coping 6 ins. x 14 ins. is arranged on top of walls on this elevation, the coping being broken into caps at the pilasters. This entire stone finish and brick corbeling develops into a very neat appearing and substantial design.

The south elevation, next to the Pennsylvania Railroad tracks, has double windows with wood mullions and steel lintels, and is finished plainly but substantially with a 12-in. salt-glazed tile coping. The east and west elevations contain the doors for the entrance tracks, the details for which, as well as the windows, are shown in the drawings. The doors are not to be equipped with frames, but are to fit snugly into the openings and are to swing out. When in the latter position there is a clear opening of 10 ft. It was possible to use a minimum size door opening, as all the tracks enter and leave the building practically on tangent alignment. The wooden doors are much to be preferred over steel rolling shutters, as they are more convenient and may be arranged with sash and glass.

Experience has proven that there is no part of the design of a shop building, and especially a paint shop, more important and as worthy of careful consideration as the quantity and quality of light. In deciding on a standard design for the shop buildings at hand a great deal of study was indulged in to select an economical, efficient and substantial roof, and numerous plans were discussed and considered. Of course a roof delivering a north light was desirable, but there is only one type that up to the present has been very much in vogue, and that is the familiar saw-tooth or weaving roof. This has several very serious defects. It is difficult to get a very satisfactory gutter construction in the common saw-tooth roof. The gutter is hard to keep tight, and in the winter months much annoyance is caused by ice and by snow drifting and banking up on the glass, so that the light is obstructed. The roof finally adopted is shown herewith. Advantage is taken of the north light as in the ordinary saw-tooth roof, and the plan may be termed a modified weaving roof. This design gives the advantage of using the well-known Fink type of truss and therefore the most economical distribution of metal may be obtained. Moreover, the scheme admits of the common and efficient valley gutter construction, and also of a well-protected skylight.

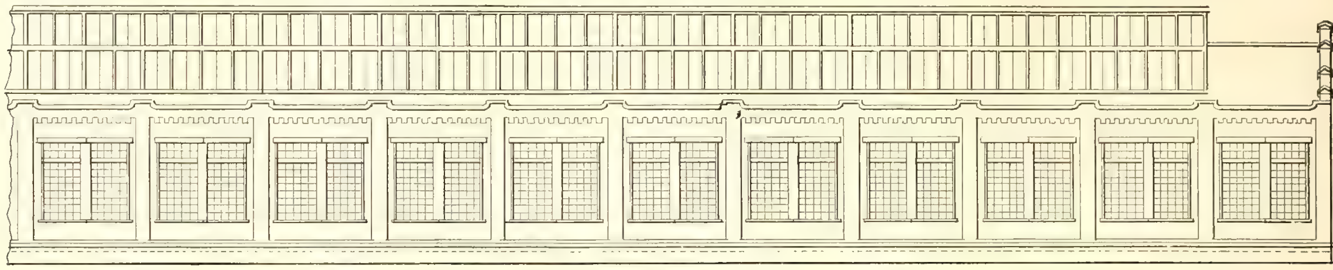


SECTION SHOWING MAIN TRUSSES IN NEW PAINT SHOP



FLOOR PLAN OF NEW PAINT SHOP, PLANK ROAD PLANT

Condensation gutters may be very conveniently attached on the inside to take care of the skylight drip at the bottom of the vertical leg. The roof is constructed so that there are about 12 ft. of skylight in each span, the rise of the roof being equal to the height of the vertical leg of skylight.



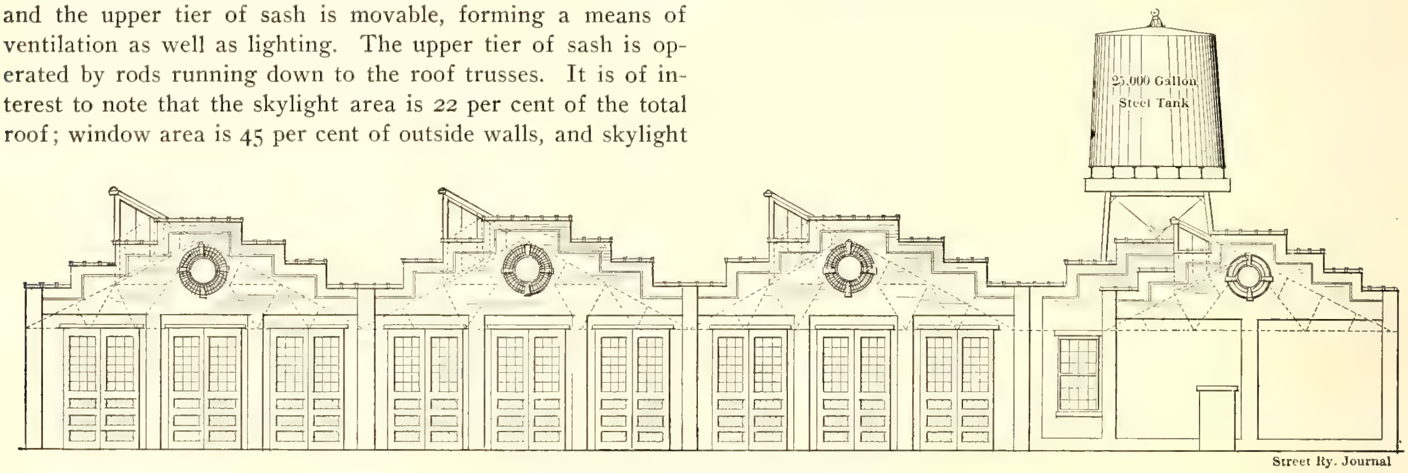
FERRY STREET ELEVATION, NEW PAINT SHOP

The skylight frames and moldings are made of No. 24 galvanized iron and all the sash bars are reinforced with steel rods. Sash are placed in two tiers so that the lower tier is stationary and the upper tier of sash is movable, forming a means of ventilation as well as lighting. The upper tier of sash is operated by rods running down to the roof trusses. It is of interest to note that the skylight area is 22 per cent of the total roof; window area is 45 per cent of outside walls, and skylight and window area is 29 per cent of the entire superficial area of the building property. The inside lighting will also be improved by finishing all the interior of buildings, including walls and roof, in white with two coats of cold water paint.

The purlins are formed of 8-in. channel irons and are supported at the channel points of the trusses at about 6 ft. centers.

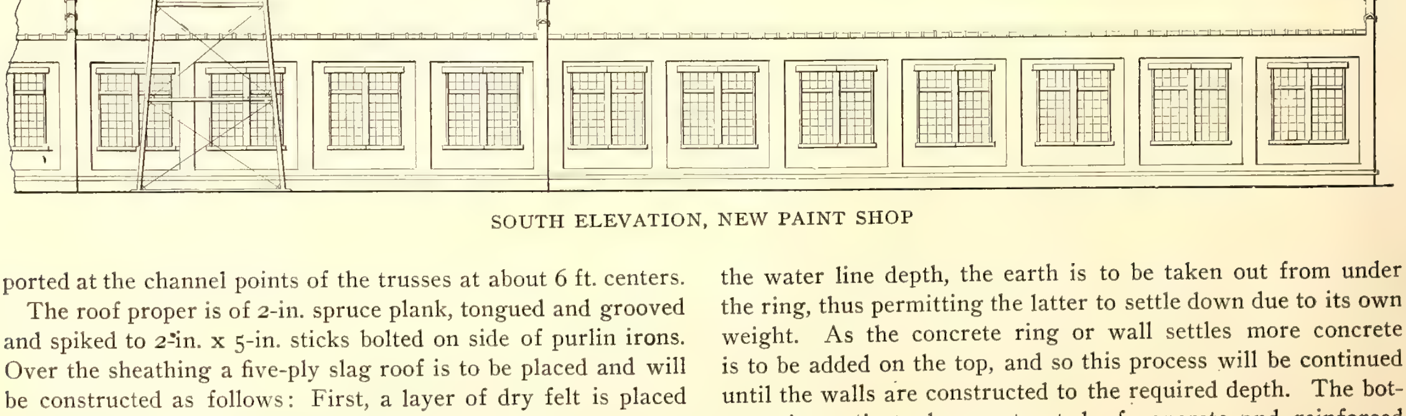
The roof proper is of 2-in. spruce plank, tongued and grooved and spiked to 2-in. x 5-in. sticks bolted on side of purlin irons. Over the sheathing a five-ply slag roof is to be placed and will be constructed as follows: First, a layer of dry felt is placed on sheathing, and over this four thicknesses of wool roofing felt, weighing 15 lbs. single thickness to every 100 ft. The felt is to be evenly and smoothly laid on, cemented together, the whole width of lap being not less than 9 ins. between each layer, with best refined tar, using 100 lbs. of tar to 100 ft. All joining along walls and around openings will be carefully made. The roof is then to be covered with a heavy coating of roofing tar and clean slag, there being not less than 1 cu. yd. of slag to every 600 sq. ft. of roof surface.

All the flashings of the entire roof are to be 16-oz. copper in sheets 4 ft. wide, and all the counter flashings will be 4-lb. sheet lead. It is estimated that the flashings for the entire shops will cost $3,000 in excess of the ordinary galvanized iron flashings, but it is believed that this amount will soon be saved in building maintenance with the former construction.



WEST ELEVATION, NEW PAINT SHOP

The storage cistern already referred to will be made of concrete, and as it is 15 ft. in depth the bottom of the cistern will be about 10 ft. below the water level at high tide, and hence must be constructed to withstand a water pressure of about 600 lbs. per sq. ft. First the excavation for the walls will be made to near the water line, and then the concrete walls built in to make a concrete ring. After the walls are constructed to the water line depth, the earth is to be taken out from under the ring, thus permitting the latter to settle down due to its own weight. As the concrete ring or wall settles more concrete is to be added on the top, and so this process will be continued until the walls are constructed to the required depth. The bottom cistern is to be constructed of concrete and reinforced with steel rods to stand the required pressure. The whole will



SOUTH ELEVATION, NEW PAINT SHOP

be made thoroughly waterproof with paper and tar, so that no salt water can possibly leak into the tank.

Steel I-beams are to be placed over the top of the storage cistern, with 4 ins. of reinforced concrete between the beams and top finished with 1½ ins. of cement. The steel tank is to be fed from the storage cistern by a Buffalo Forge vertical suction pump with a 5-in. discharge, and capable of delivering 940 gals. of water per minute against a 100-ft. head. The pump is to rest directly on the bottom of the cistern, and has the advantage over any other type inasmuch as it always is primed and ready for service. A 40-hp 500-volt vertical shaft, direct-connected Northern Electric d. c. motor operates the pump and is placed on the top of the cistern. Regulation is obtained by a float placed in the steel tank. When the water in the steel tank is at a low level, the copper float therein operates a chain that is electrically connected to a Cutler-Hammer starting device, so that the armature of a solenoid closes a switch, thus sending current into the motor which causes the pump to immediately discharge water into the steel tank. Again, when the water in the tank reaches the high point, the float operates the chain that causes the electrical solenoid to open the switch at the starting box, thus shutting off current and stopping the pump.

In case more rain water comes into the storage cistern than is used, a 12-in. overflow placed near the top will carry the water into the Ferry Street sewer, and the cistern acts as a catch basin in the trunk sewer line.

The foreman's office in the paint shop, like all the offices in the remaining buildings, is to be constructed entirely fireproof, the general design being ¾-in. steel channel studs placed on 12-in. centers and reinforced with rolled steel sections at angles and openings, the whole to be covered with metal lath. Over the lath on the outside a cement mortar is to be spread and on the inside a covering of gypsum mortar to make a 2-in. finished fireproof wall. The office roof is to be constructed of reinforced concrete slabs 2 ins. thick and supported by steel.

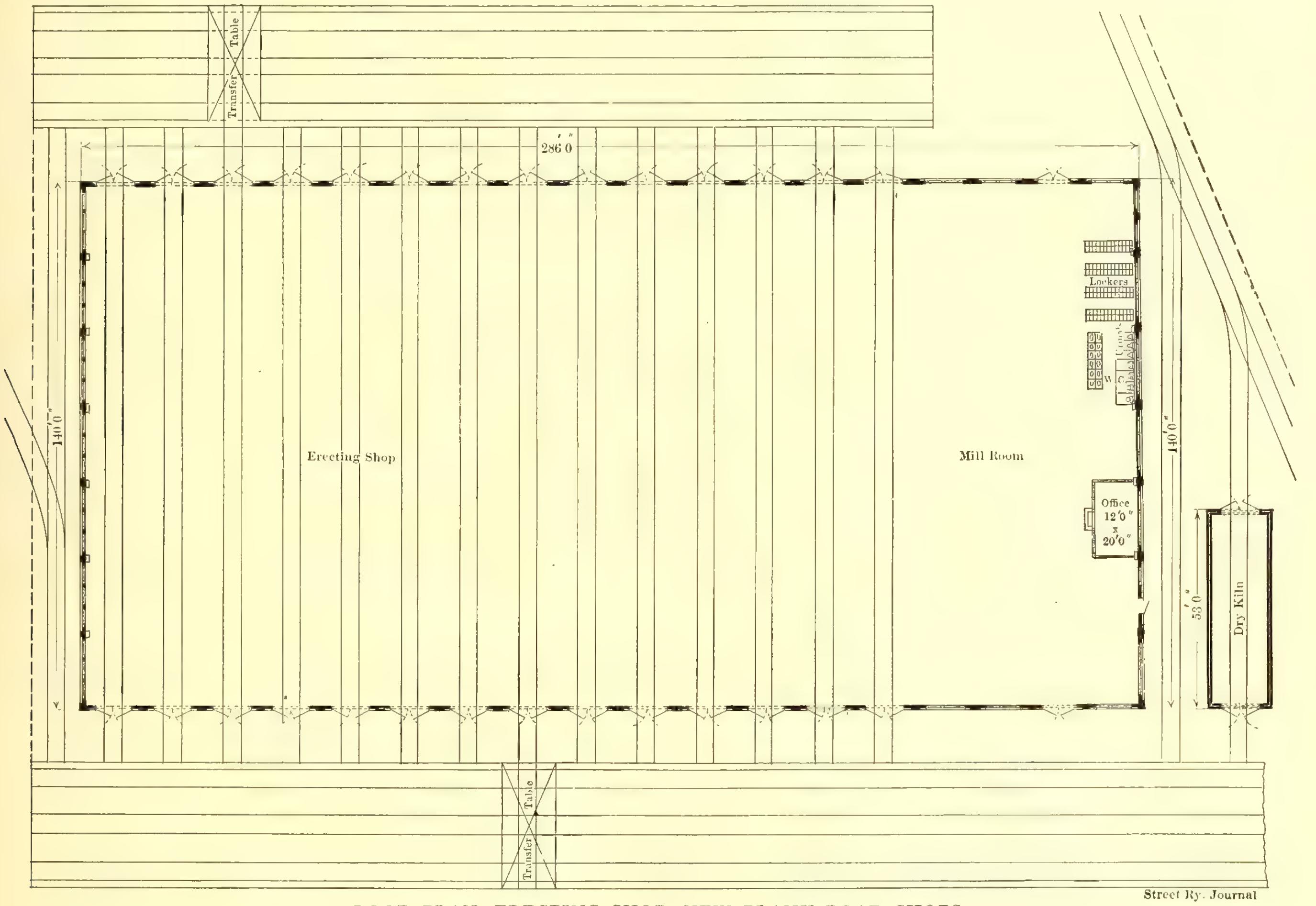
For fire protection a 4-in. fire line connection is effected from the city main in Ferry Street, and seven 2-in. hose valves, each equipped with 50 ft. of 1½-in. linen hose with rack and nozzle, are distributed throughout the building, allowing about 6000 sq. ft. of floor area for each connection. The fire lines will also be cross-connected with the elevated tank service, so that when the rain water is plentiful the fire lines may be supplied from the storage tank. One 3-gal. Underwriters chemical fire extinguisher is to be apportioned to every 2000 sq. ft. of floor area, and one fire pail distributed to every 1000 sq. ft. of floor space.

A thorough system of two-way standard 6-in. fire hydrants is to be installed around the exterior of buildings and grounds, so that any building may be covered with several independent lines of hose.

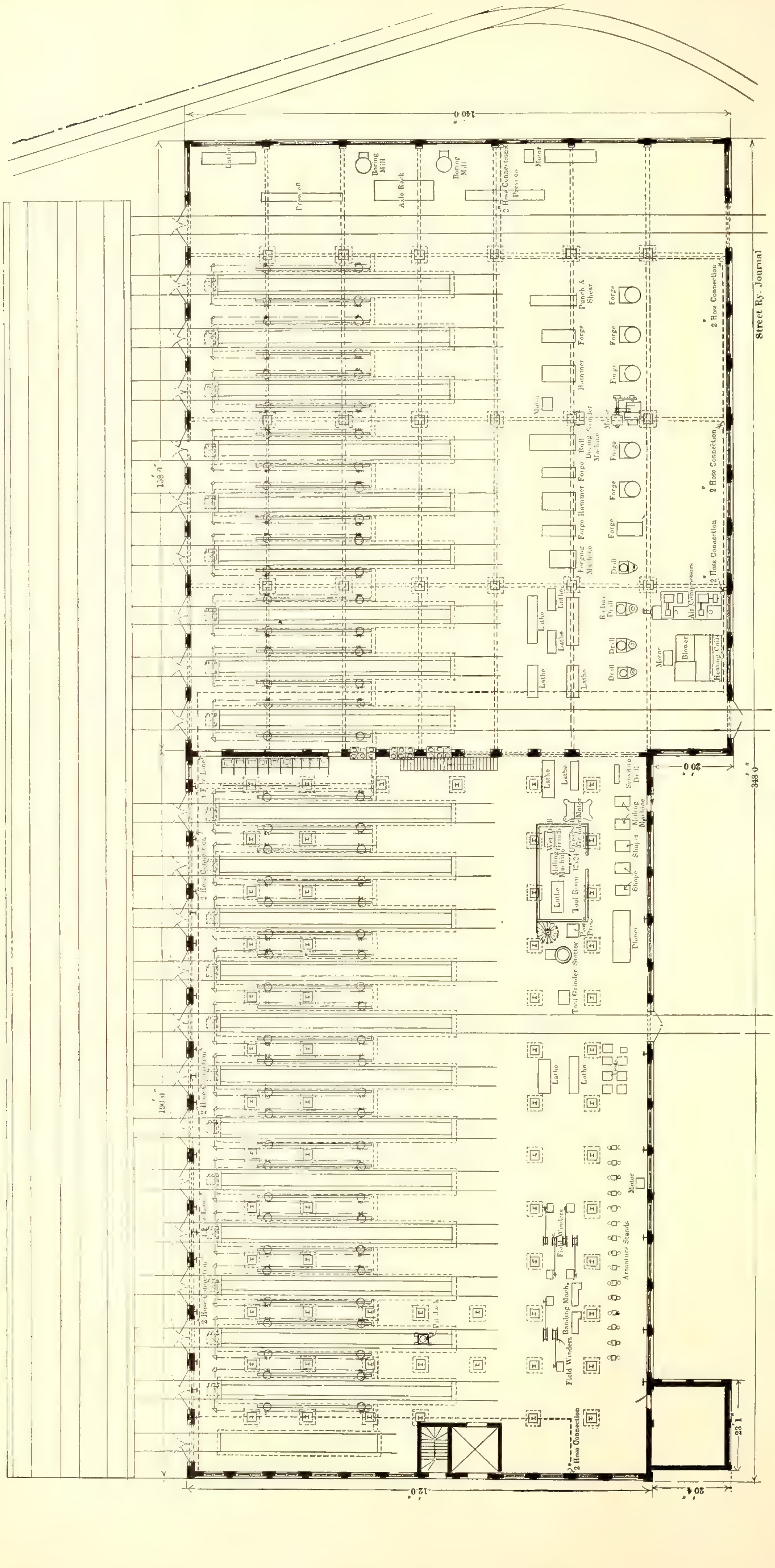
The old buildings are at present equipped with an auxiliary fire alarm system, which will be extended for the new shops. This arrangement is installed and maintained by the New York & New Jersey Fire Alarm Company, and operates as follows: Small fire alarm boxes are distributed in the buildings, one for about every 10,000 sq. ft. of floor area. The auxiliary boxes are electrically connected to main fire alarm box placed on a pole on Ferry Street. The main box in turn is wired up to the city's fire alarm circuit, and its location on record is similar to any city station. In case of fire, if any auxiliary box in the building is pulled, the effect is similar to that of turning the alarm in at any of the city's fire stations.

Two electric bells are to be situated in the office of the superintendent of rolling equipment, one sounding in case any auxiliary box is pulled and one will ring in case there is any defect in the entire auxiliary system. A sprinkling system is at present being considered and may be installed throughout the buildings later on.

The lighting of the paint shop and the entire plant and



FLOOR PLAN, ERECTING SHOP, NEW PLANK ROAD SHOPS



FLOOR PLAN OF MACHINE SHOP, NEW PLANK ROAD SHOPS

grounds is to be accomplished with 110-volt alternating current supplied by the lighting department of the Public Service Corporation. Both incandescent and arc lights will be used, and all wiring is to be done in iron conduit and according to the National Electric Code.

The paint shop is to be heated by direct steam heat. Wall radiators are to be placed under all the windows and 1¼-in. pipe coils are to be suspended under vertical skylight legs in roof trusses, there being 14,000 sq. ft. of radiating surface provided, or about 1 sq. ft. of radiating surface to each 85 ft. of cubical contents. It is estimated that this surface will heat the building to 80 degs. F. in zero weather. The main steam pipe is 10 ins. in diameter and the main return is 4 ins. in diameter.

Steam will be distributed from the central boiler house at high pressure and sent through a reducing valve at the building, reducing the pressure to about 5 lbs. The radiators and coils are to be equipped with special return valves, and a vacuum pump at the boiler house will bring back the air and water, delivering the same into a tank arranged with a vent to leave out the air. The boiler feed-pumps are to take the water from the supply tank and pump it back into the boilers.

This arrangement gives positive return of condensation water regardless of the position of radiators and coils in relation to the water line of the boilers.

ERECTING SHOP

In one of the engravings is illustrated the ground plan of the new erecting shop. This building covers an area of 286 ft. x 140 ft. There is also a dry kiln 53 ft. x 18 ft. In the erecting shop there are fourteen working tracks on 16-in. centers

and which accommodate 42 cars. The mill room is 65 ft. x 140 ft. and situated, as shown, in the south end of the building. Here will be placed the heavy machine tools for woodworking, the toilets, foreman's office, lockers, etc. It is the intention to install a tool equipment capable of taking care of machine work necessary to construct any part of a car body.

The general design of the erecting shop is very similar to that of the paint shop and needs no further description. However, it was decided to reduce the pitch of the roof to 1-5 of the span instead of ¼. The skylight area would be decreased so that the height would only be 9 ft. 6 ins. by this arrangement, but that amount of light is satisfactory for an erecting shop. Besides a 1-5 pitch roof is more desirable for slag than one of a greater angle.

The fan system is to be used to heat and ventilate the erecting shop. A 120-in. fan will be installed in the south end of the building with a bank of 8600 ft. of 1-in. steam coils, delivering hot air through galvanized iron pipes. The galvanized iron pipe is supported by the roof trusses and is to be placed out of the way above the bottom chords. The galvanized pipe delivering hot air is 74 ins. in diameter at the fan and divides into two branches running the entire length of the building and arranged with outlet branches every few feet. Steam will be supplied to coils similar to the system followed in the paint shop, that is, at high pressure from the main boiler house and then through a reducing valve in the building. The main steam supply pipe, after passing the reducing valve, is 6 ins. in diameter. The main return is to be 2½ ins. in diameter, and will also be brought to the boiler by vacuum and boiler feed pumps.

The heating arrangement will give a temperature in the building of 60 degs. F. in zero weather.

DRY KILN

The dry kiln is to be constructed to accommodate a flat car loaded with lumber, it being intended that the lumber remain on the car while the wood is being dried. The outside walls of the dry kiln are to be 20 ins. thick, consisting of two bricks and a 2-in. air space.

The roof is reinforced concrete supported by steel I-beams; 6-in. steel I-beams support the track over a pit 3 ft. deep inside of the kiln, and under the I-beams in the pit direct heating coils are to be placed so that the air inside may be heated to a temperature of 125 degs. F.

MACHINE SHOP

An extension is to be built to the old shop building, and the old shop will be reconstructed to conform with the new layout. The old building is 190 ft. x 120 ft., and the new addition is 153 ft. x 140 ft. The general design of the new work follows that already described. However, the new addition is 18 ft. in the clear under bottom of trusses, and the old building is 18 ft. in the clear under I-beams that support the balcony.

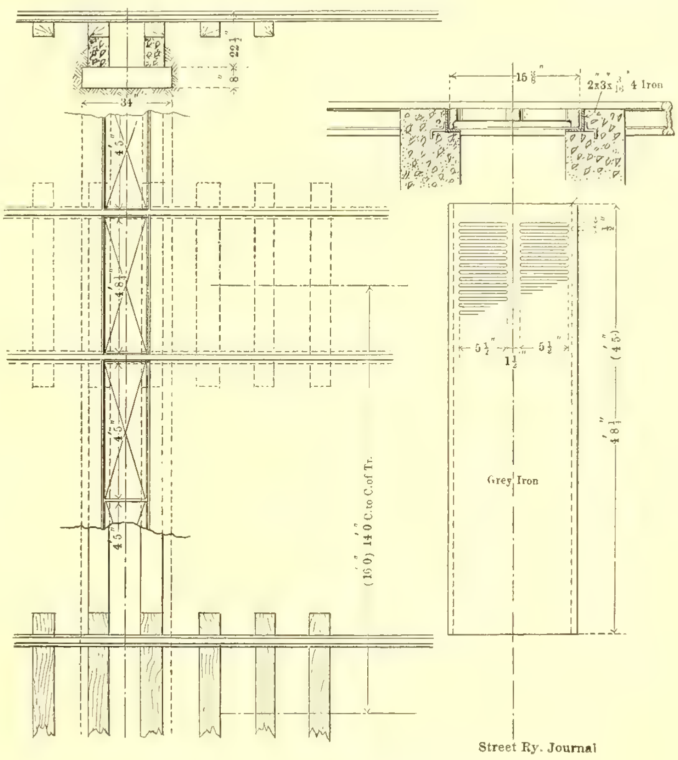
The balcony is 32 ft. wide on each side of the old building, and is built of steel and reinforced concrete designed for 300 lbs. per sq. ft. total dead and live load. Generally 18-in. 55-lb. I-beams are placed on 13-ft. 8-in. centers, and concrete beams on 4-ft. 6-in. centers are supported between the I-beams. Over the whole, as shown, a 5-in. reinforced concrete floor is installed and finished with a 1-in. cement wearing surface. Formerly the second floor of the old shop was of mill construction and was used for the winding department, machine shop and general store room. In the new layout the center of the old building will extend up to the roof, which will greatly aid in furnishing better light and ventilation.

It took considerable scheming to make the old building meet the new conditions. The old shop had already been changed from a power house to a repair shop, hence was of very irregular construction. For example, the steel columns supporting roof trusses on the west side of the house were not in alignment with the columns on the east side, so that in bringing the tracks in from the east side the columns came in the door openings. The track spacing was finally arranged so that only four of the eight columns have to be removed. The track spacing in the machine shop is 13 ft. 8 ins. This is not considered an ideal spacing, but is practical and the best, considering other difficulties to be overcome.

The office construction of the first and second floor in the old building is entirely fireproof and of cement and steel construction, as that described in the paint shop.

The heating of the new machine shop is accomplished as described for the erection shop. A 148-in. fan carries air through 16,000 ft. of 1-in. heating coils on the west side of building, distributing the same through galvanized iron pipes. The pipes are carried up into roof trusses in the new addition and under balcony floor in the old house.

The east side of the structure is reserved for the pit track.



DETAILS OF STAND FOR WASHING CARS

There are 23 tracks in all entering the building, three of which are through tracks, so that material may be taken in or out conveniently. The extreme north track is equipped with a pit arranged with a specially designed wheel-grinding apparatus. A car may be run in on this track, a flat wheel ground into shape and the car taken out again every 20 minutes. This method is considered greatly superior to that of removing the wheel and axle of a car to grind away flats. All the repair pits are also equipped with a specially designed car hoist and air jack, the details of which are shown on page 140.

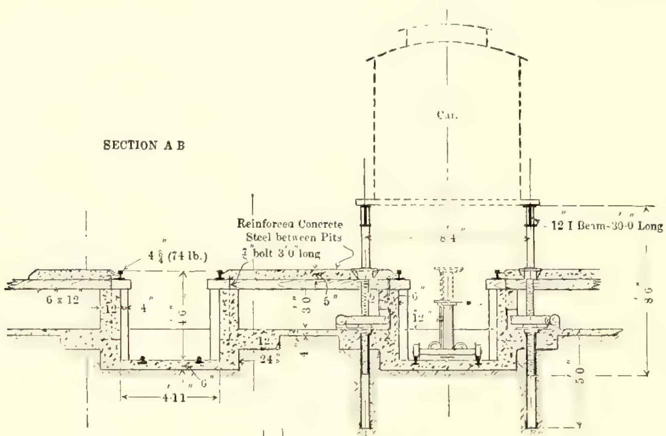
The car hoist is composed of four screw jacks which are driven by a motor, as indicated, power being transferred to jacks by means of steel shafts and miter gears. This driving arrangement is believed to be superior to the chain drive, inasmuch as the pits are left perfectly clear and do not have to be crossed by the driving mechanism. Two 12-in. I-beams 30 ft. long rest on the screw columns and form the carrying support for each hoist. This arrangement is very reliable, positive and rapid, and is to be especially approved in a shop where the head room is not sufficient for an overhead hoist. The drawing also shows each pit arranged with an air jack. This jack may be moved in a longitudinal or transverse direction,

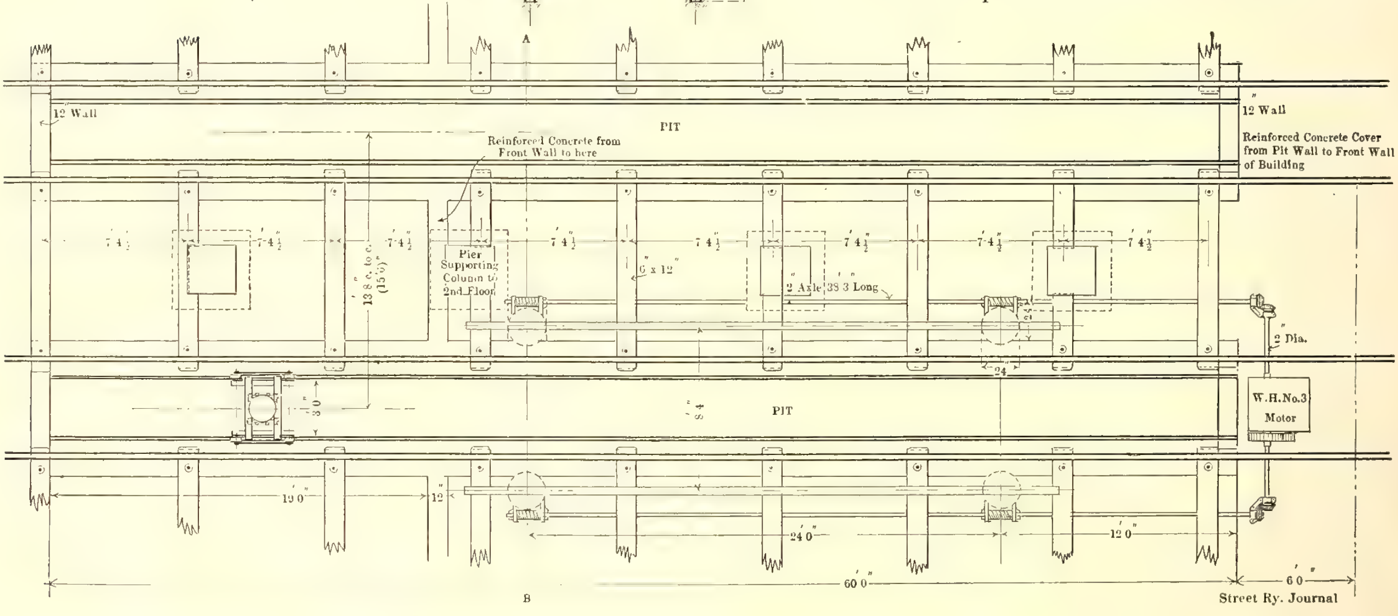
making it very efficient for handling motors and heavy parts suspended underneath the car.

Axle and wheels are to be attended to in the south end of new extension, and the space outside between the outside wall and track is to be reserved for a wheel platform. The west side of building is the shop proper, with electrical department on the north side. The machine tools are arranged in gangs and operated by an overhead shafting and belting, except the machines in isolated positions, which are to be independent and electrically driven. A dipping room and oven are provided for in a separate fireproof department that is independent of the main structure. The vacant space west of the forge shop will be used for brass foundry and an iron rack. For the present the heavy pieces will be taken in and out of the machine tools by means of chain hoists. But later a traveler system is to be installed. This will consist of I-beam runways suspended from the bottom of trusses in the new building and from second floor beams in the old structure. Upon the runs movable air and chain hoists may be propelled to any desirable position on the building.

The shop superintendent's office is situated directly over the tool room, and has sides almost taken up with windows, so that a good view may be had in any direction about the building. The side walls of the tool rooms are solid to a height of 3 ft. But the remainder of walls is covered with wire netting, the whole being of steel framing, cement floors and fireproof.

An insulating room for taping armature and field coils is located on the balcony. The intention is to employ girls to do this work, and the latter may come and go independent of the remainder of the shop, as there are fireproof stairways to the Ferry Street side. The small elevator in the northwest corner forms the mode of conveying material to and from the electrical department below. The shop office, which will be the headquarters of the superintendent of rolling equipment, is also on this floor, besides a reading room for the employees, and a space reserved for repairing registers and controllers. Later it is probable that a kitchen and dining room will be constructed on the second floor. The remainder of space on the balcony is to be taken up by light shop stores, which are to be brought up and down on the large elevator at the north end of the building.





DETAILS OF PIT AND CAR HOIST FOR NEW MACHINE SHOP

STORE ROOM

The new store room is to occupy the present blacksmith shop, which will be removed to new quarters in the machine shop building. An addition will be built to the old blacksmith shop, so that the new store room is to occupy a space 140 ft. x 95 ft. The new addition to conform with part of the store room will be of brick with a mill construction roof. Here are to be kept the general stores for the complete system, and from this point material will be distributed to the minor store rooms all about the road. It is clear that a freight car can be taken from the Pennsylvania tracks directly to the track alongside of store room, for loading or unloading freight supplies; also that the building is easy of access from Ferry Street by trucks, and convenient for the company's supply cars.

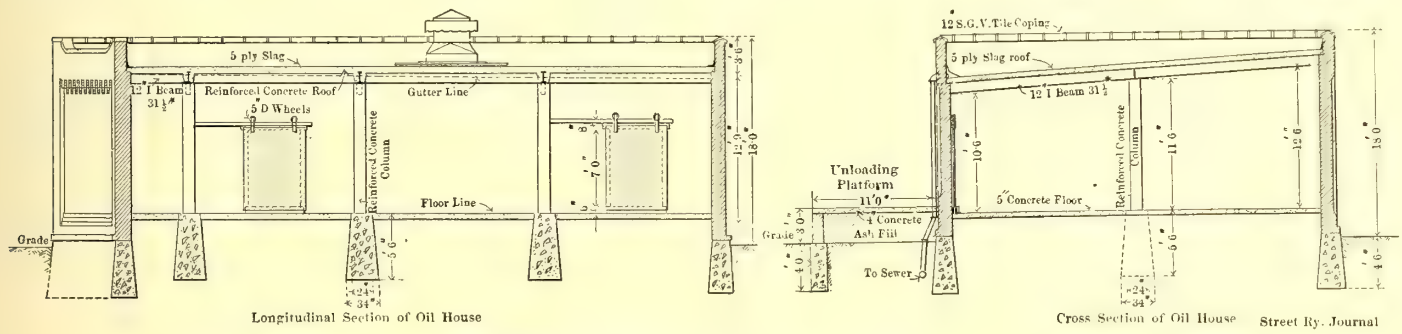
OIL HOUSE

A general storage house for oil 58 ft. x 35 ft. is situated near Ferry Street. The oil house is a complete fireproof building of brick walls and reinforced concrete roof and supporting columns. It has a platform on the east side for ease in loading and unloading barrels of oil. The building floor is 6 ins. below the platform landing, so that any waste oil will always be retained inside. The oil house is designed to hold two car loads of oil, and here will be stored the oil ready to be apportioned in barrel lots to the general shop or any auxiliary repair points about the road.

STORAGE HOUSES

On the north side of Ferry Street are the present storage barns that hold 130 cars. One more bay capable of housing 30 more cars will be added to the present building, making the total storage 150 cars on the north side of Ferry Street. New storage houses are to be built on the south side of Ferry Street and west of new store room, as seen in the general layout.

The new storage houses are to be built in three bays, each bay containing four tracks covering an area of 450 ft. x 44 ft., and capable of storing 120 cars. This will make the total storage capacity for the present amount to 270 cars, which will take care of the system for the time being. The details of construction for the new storage houses have not been entirely decided upon, but probably the building will be made of concrete and steel, the roof to consist of reinforced concrete girders, 1 ft. thick and 4 ft. high, the girders being placed at intervals of 6 ft. Smaller reinforced concrete steel beams will be installed on 8-ft. centers between the large girders, and then the whole will be covered with a reinforced concrete roof 4 ins. thick. The column supporting the large girders will be reinforced concrete steel and 20 ins. thick x 2 ft. wide. The curtain walls between the supporting columns are also to be composed of steel bonding rod and concrete. These will be only 6 ins. thick and carried by the columns, so that the curtain wall will extend only 6 ins. below the grade line. Under the curtain wall there are to be placed 12 ins. of steam ashes to protect the same in freezing weather. It is estimated that a considerable saving will be made by adopting the concrete construction, and surely it is more desirable from an insurance standpoint than the brick and wood. The ends of the storage barns are to be equipped with four overlapping sliding doors instead of steel shutters. By this arrangement three-quarters of the storage barns may be open at any one time, and this is deemed satisfactory. The sliding doors are considered far superior to the rolling shutters.



NEW OIL HOUSE, PLANK ROAD PLANT

BOILER HOUSE

All the steam for the different heating systems will be generated and supplied from a central boiler house, the location of which is shown in the general layout. This is to be a brick building 40 ft. x 40 ft., with iron trusses and a monitor roof. Equipment will consist of four 125-hp Weatherhill tubular boilers, each boiler being 16 ft. long, 5 ft. in diameter, and fitted with forty-four 4-in. tubes. These boilers are old equipment to be obtained from the lighting department of the corporation. There is also to be a duplicate set of boiler feed and vacuum pumps.

Steam will be delivered to each of the particular buildings at about 100 lbs. pressure, and reduced to 5 lbs. pressure by Foster reducing valves before entering the various heating apparatus. By using high-pressure steam from the boiler house, the piping to the individual buildings may be smaller than with the use of low pressure, owing to the higher velocity of steam. In addition, the reducing valves at the heating apparatus in the different buildings may be adjusted in accordance with severe variations in the temperature of the outside air, while the boilers can be maintained at a constant pressure. Also, high pressure at boilers gives better conditions for operating the pumps.

The draft for the boilers will be furnished by a self-supporting steel stock 60 ins. in diameter and 100 ft. high.

The entire layout for the new shop and storage plant, as outlined in the foregoing article, was designed and laid out by the corporation's own engineering staff, under the direction of Col. Charles A. Sterling, vice-president of the Public Service Corporation, and Albert H. Stanley, superintendent of the railway department. Charles E. Remelius is superintendent of rolling equipment, and has charge of all repair shops on the system.

PROGRAMME OF THE MECHANICAL ASSOCIATION

The tentative programme of the Philadelphia convention of the American Railway Mechanical and Electrical Association has just been announced by the secretary, and includes reports of committees on the following subjects:

"Controlling Apparatus," J. S. Doyle, master mechanic of the Interborough Rapid Transit Company, New York, chairman. This report consists of two papers, one by Hugh Hazelton, of the Hudson Companies of New York, on "Multiple-Unit Systems of Train Control;" the other by W. A. Pearson, electrical engineer of the New York City Railway Company, on "Series-Parallel Railway Control."

"Way Matters," F. G. Simmons, superintendent of construction and maintenance of way of the Milwaukee Electric Railway & Light Company, chairman. The report of this committee is composed of the following papers on the welding of rail joints: "Thermit Rail Welding," by George E. Pellissier, civil engineer of the Holyoke Street Railway Company; "Zinc Welding," by H. B. Nichols, engineer of way of the Philadelphia Rapid Transit Company, and by C. B. Voynow, assistant engineer of the same company; "Electrical Welding," by T. W. Wilson, general manager of the International Railway Company, Buffalo, and one from the "Iron Age;" "Cast Welding," by F. G. Simmons, chairman of the committee. Mr. Simmons has also prepared a fitting introduction and summing up of the complete subject.

"Brakes," D. F. Carver, superintendent of the Rochester Railway Company, chairman. F. F. Bodler, master mechanic of the United Railroads of San Francisco, will contribute a paper on "Track Brakes," which forms a part of this report. Other papers on this subject will be announced later.

"Maintenance and Inspection of Electrical Equipment," Wm. Pestell, of J. G. White & Company, chairman. The papers forming this report will be announced later.

"Wheels," G. J. Smith, master mechanic of the Metropolitan Street Railway Company, of Kansas City, chairman. The papers forming this report will be announced later.

In addition to the foregoing reports of committees, the association is to have papers on the following subjects: "Power Distribution," by C. H. Hile, superintendent of wires, Boston Elevated Railway Company; "The Power Load Factor as a Factor in the Cost of Operation," by L. P. Crecelius, chief electrician, United Railways Company of St. Louis, Mo.; "Power Houses," by Fred Bushnell, chief engineer, the Rhode Island Company, Providence, R. I.

The Question Box will also form a prominent feature this year.

NEW ENGLAND RAILWAYS' ADVERTISING OF PARKS AND OTHER ATTRACTIONS

The Boston & Northern and Old Colony Street Railways, who own and operate nearly 900 miles of track north and south of Boston, have five pleasure parks where entertainments are given every afternoon and evening during the summer months for a period of about ten weeks. Contractors and workmen have been busily engaged at the parks for several months past renovating and thoroughly going over them, cleaning them up and making numerous and extensive alterations, additions and improvements. Many amusement enterprises, such as roller-skating rinks, boxball bowling, merry-go-rounds, as well as a collection of monkeys, have been added this year, while swings and rustic benches abound among the trees. In four of these parks boating may be enjoyed.

PREPARING TO TRANSPORT 140,000 FOLDERS

RACK USED FOR DISTRIBUTING FOLDERS, BOSTON & NORTHERN STREET RAILWAY COMPANY, PASSENGER DEPARTMENT

THE BOSTON & NORTHERN AND OLD COLONY STREET RAILWAY COMPANIES' ADVERTISING CAR IN FRONT OF THE PRINTER'S OFFICE

The official opening day for these resorts for the season of 1905 was set for Monday, June 26. On this day the theaters were opened, each with a different play, together with a band concert and a grand display of fireworks in the evening. The theaters have been enlarged so as to seat more people than ever before, and the auditoriums have been covered to protect the public from the sun as well as the rain. Such well-known plays as "The Girl from Paris," "The Telephone Girl," "Boys and Girls," "1492," "When Reuben Comes to Town," etc., will be given at these theaters. There will be two weeks of vaudeville during the entire season.

Such an extensive entertainment outlay as this, added to the companies' other pleasure trips, requires an advertising campaign which must be carried out on a large scale. This fact is made clear in graphic fashion in two of the accompanying views, one of which shows the advertising car leaving the printer's office, and the other the car's interior containing 140,000 folders in bundles. The third illustration shows the type of folder case distributed at a number of points over the two systems.

All of this work is in the care of Robert H. Derrah, who prepares the newspaper advertisements about the different theatrical attractions, the illustrated folders covering various trolley trips, press notices, etc. He has been very successful in the latter form of advertising as a result of the several trolley trips on which he has chaperoned members of the New England press.

THE JACKSON & BATTLE CREEK TRACTION COMPANY'S DESPATCHING SYSTEM

During the past two years the Jackson & Battle Creek Traction Company has been using with great success the telephone despatching system, of which details are presented in this article by the courtesy of E. S. Loomis, superintendent of the company.

Owing to the proximity of the high-tension transmission wires, it was considered advisable to install the telephone system with a complete metallic circuit. The telephone wires are also attached to the transmission wire poles, and are transposed at every fifth pole to neutralize the effects of induction. In the despatcher's office at the Albion shops, which are located about the middle of the railway, the telephone line is divided into two sections—a call from the west being indicated by a bell signal, and one from the east by a buzzer. Therefore, the line is normally cut at the despatcher's office so that if an outsider wishes a through telephone connection, the despatcher is requested to insert the necessary plug in the box shown in the accompanying illustration of the despatcher's table.

A train despatcher is always on duty when any cars are on the road, and no cars are allowed to run over any portion of the line without his instructions. Before starting out, the conductors report for orders at one of the terminals. Should there be no orders for them the agent gives them in duplicate the clearance card, form T.7, reproduced herewith. If the despatcher desires to give out a train order, he calls up the agent and gives him the necessary instructions as per the accompanying form T.6½. Upon receiving this order, the agent repeats it to the despatcher, gives his name, and thereafter must not give a clearance card to the train specified. Upon receiving either his clearance card or other train order, the conductor calls up the despatcher, repeats the instructions, gives his name and starts upon receiving the despatcher's approval.

All stations, aside from the terminals, are equipped with the regulation train order signal, which is used to hold trains when-

INTERIOR OF THE DESPATCHER'S OFFICE AT THE ALBION SHOPS

Limited Trains
JACKSON & BATTLE CREEK TRACTION COMPANY
Third Rail System

Form T.7

CLEARANCE CARD.

....190

To Conductor and Motorman No. ....

I have No Orders for your Train.

....**Operator.**

Time .... **m.**

CLEARANCE CARD GIVEN TO TRAIN CREW BY STATION AGENT

TRAIN ORDER.

Limited Trains
JACKSON & BATTLE CREEK TRACTION COMPANY
Third Rail System

Form T.6½

Albion Shops .... 190....

To Agent..................................

Complete at..................m.   Signed ....

TRAIN ORDER TRANSMITTED THROUGH STATION AGENT

Train Order.

Limited Trains
JACKSON & BATTLE CREEK TRACTION COMPANY
Third Rail System

Form T.6

Albion Shops 190

To Conductor and Motorman ....

at..................................

Complete at.............m.   Signed.................................. ..Conductor.

DESPATCHER'S TRAIN ORDER FORM TO CONDUCTOR AND MOTORMAN DIRECT

Limited Trains
JACKSON & BATTLE CREEK TRACTION COMPANY
Third Rail System

....190 ....

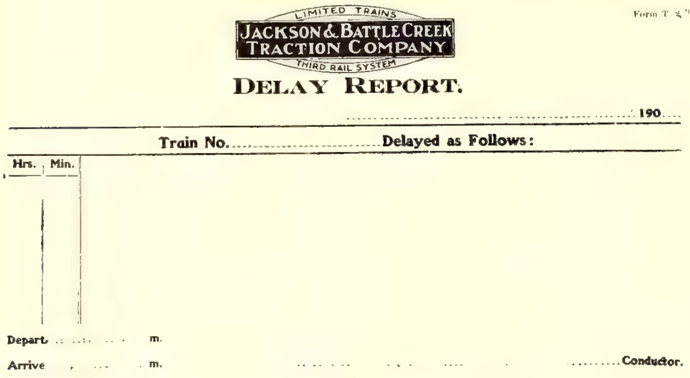
TRAIN NO.	CAR NO.	ARRIVED	DEPARTED
		M.	M.

AGENTS FILE ON SPINDLE.

.... **Conductor.**

TRAIN CARD GIVEN TO STATION AGENT BY CONDUCTOR

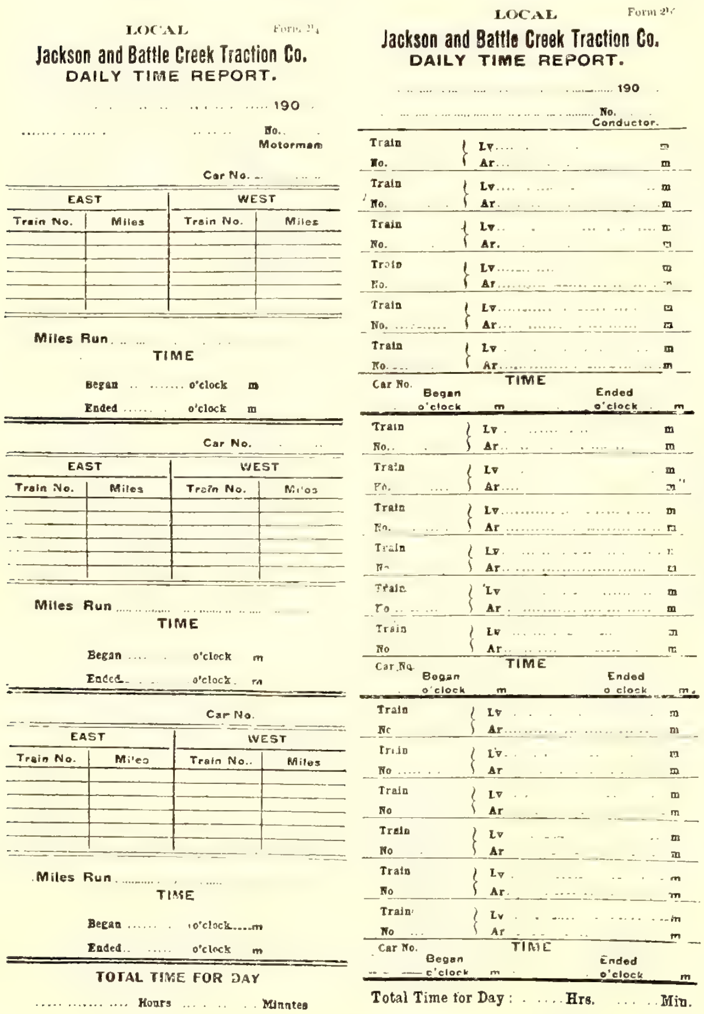
ever necessary. For this purpose copies of the form T.6½ are handed to every conductor. Then if his train is held he reports at once to the despatcher for further orders before proceeding. Each conductor is supplied with a pad of form T.6 blanks, together with a carbon sheet for making duplicates,


LIMITED TRAINS
JACKSON & BATTLE CREEK TRACTION COMPANY
THIRD RAIL SYSTEM
Form T 6½
DELAY REPORT.
190
Train No. Delayed as Follows:
Hrs. Min.
Depart m.
Arrive m.
Conductor.

CONDUCTOR'S DELAY REPORT

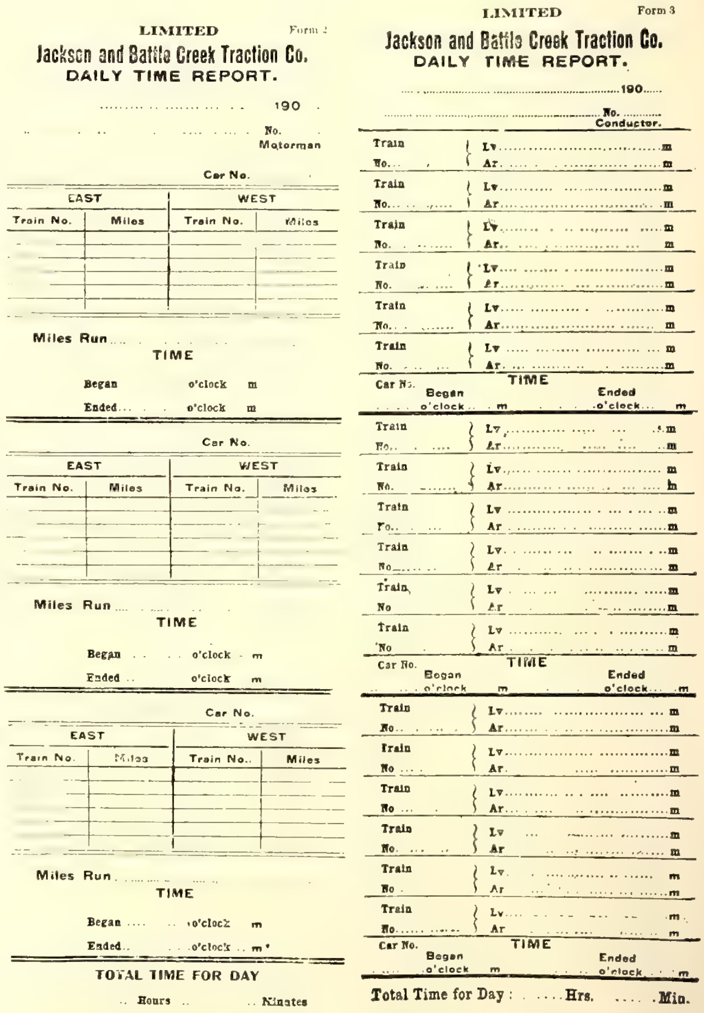
one copy being given by the conductor to his motorman, who must read back the instructions aloud before proceeding, as no verbal orders are permitted.

The forty-six miles of line operated by this company has fifteen sidings, all of which are equipped with standard split switches locked for the main track. They are furnished with


LOCAL Form 2¼
Jackson and Battle Creek Traction Co.
DAILY TIME REPORT.
190
No. Motorman
Car No.
EAST WEST
Train No. Miles Train No. Miles
Miles Run
TIME
Began o'clock m
Ended o'clock m
Car No.
EAST WEST
Train No. Miles Train No. Miles
Miles Run
TIME
Began o'clock m
Ended o'clock m
Car No.
EAST WEST
Train No. Miles Train No. Miles
Miles Run
TIME
Began o'clock m
Ended o'clock m
TOTAL TIME FOR DAY
Hours Minutes

LOCAL Form 2½
Jackson and Battle Creek Traction Co.
DAILY TIME REPORT.
190
No. Conductor.
Train No. Lv m Ar m
Train No. Lv m Ar m
Train No. Lv m Ar m
Train No. Lv m Ar m
Train No. Lv m Ar m
Train No. Lv m Ar m
Car No. TIME Began o'clock m Ended o'clock m
Train No. Lv m Ar m
Train No. Lv m Ar m
Train No. Lv m Ar m
Train No. Lv m Ar m
Train No. Lv m Ar m
Train No. Lv m Ar m
Car No. TIME Began o'clock m Ended o'clock m
Train No. Lv m Ar m
Train No. Lv m Ar m
Train No. Lv m Ar m
Train No. Lv m Ar m
Train No. Lv m Ar m
Train No. Lv m Ar m
Car No. TIME Began o'clock m Ended o'clock m
Total Time for Day: Hrs. Min.

TRAIN CREW'S REPORTS FOR LOCAL TRAINS


LIMITED Form 2
Jackson and Battle Creek Traction Co.
DAILY TIME REPORT.
190
No. Motorman
Car No.
EAST WEST
Train No. Miles Train No. Miles
Miles Run
TIME
Began o'clock m
Ended o'clock m
Car No.
EAST WEST
Train No. Miles Train No. Miles
Miles Run
TIME
Began o'clock m
Ended o'clock m
Car No.
EAST WEST
Train No. Miles Train No. Miles
Miles Run
TIME
Began o'clock m
Ended o'clock m
TOTAL TIME FOR DAY
Hours Minutes

LIMITED Form 3
Jackson and Battle Creek Traction Co.
DAILY TIME REPORT.
190
No. Conductor.
Train No. Lv m Ar m
Train No. Lv m Ar m
Train No. Lv m Ar m
Train No. Lv m Ar m
Train No. Lv m Ar m
Train No. Lv m Ar m
Car No. TIME Began o'clock m Ended o'clock m
Train No. Lv m Ar m
Train No. Lv m Ar m
Train No. Lv m Ar m
Train No. Lv m Ar m
Train No. Lv m Ar m
Train No. Lv m Ar m
Car No. TIME Began o'clock m Ended o'clock m
Train No. Lv m Ar m
Train No. Lv m Ar m
Train No. Lv m Ar m
Train No. Lv m Ar m
Train No. Lv m Ar m
Train No. Lv m Ar m
Car No. TIME Began o'clock m Ended o'clock m
Total Time for Day: Hrs. Min.

TRAIN CREW'S REPORTS FOR LIMITED TRAINS

the regulation banners and lamps which, like the signal lamps, are lighted by current from the third rail. At each siding there is a telephone booth 3 ft. 6 in. x 3 ft. 6 in. x 7 ft. high, lighted in connection with the railway switches. All booth telephones are provided with a switch and are cut out when not in use. All trains have the right of track to meeting points as scheduled.

Among the other forms used in connection with the despatching system, as illustrated herewith, are the following: Form T.2, delay report made out by the conductor, giving the train number, the cause for losing time and the amount of same, as well as the time of departure and arrival; the form shown at the bottom of page 143 is signed by the conductor and given to the station agent for filing; forms 3 and 2 are respectively the daily time reports made out by the motorman and conductor of a limited train, while forms 2¼ and 2½ are used by the trainmen of the locals.

THE TECHNICAL PERIODICAL

R. A. Hadfield, the well-known manufacturer of special work of Sheffield, England, and one of the greatest living authorities on steel, has recently been elected president of the Iron and Steel Institute of Great Britain. In his presidential address to the Iron and Steel Institute, he paid a tribute to the technical press in the following words:

I take this opportunity of expressing our great indebtedness to the technical press for the wonderful work they do in keeping us supplied with the most recent information. There are, I believe, now published about 103 important technical journals, many of them issued weekly. Two-thirds of these papers are published in English, being equally divided between this country and America. Germany follows with about one-sixth of the total. It is not, of course, multiplicity that is of chief value in technical literature; a higher consideration is the quality of the information, and next to that comes the number of readers. On this point England and America can safely be said to hold their own. We often wonder at the marvels of daily journalism, but to me they do not seem to compare with the work done by the technical press, where the matter must be correct and exact. The daily press, however essential to our well-being, does work of a more or less ephemeral nature, that of the technical papers is of a lasting description.

SOME PHASES OF THE FEED-WATER HEATER PROBLEM

BY WALTER E. HARRINGTON

In a recent editorial which appeared in the Street Railway Journal, attention was called to the fact that too little consideration is given to the very important subject of boiler room economies. From the tendency of certain phases of power plant design recently exhibited, it is evident that this important field, which has great possibilities for improvement, is being neglected and needless wastes are resulting where pronounced savings should be the rule. It is true that careful consideration is now being given to the subject of greater economy in power generation by the use of the steam turbine and other refinements which are being entered into for this purpose. But in the majority of power plants the possibilities for economy through the proper use of the boiler auxiliaries are many times greater than those which can be obtained through discrimination between designs of boilers, engines, turbines, generators, etc.

There can be no doubt that large and important savings will result from intelligent and careful use of stokers, damper regulators and many other valuable auxiliaries. But it is safe to say that no one type of boiler auxiliaries occupies a position of so great importance as the feed-water heater. The feed-water heater indeed bears the same relation to the boiler which the condensing equipment bears to the engine. It not only increases the efficiency, and hence the capacity of the boiler, but it also performs the important function of reducing the incalculable strains and irregularities by heating the feed-water before it enters the boiler.

It is a well-known fact that for every 10 degs. added to the temperature of the feed-water before it enters the boiler about 1 per cent of the total fuel otherwise required will be saved. The theoretical saving is slightly less than 1 per cent; the actual saving, as demonstrated by numerous tests, ranges as high as 1.4, with 1.2 as a fair average; this means that if a feed-water heater is raising the temperature of the feed-water from 50 degs. F. to 160 degs. F., or an increase of 110 degs., a saving of about 13 per cent is effected in the fuel bill. If, however, the feed-water heater is capable of raising the temperature to 210 degs. F., an increase of 160 degs., the saving of fuel would be about 19 per cent. It will therefore be seen that it is not only important to make use of a feed-water heater, but that it is of the greatest importance that the power plant manager should select that type of heater which will enable him to obtain the maximum increase of temperature in the feed-water.

There still exists to some extent a difference of opinion as to the relative desirability of using the open or closed type of feed-water heater, but the degree of perfection which the open heaters has attained has eliminated formerly objectionable features and has enabled open heaters to make for themselves records which cannot be approached with closed heaters. It is doubtful whether the advantages of the open heater are fully recognized and appreciated by steam users in general. The chief objection which attended the early use of the open heater, namely, that the oil from the exhaust steam was carried into the boiler, did much to discourage its more general adoption. While it is true that trouble was formerly experienced in this direction, it is also true that this objection does not hold good against the better designs of open heaters now on the market, and that it is entirely possible to exclude the oil from contact with the feed-water. There are thousands of installations in which the open heater is now being used where no difficulty is experienced from the contamination of the feed-water by oil. The perfection of oil separators for use in the exhaust steam connection to the heater has rendered this possible.

The open or direct-contact type of heater differs from the closed heater, primarily in that the water is heated in it by direct and actual contact with the steam, whereas with the closed heater the heat from the exhaust must be transmitted from the water through intervening metal surfaces, such as tubes or coils. It cannot be questioned that a greater heating efficiency is possible where the steam is brought into direct contact with the water. The tubes used in the best designs of closed heaters are fairly good transmitters of heat when new and clean, but the heating efficiency is quickly and materially impaired by the coatings of impurities which form on both sides of the tubes. Scale is sure to form on one side and cylinder oil to accumulate on the other, and between the two the heat conductivity is greatly reduced. Moreover, as the closed heater is operated under boiler pressure, it is not unusual for tubes to collapse, burst, leak or otherwise give trouble. This is, of course, obviated in the open heater, which is never operated at a pressure higher than that which prevails in the exhaust steam main—generally a matter of a few ounces only.

This cardinal difference between the open and closed heaters —i. e., that in the open heater the steam and water are brought into actual contact, whereas in the closed heater they are separated by intervening metal—enables the open heater to make some important savings over a heater of the closed type. For example, in the open heater, as the heat from the exhaust steam is transmitted to the feed-water the resulting condensation of the steam mixes with and forms a part of the feed-water. The advantage of saving and utilizing this condensation is four-fold.

First—It means saving the heat in the condensation itself.

Second—As a result of the first advantage less exhaust steam is required to heat the water. Under average conditions the open heater will heat the water to a given temperature with about one-seventh less exhaust steam than the closed heater requires. Or, conversely, given a limited quantity of exhaust steam, the open heater will heat the water to a higher temperature than will the closed heater.

Third—Less fresh water is required to be furnished and heated, since the condensation of the exhaust steam (which has a temperature of 212 degs. at the moment when the steam is condensed at atmospheric pressure) displaces an equal amount of cold water, this amount averaging about one-seventh of all the water that would have to be supplied to the closed heater. This is of exceedingly great importance where city water has to be purchased, or where water is scarce or costly, or where it contains considerable scale-forming matter.

Fourth—Since this condensed steam is perfectly pure—being nothing more nor less than distilled water—the quality of the whole feed supply is materially improved. A simple illustration will make this plain. Suppose that of two batteries of boilers one was fed continuously (seven days in the week) with impure water. And suppose that the other battery was fed with the same kind of water six days in the week, but that on the seventh day it was supplied with perfectly pure water. Certainly at the end of a year, or of six months, or of one month, this second battery of boilers would be in a better condition than the first, and this essentially is the advantage which is gained by saving the condensation of the steam used in heating the feed-water in an open heater.

Important as is the saving of this condensation in improving the quality of the feed-water, it is not the only way in which purification is obtained in an open feed-water heater. It is a well-known fact that some of the most troublesome and prevalent scale-forming impurities found in feed-waters are carbonates of lime and magnesia. These are held in solution in the water in the form of bicarbonates. By heating the water to the temperature of 200 degs. or over, as is readily done in an open feed-water heater, the extra measure of carbonic acid gas in the bicarbonates is driven off, the open heater being freely vented to the atmosphere. The remaining mono-car-

bonates of lime and magnesia are precipitated in the heater in the form of insoluble, flaky particles, which can be mechanically removed from the water by settlement and filtration, and thus be prevented from entering the boilers, where they would form scale.

The action of the heat also liberates other gases and the air which are in the water, and which, if they entered the boilers—as they would if no heater, or if a closed heater, were used—would cause severe pitting and corrosion, since they are very active in attacking moist iron. Again, in an open heater the feed-water can be relieved of mud and other solids to a very considerable extent by filtration, while the lighter impurities which rise to the top of the water in the settling chamber can be carried off by flotation.

Thus it will be seen that in an open feed-water heater purification of the water is obtained by saving and utilizing the condensation of the steam used in heating the water, and by precipitation, deposit, settlement, filtration and flotation.

Against this vitally important function of the open heater, the closed heater gives practically no purification, and it presents no offsetting advantages. Whatever degree of purification is obtained in the closed heater must be slight, and is at the cost of impaired heating efficiency, as already explained.

The capacity of the open heater is not limited by any consideration of heating surface or of the condition of this surface, inasmuch as the direct contact of the steam with the water effects the heating by condensation, the capacity for heating the water being limited only by the amount of water and steam that can be brought together. Large quantities of the steam are condensed and become a part of the feed-water. In the act of heating, the only requisite in thus using the exhaust steam is that the steam be freed from such impurities as entrained cylinder oil before coming in contact with the water. As already mentioned, this is easily taken care of by the oil separator, which has now been brought to a state of perfection which enables it to be operated with the utmost certainty as to results. In the open heater it is steam to water and water to steam all the time, with no intervening metal surface to become scaled and no question as to the number of square feet of heating surface in relation to the rated horse-power, as is the case with the closed heater. The maximum heating capacity of the open heater is maintained just as long as the steam and water can be brought together in the heater—that is, the heating continues just the same whether the trays are clean or whether they are covered with a large quantity of scale. The only consideration which governs the size of the open heater is that of providing for the separation and settling of the impurities which are thrown out of the feed-water by the purifying effect of the heating; this is amply provided for by the trays over which the water is passed for the deposit of precipitated matter.

Furthermore, by thus bringing the steam into actual and direct contact with the water to be heated, it is always possible to obtain the full temperature of the steam for that pressure. The "actual contact" method of transmitting heat involved in the open heater is ideal. If it were only possible to generate high-pressure steam in a boiler by bringing the water into direct contact with the products of combustion without the intervening surfaces of sheets and tubes, one of the greatest desideratums in power practice would be gained. An equivalent result is here accomplished, however, at atmospheric pressure with equally favorable results. There can be no deterioration in the heating efficiency or capacity in an open heater—no matter how long it has been in use or whether it is clean or not. Inasmuch as the open heater is operated under atmospheric pressure, the construction is simplified, the use of cast iron, copper and brass being permissible for all parts subject to deterioration, which would be impracticable if the heater were operated under pressure.

In connection with the matter of purification comes the question of provision made for cleaning heaters, and at this point also the comparison is decidedly favorable to the open heater. Every reasonable provision can be made in the open heater for easy and rapid cleaning. Large doors can be provided for removing and cleaning the distributing trays and filter bed. No inaccessible internal compartments need be used, so that a man can enter the heater for the purpose of cleaning the interior. In all of the work of cleaning the open heater no pipe connections are disturbed.

On the other hand, it is practically impossible to clean more than one side of the tubes or coils in the closed heater. In some cases it is impracticable to clean either side. For even such scant cleaning as can be accomplished in the closed heater it is frequently necessary to disconnect the piping.

It is a well-established fact that the amount of steam required for the operation of the boiler auxiliaries is about one-tenth of all the steam generated. Furthermore, practice shows that the exhaust steam from the auxiliaries is sufficient in quantity to heat the feed-water for the boilers if the open heater is used. It is evident from these two facts that the steam from the auxiliary engines can be used to good advantage for heating the feed-water. By this method it does not matter if the auxiliaries are of low economy, inasmuch as all of the heat in the steam not actually utilized in mechanically operating them is returned by means of the open heater to the boilers. Thus duplex pumps may be used with the assurance of the highest economy of operation, regardless of other conditions. If the exhaust from the auxiliaries were passed through the condensers, more than 85 per cent of the heat of the steam would be entirely wasted, but by operating the auxiliaries non-condensing and utilizing the exhaust in an open heater, the heat in this exhaust is saved, and, moreover, the pure water of condensation is added to the feed-water to the amount of over 12 per cent of the total supply, and a considerable portion of the scale-forming impurities is kept out. This mode of operation is particularly valuable where water is scarce or impure.

The crying need of many boiler plants is for extra boiler capacity, not only as a reserve so that repairs and cleanings can be given to the others, but also to give the extra steam required at periods of heavy load, and to save some of the coal that is wasted in forcing the boilers beyond their capacity. The simplest solution of this problem, which is applicable to the majority of power plants, is to feed the boilers with water at the highest possible temperature—not water at 150 degs. or 160 degs., but at the temperature of the exhaust steam, or nearly so—and also to purify the feed-water, and thus reduce the amount of scale-forming impurities entering the boilers. A case may be cited where in a power plant the maximum capacity of eight boilers with the heaviest load on, feeding water through a closed heater, was about 1000 hp. By replacing the closed heater with an open heater of an approved type, the operators at this plant were enabled to deliver comparatively pure water to the boilers at a temperature of 210 degs., in consequence of which, with the same boilers, they are now enabled to easily carry 1200 hp, while the normal load which formerly required every one of the eight boilers can now be carried with ease by seven boilers. Another result of the installation of the open heater was that the old scale came off the boiler tubes in great quantities. In addition to all this, it was found that after the installation of the open heater the fuel consumption was materially reduced. This is but one of many instances that may be cited where power plants have been daily throwing away large quantities of perfectly pure hot water and feeding into the boilers water containing many impurities that make scale, whereas by the adoption of the open heaters this pure, hot water could be saved and utilized with correspondingly beneficial results in the way of economy and efficiency.

THE QUESTION BOX

The regular Question Box department of the Street Railway Journal is herewith resumed. Occasion is taken to again invite all the readers of this paper to participate in this department by sending suggestions or statements of experience relative to any of the questions pertaining to any phase of practical electric railway work.

A.—GENERAL

A 1a.—What means of advertising have you found most effective?

Some of the means employed by the Railways Company General in advertising the different railways that it controls are folders containing maps, time cards, engravings of different scenes along the roads and booklets giving general and historical information regarding points of special interest. We also have time-tables printed in the newspapers in the different towns, and also have special reading notices inserted in the papers regarding changes of schedule, and special schedules on holidays, or notices about special events that would be of interest to the public. We also have billboard posters advertising the resorts and attractions, and small posters for shop windows, and display cards for the inside of the cars. We also make a practice of having small dodgers printed, to be hung inside the cars, telling of any special excursions and giving the weekly attractions at the parks. These dodgers are attached to a string, so that they can be pulled off and read. They are also hung up in the waiting rooms along the line of the roads and distributed in the towns. We attach display boards to the company's side poles, on which the attractions are advertised. We also hang display banners on the front and rear dashers and vestibules of the cars for advertising any special events. For one of the lines of this company, where there is a large summer resort, we have a very finely engraved booklet, in which are described different resorts along the lake, and also the location of the hotels and boarding houses, giving prices and capacity of each house. The booklet also gives general information as to how the different points on the lake may be reached from the terminal of the electric railway. The most effective advertising means we have found is by the newspapers, especially for interurban lines, where the through travel is from traveling men and tourists, who invariably look in the newspapers for time-tables of the interurban lines, just as they do for the steam railroad schedules. As the railroads publish their schedules in the newspapers, if the interurban roads wish to compete with them in traffic between the same points, they must also publish their time-tables and schedules in the local newspapers, for traveling people, as a rule, always look in the newspapers for such information. Next to this manner of advertising, we have found that the small dodger is the most effective for reaching the general public, when the distribution is carefully looked after. D. A. Hegarty, Gen. Supt.,
Railways Company General, New York City.

A 3.—How much money can be spent profitably by an electric railway company for advertising?

The amount of money spent profitably by an electric railway for advertising depends a great deal upon the kind of a railway advertised. The class of patrons riding on an interurban road are different from those patronizing a city line. The interurbans are used more for pleasure riding, and, consequently, they are the roads that require the most advertising. There is a general practice of giving transportation in exchange for newspaper advertising, which I think is a fair exchange, and a source of revenue to both parties to a certain extent, as the newspaper advertisements bring riders to the roads, and the fact of the schedules being advertised in the newspapers induces people to buy the papers.

D. A. Hegarty, Gen. Supt.,
Railways Company General, New York City.

A 17.—At one time the use of trail cars was quite general on electric railways throughout the country. Then came a period when the running of trailers was looked upon with more or less disfavor. There seems to be a decided tendency at the present time to go back to trailers. Please give your ideas and experience relative to trailers. Under what conditions do trail cars properly find a place in the operation of a modern electric railway? Do trail cars cause a greater number of accidents? If they do, what can be done to make them safer? What is the economy in running trailers?

We have two city lines in Western cities where there is a resort to which large crowds of people go between the hours of 2 in the afternoon and 12 at night. On the division running to these resorts we use motor cars with two trailers attached to each motor car. There are times, on Sundays and holidays, when we have to attach three trailers to a motor car. To operate trailers, it only takes a conductor for each trailer, thereby doing away with a motorman for every trailer operated. By having the power contained in one car it materially lightens the load that would otherwise have to be carried on the trailers. The saving in the operation of trailers comes not only from the fact that you save just half the wages per trailer on account of using only one man, but you also save the first cost of the investment, by not having any electrical equipment under the trailers. A trail car is no more liable to cause accidents than a motor car of the same style of construction. All cars opening on the sides are more likely to cause accidents than center-aisle open cars, with the sides barred off, and these cars the conductor has only the back platform to watch when passengers are getting on or off, whereas, in the case of the other cars the conductor must watch as many places as there are openings in the side of the car. Therefore, I prefer the center-aisle open cars for the prevention of accidents.

D. A. Hegarty, Gen. Supt.,
Railways Company General, New York City.

Trail cars are of great value to those roads that are subject to a heavy intermittent service that calls for a large number of cars on special occasions, the frequency of which are insufficient to justify an investment necessary for complete equipments. Unless extra precautions are observed the elements of danger are considerable. For the smaller cities where the passengers are less active and observant, an employee should be stationed on the rear platform of the motor car, or where there are heavy grades, on the front of the trail car at the brake, and the duties of this extra man should be to watch the passengers in getting on and off, and to give all signals to the motorman. By this arrangement the conductor is enabled to give his entire attention to the fares of both cars.

F. H. Brooks, Supt., Lincoln (Neb.) Tract. Co.

The topography of the lines, in the writer's opinion, is the deciding factor with respect to the use of trailers. The fact that lines are hilly does not necessarily preclude the use of trailers, but a combination of hills and curves makes the running of trailers undesirable. In Wheeling we have reached the stage where the carrying capacity on certain lines must be increased, and we are meeting the situation by substituting for our 18-ft. and 20-ft. single-truck cars a light type of 40-ft. double-truck car. These double-truck cars will take care of our traffic for some time to come. As some of our lines are single-track, we will meet any fututre demand for increased carrying capacity on these lines by double-tracking. In our city trailers will come as a last resort. Geo. O. Nagle, Gen. Mgr.,
Wheeling Tract. Co., Wheeling, W. Va.

B.—EMPLOYEES

B 1.—What are the requirements demanded of applicants for conductors and motormen on your road? The editor will appreciate receiving copies of all the blanks used in your employment department.

Applicants for positions as conductors or motormen must be over 21 and under 40 years of age, not less than 5 ft. 6 ins. in height, and weigh at least 150 lbs., physically sound with perfect eyesight.

Albert Eastman, Supt. of Employment,
Public Service Corporation of New Jersey.

Before employing motormen and conductors we require that they produce three letters of introduction from responsible business men, no letters from politicians, lawyers or salaried men being accepted. In oral interview we determine if the applicant smokes cigarettes, drinks, owes any debts or belongs to any labor organization. If his investigation is satisfactory, and he has a watch and enough money for badges, he is allowed to fill out application blank, a copy of which he is instructed to keep.

L. M. Levinson, Mgr., Shreveport (La.) Tract. Co.

B 3.—For conductors and motormen do you prefer married or single men and country bred or city men? Please give your reasons for your answer.

Married men, regardless of whether they are country or city bred. Married men usually take more interest in their work, as the loss of their positions means more to them than it does to a single man.

Albert Eastman, Supt. of Employment,
Public Service Corporation of New Jersey.

We prefer country bred men, but have no preference as to married or single.

L. M. LEVINSON, Mgr., Shreveport (La.) Tract. Co.

B 4.—Do you employ men who have had previous experience on other electric roads? Why?

We accept inexperienced in preference to experienced men.

ALBERT EASTMAN, Supt. of Employment, Public Service Corporation of New Jersey.

B 6.—Do you consider it a good idea to make applicants swear to the statements in their application blanks? Why?

I consider it a good idea to make applicants swear to the statements in their application blanks. The adoption of this would prevent the filing of a large number of "fake" applications.

ALBERT EASTMAN, Supt. of Employment, Public Service Corporation of New Jersey.

C.—PARKS AND PLEASURE RESORTS

C 1.—Give suggestions, based on your experience, as to the best method of handling park travel.

Our baseball park and our summer theater and dancing pavilion are located on a 5-mile belt line, with cars running in both directions, trailers being used behind each motor car. If the attraction is a good one, we run these trains in sections, tying up the extras on a long spur track for that purpose while the entertainment is on, and running them out when it is over.

L. M. LEVINSON, Mgr., Shreveport (La.) Tract. Co.

C 3.—Is it better for the railway company to operate a park and its attractions or to induce outsiders to operate them on a percentage basis?

We lease our parks and furnish all necessary lights. Our revenue is limited to car fares.

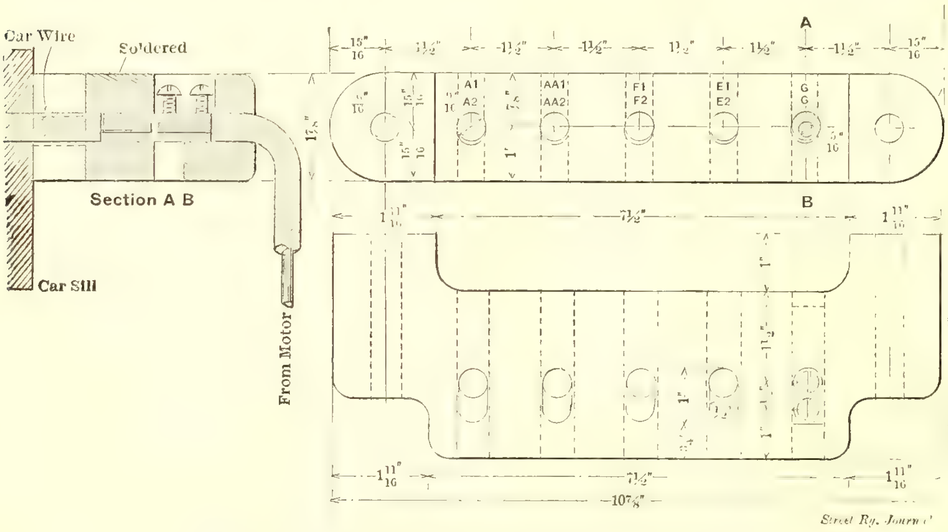
L. M. LEVINSON, Mgr., Shreveport (La.) Tract. Co.

E.—MASTER MECHANICS' DEPARTMENT

E 11.—What can the master mechanic of the average surface road do to render his cars more nearly fireproof?

The drawing shows a railway motor connecting board as used on the cars of the West Penn Railways Company. The board consists of a plain wooden board, sawed out on band saw and drilled on a post borer or by hand. There are five standard two-way connectors, and two ½-in. bolts for fastening board to car timber immediately over the motor leads. The board is thoroughly soaked in insulating compound and baked before using. The connectors for this board are purchased with only two holes tapped, as the car cables are soldered in one end. Two standard ¼-in. machine screws are used in the other end of the connector, and the board is so proportioned that it is impossible for any metallic substance falling on its top to short circuit the wiring. The connector fits snugly the hole that is bored for it, and is definitely located by being soldered to car wire and by the screws. The connector is set back from the face of board, and hole leading to it is made of such size as to fit the car wire right up to connector face; the strain from the motor leads is thus largely removed from the connector screws, and the chances of the leads being pulled out are largely lessened. The outlines of the board are such as to keep water used in scrubbing cars from collecting on it. The boards are stamped uniformly, A1, AA1, F1, E1, G, and this has proved of great assistance in quickly connecting up an equipment that has been removed from a car body, as it does away with reference to wiring diagrams and the ringing out of wires. The board installed is strong enough to support the weight of a man. The uniformity of car wiring, secured by the use of the board, is a help to the men, and the small space that the board occupies, 4 ins. x 11 ins., is an advantage. No tape is required, and this effects considerable economy. Quite a saving is also made in time necessary to disconnect and connect up equipments over some other methods.

J. W. BRIDGE, M. M., West Penn Railways, Connellsville, Pa.



RAILWAY MOTOR CONNECTING BOARD, WEST PENN RAILWAYS

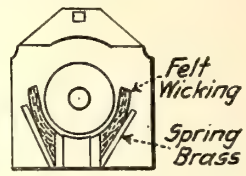
Use fireproof material and electric or hot water for heating purposes. Supersede for wood iron panels, ribs and angle-iron sills and bumpers.

R. H. YOUNG, M. M., Lincoln (Neb.) Tract. Co.

E 47.—Give description, with sketch, of journal box suitable for using oil for motor lubrication.

The journal most suitable for oil is one that has a felt wicking, either at the side or bottom, which feeds the oil to the journal. (See sketch.)

R. H. YOUNG, M. M., Lincoln (Neb.) Tract. Co.



JOURNAL WITH FELT WICKING

E 76.—Many of the steam roads dry-wipe their cars without the use of any water. Do you think this method is applicable to electric cars?

The accumulation of dirt on a steam car is of a different nature to that gathered up by an electric car, and each requires a separate treatment to remove, and I do not think a system of cleaning could be worked out which would prove satisfactory to both. A steam car does not become dirty while in active service from an accumulation of ordinary dust, but it is rendered dirty by a peculiar greasy slime intermingled with certain fine particles of coal and ash, given out by the locomotive. This foreign matter comes in contact with the surface of the varnish, and the speed at which the train is traveling forces this hot greasy matter to hold on to the surface, and on some roads where a constant war is not carried on to erase it this slimy matter becomes like a scale, or blight, over the whole surface, so much so that on railroads using soft coal, the coating of greasy stuff becomes so thick as to obliterate the color, striping and lettering of the car. Clear water has no effect on this unless a little friction is applied to remove it, and this is the reason we have so many patent articles on the market claiming to remove this dirt without injury to the surface of the varnish.

Most of the Eastern roads overcome this smoke nuisance by a constant fight carried on by means of the "Dry-Wipe" system, which the writer thinks is about the best thing to do, giving the cars a thorough soap and water and elbow-grease washing every two or three months. The above conditions are not encountered in the operation of an electric railroad, there being no smoke, and whatever dust is taken up is from the roadbed, and is of an ordinary character, and this, together with the dust settling on the car when it is housed for the night, is made to hold on to the varnish by occasional rain and sun baths; but this dirt is far more easy to clean off than the steam car "smudge," and should not be allowed to stay on so long a time between washings as to enable it to become fixed into the varnish. The electric car is somewhat at a disadvantage in having to withstand a constant spattering of mud in going through the crowded and, sometimes, dirty streets of a great city; if this filth is allowed to remain on the varnish any length of time it is a great enemy to your bright and clear surface; I should advocate a constant system of regular washing with clean water—a merely superficial cleaning, which would serve to keep the varnish free from an accumulation of dust and dirt, this to be followed by a monthly soap and water cleaning.

A few years ago the writer had a contract to wash and keep clean the cars of a street railway operated by horses, and the manner in which this work was performed may suggest a like method for washing electric cars. Of course, it will be understood that the description refers to washing a closed or winter car. Open cars require quite a different treatment for many reasons.

The conditions of the road in question called for a nightly wash of all the horse cars on a line operating 300 cars. The night men commenced to wash cars at 6 p. m., when the cars began to run in for the night. The time between cars coming in was irregular. First a batch at 10-minute headway, then a rest until about 8 o'clock, then a rush of fifty cars came in at a 2-minute headway. Then the hustling began, for it was the rule that the driver of each team had to bring his car on to the washing platform, wait until it was washed, and hitch on his team again and switch his car to its proper place for the night, before he could take his team to its proper place and then go home. It will be easily realized how necessary it was for the washers to hurry, and I hope it will be equally understood that we did not attempt to wash a car completely in two minutes. What we did was to split up the operation into sections.

First, it was necessary to have the water-washing done in one place on a properly constructed cement floor, arranged to slope down under the car and drawn off into the sewer. This place was called the "wash-stand." The writer had electric lights arranged so as to cast a powerful light on both sides and ends of the car; also lights casting rays from above and lights placed in a glass cover near the ground, casting rays upward. By this means no part of the car was in shadow, and the dirt was easily distinguished on the car. There was "no groping in semi-darkness."

The writer invented a special broomhead having a place in the stock to receive the end of a brass elbow screwed in and clamped for strength. This elbow was screwed into a water-pipe handle attached to a rubber hose, so that a continuous stream of water passed through the broomstick and through the broomhead and on to the car. All the man had to do was to move the broom quickly over the surface and the dirt was quickly gone. These cars were 17-ft. bodies, 28 ft. over all. A man was placed on each side of the car and a man at each end, four men in all outside. Each outside man had a water-broom. Two men were placed inside the car for sweeping, dusting and cleaning inside of the windows. This operation was done in 2 minutes as far as the outside was concerned. The driver then hitched on his team and put his car in its proper place, where another gang of washers went at it with chamois, wiping the panels and windows, while others cleaned the handles. It will be noticed that the main object was to get the "sloppy" work done in one place and to do it quickly.

The finishing of the job was done more leisurely. It was also necessary to keep the incoming track clear of cars so as to avoid a blocking of cars on track in the street and to switch each car to its proper berth for the night.

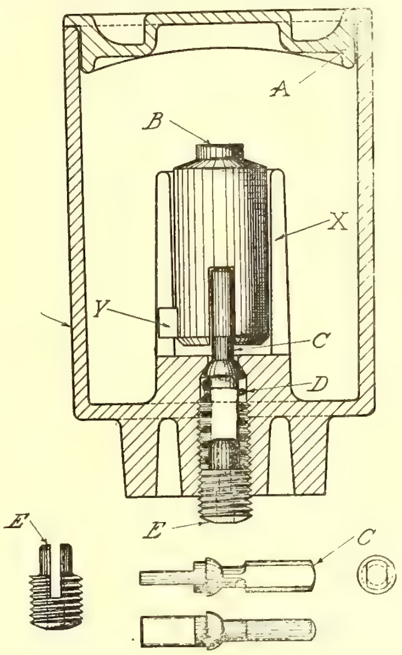
By following this mode of car cleaning, the writer was able to keep the whole equipment clean at a very economical cost, considering the amount of work accomplished, and to further aid in keeping the brilliancy of the painting at its best possible appearance and the cars as a whole clean and sweet, I introduced what I called a special "clean up," which consisted of a gang of men working by daylight; and by giving these men a certain number of cars a day to "clean up," the whole equipment went through this thorough cleansing process in such a way that each car received its treatment in regular consecutive order. The only difficulty lay in the trouble in so handling the men as to enable them to get at the cars and do this work while the cars were on their "daily swing;" but with the co-operation of all concerned we were enabled to overcome all obstacles.

The writer is fully aware that in the foregoing there are many features peculiar to the "horse car age," yet, notwithstanding, I do think that a modified form of the "special clean up" method could be adapted to electric equipment. I wish, however, to advise that, whatever system is adopted in order to clean and properly wash the cars, all the sloppy wet work be done in one part of the depot, for having the washing done all over the flooring of the building gives rise to many evils. The writer was ever ready to give a fair trial to any patented article which came along, but in the end found the "old reliable" laundry soap, water and plenty of energy to be the best car cleaner, when intelligently applied; for good soap is beneficial to the varnish when used at proper intervals of time. To sum up the whole situation, the writer is of the opinion that a proper regard to the handling of an electric railway car equipment, in reference to car washing, is absolutely necessary, and should receive careful attention by the management as to the best way to go at work so as to get the best results for the amount of money available for the purpose. It will be found that the item of car cleaning is a serious one, and a large amount of money can be expended without a satisfactory result, unless it is accomplished in a systematic way and not in the fast and loose manner too frequently followed.

JOHN C. WEAVER, Bound Brook, N. J.

E 47.—Give description, with sketch, of journal box suitable for using oil for motor lubrication.

The accompanying sketch illustrates a novel form of lubricator that has been in use on motors of the Rhode Island Company (Providence) since last August, with very satisfactory results. In service the weight "B," which fits loosely in the vertical tube "X," responds to the jar caused by the motion of the car, and is free to rise and fall, thus striking a hammer blow on the end of valve stem "C." This action disturbs the valve so as to allow a very small quantity of oil to pass through. The oil is then free to flow down through the adjusting screw "E," and, forming a drop on the end of same, passes onto the journal that is to be lubricated. This lubricator has the advantage of employing no felt or wicking of any description which is liable to clog at any time from sediment, dirt and impurities.



OIL CUP, RHODE ISLAND COMPANY

The lubricator can be adjusted to meet any conditions, and this is a very necessary feature, in order to properly regulate the flow of oil to the amount needed for proper lubrication, and at the same time do away with any waste or excess of oil being used over and above what is actually needed. After the lubricator has been properly adjusted to suit the working conditions it requires no more attention, excepting that of an occasional filling, and good lubrication is assured.

To adjust tension of spring "D" under valve "C," the weight "B" is removed and a small wrench applied to end of valve "C." The other end of valve engages adjusting screw "E," and it will be seen that by the turning of the wrench on this valve the adjusting screw may be moved in or out of the casting, thus regulating tension on the spring, which controls the feed of oil. Tube "X" has three vertical slots running its full length, and lug "Y" on weight "B" must be in one of these three slots. This keeps the weight from turning, and the weight holds the valve and adjusting screw from turning, thus holding the adjustment of valve at any desired point.

These lubricators are made to be placed inside the regular grease cup of motor. The device is covered by patents and is soon to be placed on the market.

EDITORS.

E 71.—What pressure do you maintain on the springs in trolley bases?

The pressure on trolley spring should be sufficient to hold a trolley wheel up against the wire with a pressure of 15 lbs. at the end of a 13-ft. pole.

MASTER MECHANIC.

There should be between 20 lbs. and 25 lbs. pressure against the trolley wire. Never more, as it would cause an excess of wear on all parts of trolley wheel and wire. If there is much less than 20 lbs. pressure the wheel is apt to leave the wire at switches, etc.

J. L. SULLIVAN, Foreman,
Motor & Truck Dept., United Rys. Co., St. Louis.

From 18 to 20 lbs.

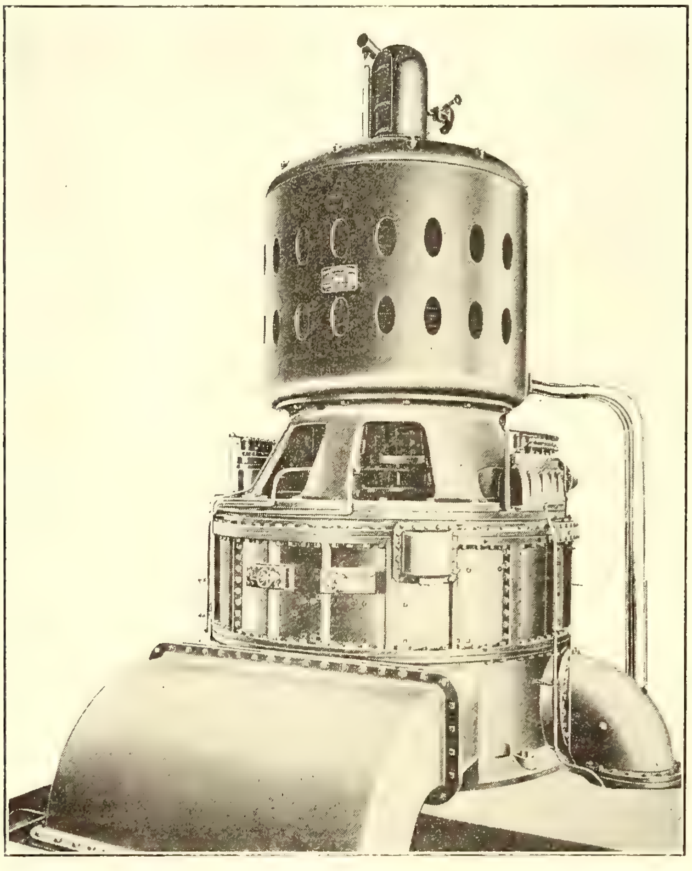
J. CHAS. ROSS, Gen. Mgr.,
Steubenville (Ohio) Tract. & Lt. Co.

Depends on the alignment and general condition of trolley wire. With wire in first-class shape, 20 lbs. tension upwards at the wheel is sufficient. It may have to be increased to 30 lbs. if the line is in bad shape. A lighter tension is also possible with a ball-bearing trolley base than with the old-style pin bearing.

FRANCIS G. DANIELL, New York City.

REPORT ON THE TEST OF A 2000-KW CURTIS TURBINE

The accompanying report gives the results of a test recently made by Frederick Sargent, of Sargent & Lundy, the well-known engineers of Chicago, and Louis A. Ferguson, vice-president of the Commonwealth Electric Company, of Chicago, on a 2000-kw, 900-r. p. m. Curtis steam turbine generating unit. The turbine is a four-stage machine, designed in 1903, and recently changed in a few particulars as a result of experiments conducted during the past year. The machine, as tested, conforms as nearly as possible to the standard four-stage machines now being produced by the General Electric Company, but is less efficient, since the changes made have been confined to the buckets, while several other important changes, which the company knows to be desirable, could not be made in this case without entirely rebuilding the machine. The results reported were determined by the most accurate methods, and have been verified by repeated tests, in addition to those conducted by Messrs.



THE 2000-KW CURTIS FOUR-STAGE TURBINE RECENTLY TESTED AT SCHENECTADY

Sargent and Ferguson, duly considering the steam pressure, vacuum and superheat.

The report of Messrs. Sargent and Ferguson to E. W. Rice, Jr., third vice-president of the General Electric Company, reads as follows:

We sent our assistants, Messrs. Clark and Eastman, to Schenectady to prepare the apparatus for making these tests, and they made several preliminary trials before our arrival, and the results of each of the trials very closely approximated the results of the official tests herein mentioned. We had all the instruments carefully tested and standardized during the trials, the electrical instruments being tested by the New York Testing Laboratory in the presence of Mr. Eastman. The surface condenser showed practically no leakage. We took every precaution to satisfy ourselves that the tests were reliable and accurate, and we beg to certify that the results obtained were as follows:

FULL-LOAD TEST

Duration of test	1.25 hour
Steam pressure (gage)	166.3 lbs.
Back pressure (absolute)	1.49 ins. of mercury
Superheat	207 degs. F.
Load in kilowatts	2023.7
Steam consumption per kw-hour	15.02 lbs.

HALF-LOAD TEST

Duration of test	0.916 hour
Steam pressure (gage)	170.2 lbs.
Back pressure (absolute)	1.40 ins. of mercury
Superheat	120 degs. F.
Load in kilowatts	1066.7
Steam consumption per kw-hour	16.31 lbs.

QUARTER-LOAD TEST

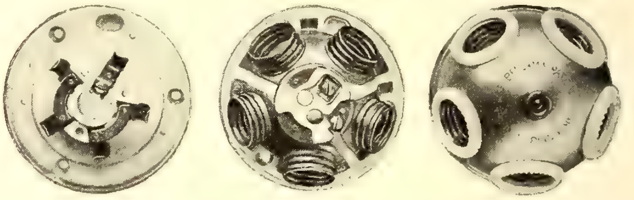
Duration of test	1 hour
Steam pressure (gage)	155.5 lbs.
Back pressure (absolute)	1.45 ins. of mercury
Superheat	204 degs. F.
Load in kilowatts	555
Steam consumption per kw-hour	18.09 lbs.

ZERO LOAD

Duration of test	1.33 hour
Steam pressure	154.5 lbs.
Back pressure (absolute)	1.85 ins. of mercury
Superheat	156 degs. F.
Steam consumption per hour	1510.5 lbs.

IMPROVED WIRELESS CAR-LIGHTING CLUSTERS

The Benjamin wireless clusters which are in extensive use on electric cars throughout the United States because of their simplicity and substantial construction have been recently still further improved. These car clusters are made in two sizes: One with a 3-in. diameter base is made for two or three lights; the larger size with a 4-in. diameter base is made to accommodate two, three, four or five lights. These clusters can be used either with or without reflectors. The 450 cars purchased by the St. Louis Transit Company just previous to the Exposition were equipped with two-light clusters having no reflectors. When the ordinary opal reflector is desired, the clusters are



VIEWS SHOWING CONSTRUCTION OF WIRELESS CLUSTERS

furnished with a sub-base by which the usual flat opal reflector can be adapted to car lighting, by being held between the base of the cluster and the sub-base between two rubber rings. Reflectors of white enameled tin or of polished aluminum are furnished to fit directly between the base of the cluster and the ceiling without a sub-base. These latter reflectors are 14 ins. and 16 ins. in diameter.

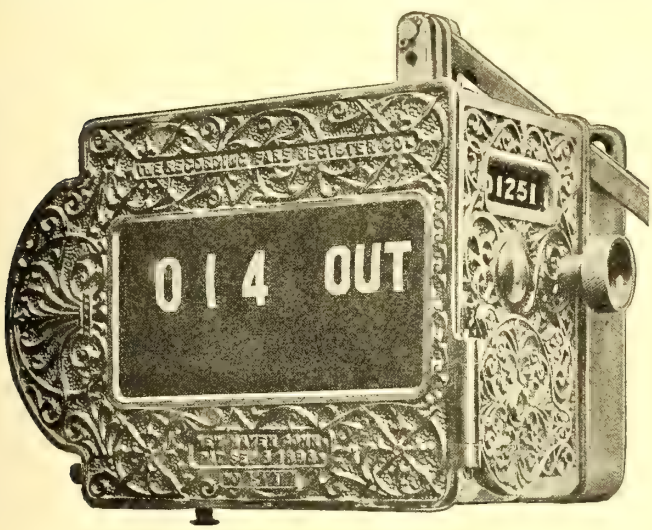
The interior construction of these wireless clusters is very simple and substantial. The contacts are all made a part of the mechanical construction of the cluster, so that the only connections the wiremen must make are at the two binding screws, where the wires lead in. Lamps are connected together in series by overlapping contacts. Between the terminals are porcelain partitions. All insulation is of porcelain, and the various parts are bolted firmly to a single porcelain block which forms the entire insulation and support of the cluster. The distance between parts of different potential is greater than in an ordinary lamp socket. In no place are parts having appreciable difference of potential less than 3-16 in. apart. In this respect the clusters are claimed to be superior to ordinary sockets. The center contacts against which the lamp bases are screwed are phosphor bronze springs with about ⅛-in. movement. This is to prevent lamps shaking loose in car service. The shell near the binding screws is fibre lined. The clusters are adapted to outdoor purposes by attaching a

flange which will screw onto a ½-in. iron pipe or conduit, the reflector holder being fastened directly onto the conduit. For outdoor use a porcelain enameled steel shade is furnished. Outdoor clusters are supplied with aluminum shells in the place of polished brass, better to withstand the action of the weather. The outdoor clusters can be used either with gooseneck bracket of iron pipe or with a suspension fitting. The latter consists of a short length of iron pipe with a cap at the top containing an eye for the attachment of the suspension cable, and means for taking out the wires by means of drip loops to prevent water from getting inside the pipe.

Among the large companies using these clusters are the New York City Railway Company, the Interborough Rapid Transit Company, United Railways of St. Louis, Detroit United Railways and the Los Angeles companies.

A NEW FARE REGISTER

In the accompanying illustration is shown the new type-E fare register, made by the Recording Fare Register Company, of New Haven, Conn., and first exhibited at the Lake George convention, where it received very favorable comment. This



NEW TYPE OF SIMPLE RECORDING REGISTER

register was designed for the purpose of giving the electric railways a first-class, simple register at the lowest cost consistent with accurate work. In general appearance it is the same as the various types of recording registers made by this company, but does not contain the recording feature. The principal points of advantage claimed are the remarkable simplicity of the mechanism and its absolute accuracy and durability. All parts are of steel and strong enough to stand the most severe use.

CONVERTIBLE CARS FOR WEST VIRGINIA

The J. G. Brill Company has recently completed for the S. George Railroad Company, Wellsburg, W. Va., the convertible type of car shown. The builder's well-known arrangement of the panels and sashes sliding into roof pockets has become widely used during the last seven years, as conversion or semi-conversion may be effected quickly and easily, and the cars, when opened or closed, are practically the same as the standard types. The car illustrated is mounted on the No. 21-E single-truck, which carries the car body 2 ins. lower than any other single truck. Brackets connect the back of the seats with the posts, thus forming convenient handles, which encourage passengers to face in the right direction when leaving the car. Twenty-eight passengers may be comfortably seated, the seats being of spring cane. Ash in natural color and decorated birch ceilings constitute the interior finish. The vestibule sashes are composed of single lights and are arranged to drop into pockets.

The general dimensions are: Length over the end panels, 20 ft. 7 ins., and over the crown pieces and vestibules, 30 ft.; the panel over crown piece, 4 ft. 8½ ins.; width over the sills and the panels, 7 ft. 2¼ ins.; width over the posts at the belt, 8 ft.; sweep of the posts, 5 ins. The side sills are 5¼ ins. x 7 ins.; the sub-sills, 3¼ ins. x 4⅝ ins., supported by 3¼-in. x 5-in. x ⅜-in. Z-iron. The thickness of the corner posts is 3⅝

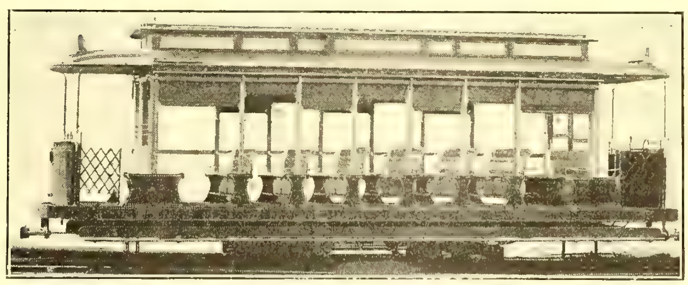
APPEARANCE OF CONVERTIBLE CAR WHEN PARTLY OPEN

ins., and of the side posts, 3⅜ ins. The No. 21-E trucks have 33-in. wheels and 4-in. axles. Among the Brill specialties are angle-iron bumpers, radial draw-bars, "Dedenda" gongs, ratchet brake handles and folding gates.

OPEN CARS FOR THE KNOXVILLE TRACTION COMPANY

Six ten-bench open cars, built by the G. C. Kuhlman Car Company, have lately been placed on the lines of the Knoxville Traction Company. The new cars will be used in the city and suburbs of Knoxville, where the company operates about sixty-five cars on 30 miles of trackage. The lines of the company reach Chilhowee Park (for whites) and Magnolia Park (for colored), which bring a large amount of extra business during the summer months.

Fifty passengers may be comfortably seated, the seats being reversible, with the exception of the two at each end. The sashes in the bulkheads are arranged to drop into pockets between the seats. Three-bar guard rails extend across the window spaces. The curtains may be drawn to the floor. The interiors are finished in ash, with three-ply birch ceilings. In-



TEN-BENCH OPEN CAR USED BY THE KNOXVILLE TRACTION COMPANY

cluded in the equipment are Brill vertical bevel gear brake handles, "Dedenda" gongs, "Retriever" signal bells, angle-iron bumpers, etc.

The cars are 21 ft. 8½ ins. over the corner posts and 7 ft. 1½ ins. over the sills. They are 30 ft. 4 ins. over the crown pieces, and from the panel over the crown piece, 4 ft. 3¾ ins. The width over the posts at the belt is 7 ft. 6 ins., and the sweep of the posts is 2½ ins. The distance between the centers of the posts is 3 ft. 9 ins. The side sills are 5 ins. x 8 ins., and the end sills are 5 ins. x 7⅛ ins. The thickness of the corner posts is 3⅝ ins., and of the side posts, 2¾ ins.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION CONVENTION

The annual convention of the Colorado Electric Light, Power and Railway Association will be held at Glenwood Springs, Col., Sept. 18, 19 and 20, 1905. George B. Tripp, of Colorado Springs, is secretary.

REPORT OF THE LONDON TRAFFIC COMMISSION

The Royal Commission on London Traffic, which was appointed by Parliament in February, 1903, to inquire into the means of locomotion and transport in London, and which visited this country during the fall of the same year, has issued its report. While in this country the committee visited several Eastern cities and interviewed a number of the leading street railway managers on the subject of American transportation facilities. The report declares that everybody knows that the existing means of transit in London are seriously defective. It adds that improvement is imperatively necessary in the interests of both public health and convenience, for the prompt transaction of business and to render decent housing possible.

The narrowness of the streets in London lies at the root of the problem of surface locomotion in that city. The commissioners recommend the widening of many important thoroughfares, and what is more important, the construction of two great avenues, one running east and west, 4¾ miles long, and the other running north and south, 4¼ miles long. Each avenue would be 140 ft. wide, with four tramway tracks on the surface and four electric railway tracks underground. The commissioners estimate the cost at from £25,000,000 to £30,000,000. Nevertheless, they strongly urge this plan if it is found to be financially practicable.

In dealing with tramways, the report remarks that the existing tramway mileage in London is quite insufficient, and is conspicuously inferior to that of American, European and provincial English cities. It recommends a large extension and the linking of various systems. More underground railways also are needed, and they should be, if necessary, aided by the local authorities. Shallow subways are regarded as preferable to deep laid tubes, although the former in some cases are admitted to be impracticable. The opinion is expressed that motor omnibuses will never take the place of tramways.

As can be seen, the construction of the two avenues and the carrying out of the commission's other recommendations would be enormously expensive. The commissioners recognize that this will prevent the adoption of an ideal scheme, but in view of the apparent fact that the population of London will reach 11,000,000 in the near future, they declare that the utmost possible ought to be done, and they urge the creation of a permanent body to deal with the question.

The system of paying cash fares on the cars came to an end on the Indiana Union Traction Company's line July 14.

GUY ANCHORS

The accompanying illustrations show the method of installing Stombaugh guy anchors made by W. N. Matthews & Brother, of St. Louis. The smaller sizes of these anchors are supplied without rods and are installed as shown in Fig. 1. A piece of galvanized-iron cable or wire, 7 ft. or 8 ft. long, is attached to the eye of a rodless anchor and is then passed through the hollow pipe of the installing wrench, shown in the illustration. The anchor is then keyed to the wrench and the wire drawn tight, after which a clamp is set flush with the cross-bar of the wrench, as illustrated in Fig. 1. The anchor is then screwed into the ground, care being taken to insert them so that the connecting cable will be at exactly the angles in which the guy wire is to run. When as deep as the conditions of the ground permit, the wrench is disconnected and withdrawn, and the guy wire is attached.

The rodless anchors are only made in 5-in. and 6-in. sizes. Larger sizes are made with a permanent rod, and are installed as shown in Fig. 2. The rod is slipped through the hollow wrench, after which a metal or wooden wedge is driven firmly into the eye, as shown in the engraving. The wedge prevents the wrench from slipping off the key from the torsional strain while the anchor is being set. When the proper depth is reached, the wrench is pulled out and the guy cable from the pole is attached to the eye of the anchor left projecting from the ground.

Fig. 1

Fig. 2

METHOD OF INSTALLING GUY ANCHORS

A new feature of these anchors is that the pipe of the wrench is now being made longer than formerly, and allows about 1½ ins. to 2 ins. of the eye to project beyond the cross-bar.

The fate of the Ware & Gilbertville Transportation Company, an enterprise which carried passengers by automobile, is interesting. It was started when the Hampshire & Worcester Street Railway was temporarily suspended, having gone into the hands of a receiver. A short time ago the street railway resumed operations, and now the manufacturers of automobiles are seeking to get their money for the machines. Automobile transportation could not stand the competition of the street railway.

FINANCIAL INTELLIGENCE

WALL STREET, July 19, 1905.

The Money Market

The money market continued firm this week despite the heavy gain in cash by the local institutions, which more than offset the payment of $11,500,000 into the national treasury by the depository banks. The demand for funds was fairly brisk throughout, especially for fixed periods, but there was no disposition on the part of lenders to offer with much freedom, in view of the heavy demands soon to be made upon the banks for crop moving purposes which promise to be fully as heavy as in former years. Money on call was in abundant supply at rates ranging from 3 to 2 per cent, with most of the business transacted at 2 to 2¼ per cent. Time money was in much better demand, and several large transactions were reported at current rates. Early in the week local and out-of-town institutions offered moderately at 4 per cent for six months and experienced little difficulty in placing their funds. Toward the close the demand for over the year maturities slackened materially, but a better inquiry developed for the shorter periods, especially for four months contracts, which commanded 3¾ and 3½ per cent. Sixty-day contracts were obtainable at 3 per cent, while ninety-day money was in good supply at 3¼ per cent. Mercantile paper continued in good demand, but the supply was extremely small considering the reported activity in mercantile lines throughout the country. Sterling exchange was weak, at a further decline of 20 points to 4.86.55 for prime demand bills, which eliminates all possibility of gold exports for the time being. A feature of the market was the unusually good showing made by the clearing house banks on last Saturday. The gain in cash amounted to $11,743,700, which was considerably in excess of the preliminary estimates. The increase in this item was due largely to the arrival of subscriptions to the new Japanese Government 4½ per cent loan, and to the transfer of funds from San Francisco to New York. Loans decreased $9,150,400, owing to the liquidation in the stock market. Surplus reserve increased $11,565,425 to $19,523,250, which compares with a surplus of $44,563,350 in the corresponding week of last year, and $13,278,475 in the corresponding week two years ago. United States deposits amounted to $11,398,800, as against $11,977,600 in the preceding week. The European markets remained easy and practically unchanged. The discount rates at the principal European centers were as follows: London, 1¾ per cent, decline ⅛ per cent; Berlin, 2⅛ per cent, unchanged; Paris, 1¾ per cent, decline 1-16 per cent.

The Stock Market

There was a material falling off in the dealings on the Stock Exchange this week, and although prices displayed considerable irregularity the general tone was firm. In the early dealings trading was fairly active, and prices continued to advance under the lead of the Northern Securities group, all of which rose sharply, but in the subsequent dealings the market developed extreme dullness, and there was a general disposition on the part of the professional elements to take profits. The market was well supported, however, and the reactions in most instances were confined to comparatively narrow limits. Commission house business fell off materially, and the transactions for London accounts were very moderate. Northern Pacific was the strong feature in the early dealings, the stock scoring an advance of 11 points, to the highest price on record. Great Northern advanced 5 points, and Northern Securities, on the curb, rose sharply in sympathy. In other parts of the list great strength was displayed, especially in St. Paul, which was lifted several points. No confirmation of the Northern Pacific rumor was obtainable, however, and prices ran off rather sharply on that account. Northern Pacific dropped 5 points, while the declines in other parts of the list amounted to 1 per cent and upwards. In the subsequent dealings prices scored substantial recoveries on a very small volume of business. St. Paul was conspiciously strong, and Reading was bought in large amounts. Southern Pacific and Union Pacific also held strong. Illinois Central enjoyed a sharp advance on buying, said to be for the account of a new pool. The steel stocks declined early in the week on rather heavy selling, but subsequently recovered part of the loss. Tennessee Coal & Iron also lost heavily at the beginning, but regained most of the loss at the close. In the specialties the overshadowing feature was the sharp break in Pittsburg Coal, on the passage of the preferred stock dividend, to near 48, which compares with a price of 80 last spring. The bond market was dull, but generally strong, about the only feature being the new Japanese 4½s, which sold at a premium of 1¼ per cent above the subscription price, and held most of the gain. The closing was extremely dull but steady.

The local traction issues were moderately active and strong, the features being Metropolitan Street Railway and Brooklyn Rapid Transit, both of which ruled around top prices on reports of large increases in earnings.

Philadelphia

There was a further falling off in the dealings in the local traction stocks this week, and although prices displayed irregularity at times the general tone of the market was firm. Interest again centered in Philadelphia Rapid Transit, of which upwards of 3000 shares were dealt in at from 28⅛ to 27½, and back to 28 at the close. Philadelphia Traction opened down ¼ at 99¾, but later recovered to 100. Philadelphia Company common was quiet but strong, several hundred shares changing hands at from 43¼ to 43½, while the preferred sold at 47¾ to 48 for small amounts. Union Passenger Railway dropped a point to 2¾ on the sale of 100 shares, and United Gas & Improvement sustained a similar loss, about 1000 shares selling at prices ranging from 95 to 94. Union Traction held steady at 60, and Consolidated Traction of New Jersey was firm at 82. Other transactions included American Railways at 51; United Traction, of Pittsburg, preferred at 50½, Railways General at 2⅝ to 3, and United Railway Investment preferred at 87.

Chicago

Trading in the traction stocks continued upon an extremely small scale this week, and apart from the sale of ten shares of Chicago Union Traction preferred at 26, the lowest point attained thus far this year, the market was absolutely without feature. Chicago & Oak Park stocks ruled firm, the common selling at 5, while several hundred shares of the preferred brought 18. Metropolitan Elevated sold at 24, and Northwestern Elevated changed hands at 21½. South Side Elevated continued to display strength, the price holding at 95. North Chicago Street Railway sold at 58 for fifty shares.

Other Traction Securities

Trading in the Baltimore market was quiet and prices generally held firm. United Railway 4s were fairly active, upwards of $30,000 changing hands at 94 to 93¾. The income bonds were less active, $14,000 of the free bonds selling at 59¾, and $10,000 certificates of deposit selling at 58½. Some activity developed in Toledo Traction 5s, $16,000 being dealt in at 100½ to 100¾. Other transactions included 100 United Railway stock at 13¼, $7,000 Norfolk Railway & Light 5s at 93¼ to 93, $2,000 Central Railway 5s at 117¼, City and Suburban 5s at 113⅜, Richmond Traction 5s at 105⅛, and Macon Railway & Light 5s at 97¾. In the Boston market dealings were upon a comparatively small scale, but prices showed only slight changes from those prevailing at the close of last week. Boston & Worcester preferred was rather more active, about 1000 shares changing hands at from 76½ to 75½, and back to 76. The common was practically neglected, ten shares selling at 31. Boston Elevated held firm, all transactions reported taking place at 157¾. Boston & Suburban sold at 69. Massachusetts Electric issues were inactive. The common sold at 18 to 18½ for about 200 shares, while the preferred broke from 63¾ to 63, but subsequently there was a full recovery. West End common sold at 97 to 97½, and the preferred at 114. The New York curb market was quiet. Interborough Rapid Transit developed moderate activity, upwards of 2000 shares being traded in at from 201 to 203¾. New Orleans common sold at from 34½ to 27½, while the preferred sold down to 70. Washington Railway & Electric preferred brought 90½ for 300 shares.

Tractions were inactive at Cincinnati. The new Ohio Traction preferred made its appearance at 106 to 106¼; this is the controlling company which holds the majority of the securities of the so-called Widener-Elkins properties around Cincinnati. Cincinnati, Newport & Covington common made a gain to 33¼; the preferred sold at 92¾. Other sales were as follows: Cincinnati Street Railway, 147¼; Toledo Railway & Light, 34½ to 35½; Cincinnati, Dayton & Toledo at 23. Several large blocks of the 5s of this com-

pany sold at 95. At Toledo, Toledo & Western stock made an advance from 13½ to 15. Toledo & Indiana sold at 14. This has come up from 9 in the past few weeks. Northern Ohio Traction & Light was particularly active in Cleveland, and reached a new high mark of 24½ on reports of improved earnings. Aurora, Elgin & Chicago common also was very active, about a thousand shares selling with a high mark on this movement of 19¼, due to the report that the company has secured a grant enabling it to operate freight and express into the center of Chicago. The preferred came into prominence with a range of from 70 to 73½. Over $100,000 worth of A. E. & C. 5 per cent bonds sold at 93 and 94. Northern Texas Traction made another upward movement from 66 to 69. Lake Shore Electric common came into prominence on reports of fine showing made by the company. The common stock will not stand a show of dividends for a long time, but it is being bought on speculation quite freely. It had a range from 10 to 11⅛. Western Ohio receipts also had an upward trend, selling at 15. The 5 per cent bonds of this company were a trifle lower, 79⅞. Cleveland Electric sold at 78.

Security Quotations

The following table shows the present bid quotations for the leading traction stocks, and the active bonds, as compared with last week:

	July 12	July 19
American Railways	50	51
Boston Elevated	157	157
Brooklyn Rapid Transit	69½	69½
Chicago City	a190	—
Chicago Union Traction (common)	7⅛	7⅛
Chicago Union Traction (preferred)	32	33
Cleveland Electric	78	78
Consolidated Traction of New Jersey	82	82
Consolidated Traction of New Jersey 5s	108½	108½
Detroit United	93	92⅝
Interborough Rapid Transit	200⅜	203½
International Traction (common)	—	26
International Traction (preferred) 4s	—	64
Manhattan Railway	164	165
Massachusetts Electric Cos. (common)	a19	18
Massachusetts Electric Cos. (preferred)	63	63
Metropolitan Elevated, Chicago (common)	23⅞	23⅞
Metropolitan Elevated, Chicago (preferred)	65	65
Metropolitan Street	125¾	127¼
Metropolitan Securities	81¾	82½
New Orleans Railways (common), W. I.	37	31½
New Orleans Railways (preferred), W. I.	79¼	73⅛
New Orleans Railways 4½s	90	90
North American	98⅝	98⅛
North Jersey Street Railway	25	25
Philadelphia Company (common)	43	43
Philadelphia Rapid Transit	28	27½
Philadelphia Traction	100	100
Public Service Corporation 5 per cent notes	97	97
Public Service Corporation certificates	69	68½
South Side Elevated (Chicago)	95	94½
Third Avenue	127	127
Twin City, Minneapolis (common)	113⅜	112½
Union Traction (Philadelphia)	59½	60
West End (common)	97	97
West End (preferred)	*114	114

a Asked. W. I., when issued. * Ex-dividend.

Iron and Steel

The "Iron Age" says that orders from the general foundry trade have been in fair volume, and have been well distributed. Much of the business was done at low price—at $11 and under in Birmingham; but now $11.85 for early delivery has become scarce, and the leading makers ask $11.50 and upward for delivery during the balance of the year. So far as can be learned, consumers have only partially covered requirements for the balance of the year. Cleveland reports that a buying pool has been formed in that important foundry center among the buyers of pig iron. Business in the heavy lines, steel rails, plates and shapes continues very satisfactory. In the lighter lines there is a notable movement in the steel bar trade, and a better feeling prevails in sheets. Export trade is very satisfactory. The export tonnage of the United States Steel Corporation during the first six months of this year was only 46,000 tons below the shipment of the corresponding period of last year, when export work was sought so vigorously and effectively.

FIGURES OF SUBWAY TEMPERATURE

General Manager Hedley, of the Interborough Rapid Transit Company, issued a statement Wednesday night showing the figures of subway air which had been reported to him by his employees. The test at City Hall station, made at 3 o'clock in the afternoon, showed a temperature of 90 degs., whereas on the street surface the mercury was at 100. At Thirty-Third Street at the same time the subway station thermometer registered 87 degs., as against 97 degs. on the surface; Columbus Circle showed 90 degs. in the subway and 100 degs. on the surface at 3 o'clock, while Sixty-Sixth Street showed 87 degs. in the station, against 99 degs. on the surface. The greatest difference was shown at the Ninety-First Street station, where at noon the thermometer was 86 degs. in the subway and 104 degs. on the surface, a difference of 18 degs. At noon the thermometer in the Seventy-Second Street station registered 89 degs., as against 97 degs. on the surface. The Ninety-First Street station registered 84 degs. at 9 o'clock in the morning, as against 98 degs. in the street above.

Throughout the hot period, according to General Manager Hedley, the temperature in the subway has averaged from 5 degs. to 14 degs. cooler than it has been on the surface.

To make a personal test of the atmospheric conditions in the subway, President August Belmont, of the company, hit upon the idea Wednesday of holding a directors' meeting in the tunnel. At the same time a general inspection was made of the tunnel route. Instead of transacting business in a board room, the directors, at Mr. Belmont's suggestion, went to the Bowling Green station, and there took a special car, and while on the trip uptown discussed and acted upon various matters affecting the road.

TRIAL ELECTRIC TRAINS ON THE LONG ISLAND

The first electric train on the Long Island Railroad was run Tuesday, July 18, from Woodhaven Junction to Flatbush Avenue and back. Two round-trips were made for the purpose of testing the clearances of the contact shoes. On Wednesday a train of five cars made a trial trip to Rockaway Beach, and it is expected that by the first of next week electricity will take the place of steam on the whole Rockaway Beach division. General Superintendent C. L. Addison and Electric Superintendent L. S. Wells were in charge of Tuesday's trial run. A speed of 35 m.p.h. to 40 m.p.h. was maintained without difficulty on the elevated portions of the track.

JUNE REPORT OF NEW YORK CITY RAILWAY COMPANY SHOWS NEW YORKERS FAVOR SURFACE CARS DURING SUMMER MONTHS

Despite the competition from the subway, as well as the elevated roads, the June gross earnings of the New York City Railway Company were the largest for any June in its history, aggregating $1,887,834. The earnings for June, 1904, were $1,865,065, or about $22,000 less than last month's; for June, 1903, $1,764,798. The figures for last month thus represent an increase of about $123,000 over the corresponding month two years ago. The record month of the Metropolitan system was May, 1903, when the gross earnings were $1,948,795. If June were not a short month and the average daily receipts had been maintained for the additional day, the record made in May, 1903, would have been surpassed last month.

In the months immediately following the opening of the subway, late last October, the New York City Railway's earnings fell off sharply. The company's statement for the three months ended March 31, which was the first covering a full quarter's operation of the system in competition with both the subway and elevated lines of the Interborough system, showed gross earnings of only $3,639,468, representing a considerable falling off in receipts, which was due to two causes—diversion of traffic from the surface roads to the underground lines and exceptionally severe weather in the winter months covered by the statement. The record showing for June also is doubtless due to two causes, the normal growth of traffic and the abandonment of the subway by many thousands of persons unable to endure the heat and the atmosphere of the underground lines.

IOWA INTERURBAN EARNINGS IN 1904

Every year the interurban railway companies of Iowa are required by law to file sworn statements with the Executive Council of the State, giving their gross earnings, operating expenses, net earnings and other information, for the use of the said Executive Council in determining the values at which to assess these properties for taxation. The statements cover the year ending December 31. The following is a brief summary of facts as shown by such statements for the year 1904:

The Interurban Railway Company, of Des Moines, reported 28.87 miles of road, same as in 1903; total gross earnings, $139,554; gross earnings per mile, $4,833; total operating expenses, $73,233; operating expenses per mile, $2,536; total net earnings, $66,321; net earnings per mile, $2,297; total value of road, including buildings, lands, power plants and equipment, $328,164; value per mile, $11,361. After making deductions for taxes it is found that the company earned more than 19½ per cent on this valuation. The gross earnings are $13,605 greater, the operating expenses are $5,548 and the net earnings are $8,058 greater for the year 1904 than they were for 1903. The company earned nearly 19 per cent on a valuation of $293,000 in 1903.

The Cedar Rapids & Marion City Railway Company reported 14.21 miles of road, as against 12.06 miles in 1903; total gross earnings, $123,974; gross earnings per mile, $8,724; total operating expenses, $96,775; operating expenses per mile, $6,810; total net earnings, $27,199; net earnings per mile, $1,914; total value of road, including buildings, lands, power plants and equipment, $180,031. After deducting taxes the company earned more than 15 per cent on this valuation. The gross earnings are $10,231 greater, the operating expenses are $6,889 greater and the net earnings are $3,342 greater for 1904 than in 1903. The company earned 11½ per cent on a valuation of $188,000 in 1903.

The Waterloo & Cedar Falls & Northern reported 74.73 miles of road, an increase of 20 miles over the amount reported for 1903; total gross earnings, $135,148; gross earnings per mile, $1,808; total operating expenses, $80,083; operating expenses per mile, $1,071; total net earnings, $55,065; net earnings per mile, $737; total value of road, including buildings, lands, power plants and equipment, $575,800. After deducting taxes the company earned over 9 per cent on this valuation. The 20 miles of additional road for the year 1904 is a road leased from the Great Western. The gross earnings are $44,376 greater, the operating expenses $32,698, and the net earnings $11,671 greater for the year 1904 than in 1903. The company earned more than 8 per cent on a valuation of $547,300 in 1903.

The Mason City & Clear Lake Traction Company reported a mileage of 14.62, same as in 1903; total gross earnings, $37,547; gross earnings per mile $2,568; total operating expenses, $28,928; operating expenses per mile, $1,979; total net earnings, $8,619; net earnings per mile, $589; total value of road, including buildings, lands, power plants and equipment, $45,200. After deducting taxes the company earned over 13 per cent on this valuation. The gross earnings are $4,439 less, the operating expenses $9,098 less, and the net earnings $4,559 greater during the year 1904 than during the year 1903. The company earned less than one-half of 1 per cent on a valuation of $52,632 in 1903.

The Tama & Toledo Electric Railway Company reports 2.75 miles of road, same as in 1903; total gross earnings, $10,771; gross earnings per mile, $3917; total operating expenses, $9,007; operating expenses per mile, $3,275; total net earnings, $1,764; net earnings per mile, $642; total value of the property of the company, $28,370. After making deduction of taxes the company earned about 5 per cent on this valuation. The gross earnings were $123 less, the operating expenses $663 greater and the net earnings $783 less during the year 1904 than during the year 1903. The company earned more than 12 per cent on a valuation of $19,996 in 1903.

The Cedar Rapids & Iowa City Railway & Light Company, which commenced operation Aug. 13, 1904, reports figures as follows for the four and one-half months of operation in 1904: Mileage, 27.63; total gross earnings, $34,281; gross earnings per mile, $1,240; total operating expenses, $17,108; operating expenses per mile, $619; total net earnings, $17,173; net earnings per mile, $621. Estimated value of the property of the company $350,000. So in four and one-half months operation the company earned about 5 per cent on this valuation.

The Boone Suburban Railway Company reports 4.7 miles of road, the same as in 1903; total gross earnings, $7,127; gross earnings per mile, $1,516; total operating expenses, $6,990; operating expenses per mile, $1,487; total net earnings, $137; net earnings per mile, $29; total value of the property of the company $17,600. The net earnings did not quite pay the taxes in 1904. The gross earnings were $899 less, the operating expenses $1,850 greater, and the net earnings $476 less in 1904 than in 1903. The company earned 14 per cent on a valuation of $18,800 in 1903.

The Iowa & Illinois Railway Company, which operated 2 miles of its line the entire year and all of its line for a little over a month in 1904, reports 36.012 miles of road; total gross earnings of $12,761; gross earnings per mile, $358; total operating expenses, $12,919; operating expenses per mile, $358; total net loss, $158; total valuation of road, including buildings, lands, power plants and equipment, $1,042,343.

The total gross earnings of the eight companies in the State for 1904 were $501,168; the average gross earnings per mile were $2,499; the total operating expenses were $325,046; the average operating expenses per mile were $1,621; the total net earnings were $176,122; the average net earnings per mile were 878. The gross earnings for 1904 were $109,801 greater than for 1903; the operating expenses were $68,575 greater and the net earnings were $41,225 greater. Four of the companies, which reported in 1903, show an increase in per cent of earnings based on actual value of the property for the year 1904, while the remaining two show a decrease, these two being the smallest two companies in the State. The two new companies which reported operation for a part of 1904 have not been in operation long enough to tell just what they will be able to do. The Cedar Rapids-Iowa City line made a good showing for the four and one-half months it was in operation, while, on the other hand, the Iowa & Illinois shows up a net loss for the month the entire line was in operation. The reports indicate, however, that the Iowa interurban companies will earn more than 10 per cent on the actual value of the property. Some of them will double this amount and a few of the smaller ones will no doubt go below it.

NIAGARA POWER CONTRACT REPORT

It is announced that the so-called Vanderbilt-Andrews syndicate has signed a contract with the Niagara, Lockport & Ontario Power Company to take power from that company for the trolley lines controlled, and to be controlled, by the syndicate. The Niagara, Lockport & Ontario Power Company, which will not have a plant of its own for several years yet, has contracted with the Ontario Power Company to take the first 60,000 hp it generates, and the Lockport Company will, for the present, by a transmitting company, supply this power to the trolley lines. The Ontario Company now has two 10,000-hp units in operation, and is assembling a third. It has put its bonds on the market for public sale. The Lockport Company, through the Archbold-Brady Company, of Syracuse, has constructed a large part of its transmission line from the Canadian shore of the Niagara River towards Rochester. It is predicted that the line will reach Syracuse next year.

PROGRESS IN SUBWAY VENTILATION

The puzzling question of properly ventilating the New York Subway has been taken up in earnest. Two powerful rotary fans have been put to work at the Brooklyn Bridge station, where they draw out hot air at the rate of 40,000 cu. ft. a minute, thereby changing the subway air at that point every five minutes. Just north of the Fourteenth Street station another large blower has been installed. Next week other big fans will be installed at the various express stations along the line of the subway. Each of the fans measures 9 ft. in diameter. At Seventy-Second Street a new ventilating shaft will be opened up from the subway to the center of Broadway. There the shaft will be 9 ft. x 12 ft., and a ventilating fan, or blower, will be put in use there, too. In addition to the big fans which will be installed, plans have been adopted for sending a current of pure air through the subway from one station to the other. Just what these plans are Mr. Hedley would not say.

At Ninety-Sixth Street three large ventilating shafts are being constructed right over the station. They will open from the top of the subway to the atmosphere. The shafts will be 7 ft. wide x 15 ft. long. At 140th Street and Broadway a large ventilating shaft opening is being made, and a large blower, driven by electricity, will be installed there. This one will remove 60,000 cu. ft. of air per minute. There are other plans now being worked out, and as fast as they are completed new devices will be installed, so as to make subway conditions as comfortable as possible in the summer months.

General Manager Hedley said that thousands of small rotary fans operated by electricity would be added to those already in the subway, to keep the air moving. It is also understood that windows of express trains will be opened from the bottom as well as from the top. To prevent accidents, wire screens will be placed across the lower part of the windows.

CINCINNATI & MIAMI CANAL RUMOR

It is announced by the Central City Improvement Association, of Cincinnati, an independent civic organization, that a company is being formed with a view to utilizing the porton of the Miami & Erie Canal within the city limits of Cincinnati for electric railway purposes. The thing has been taked of for years, but this is the first public announcement of the plans. It is announced that the Cincinnati Northern Traction Company—which means the Widener-Elkins syndicate—is interested in the project together with other Cincinnati parties, the plan being to utilize the canal banks and bed for trackage, giving the Cincinnati Northern a much desired entrance to the heart of the city. The line would be used extensively for freight, and freight yards would be located near the Mitchell Avenue aqueduct, which would be the head of the canal if the city portion was abandoned. Here the road would have track connection with nearly all the steam trunk lines entering the city. The canal bed would be deepened and bridges raised. In a number of places curves would have to be straightened, otherwise it would give a practically level private right of way to the very heart of the city. It is announced that it would cost $3,000,000 to complete the work aside from rentals that would have to be paid to the State. The civic organization mentioned, together with many prominent business men, who desire to see the useless waterway utilized, will combine in an effort to induce the State Legislature to make the desired lease of the canal.

CLEVELAND AS A CENTER FOR INTERURBAN RAILWAY FINANCING

Cleveland is regaining its old-time prestige as a center for the promotion of traction lines. Three or four years ago the city was one of the greatest, if not the greatest, financing centers in the country in this particular line, but the embarrassment of the Everett-Moore syndicate not only stopped the operations of this great group of promoters, but laid out nearly all new traction propositions for the time being. Within the last six months conditions have changed, and Cleveland capital is now building roads in all parts of the country, and many more are in a preliminary stage. Some of these might be mentioned:

The Bishop-Sherwin syndicate is pushing work on the Washington, Baltimore & Annapolis, which promises to be one of the finest properties in the country.

The Andrews-Stanley syndicate is engaged in important extensions in Central New York, in connection with the New York Central Railroad.

Denison, Prior & Company and others in Cleveland are preparing to build a line connecting Kansas City and St. Joseph, Mo.

The Pomeroy syndicate has succeeded in financing the Cleveland, Ashland & Mansfield Railway, which will practically complete a through line from Cleveland to Columbus and Cincinnati.

Cleveland people are constructing and have partly in operation the Sandusky, Norwalk & Mansfield Railway, from Norwalk to Mansfield, Ohio.

The Mandelbaum syndicate is completing the Lima to Findlay extension of the Western Ohio Railway, which has been in the air for several years. This is without exception the most important line being built in the country to-day, as it will connect up two great systems of lines in Ohio, Michigan and Indiana, making it possible to travel continuously on electric lines over some 3200 miles of track.

Barney Mahler, of the Everett-Moore syndicate, has secured the last franchises for a long line in the valleys of Utah, with Salt Lake City as a center, and he claims to have completed arrangements for financing it.

The Holcomb-Latimer syndicate has financed and is now pushing work on the Buffalo, Dunkirk & Western Railway. This is another important connecting link, as it will give a continuous chain of lines from Central New York State clear across Northern Pennsylvania, Ohio and Michigan.

J. B. Hanna and associates are engaged in promoting the Chicago Air Line, a proposed line from East Chicago to South Bend, Ind.

Luther Allen, Judge C. M. Stone and his associates have financed the Toledo & Chicago Railway Company, which proposes to extend the Toledo & Western to Fort Wayne and to South Bend. The two last-mentioned roads will complete a chain of lines from Toledo to Chicago, and with the other project mentioned above, will complete a chain from Buffalo to Chicago.

Will Christy, Will Davis and others are building the Marion, Kokomo & Western, an important connecting link in the Indiana system.

The Muncie, Hartford & Fort Wayne Traction Company, a Cleveland-owned proposition, has arranged for financing an extension from Bluffton to Fort Wayne, completing a very direct route from Fort Wayne to Indianapolis.

There are many other projects in the air in Cleveland, and unless signs fail, the end of this year will see a tremendous amount of new construction to the credit of Cleveland people.

FRANCHISE MATTERS CONSIDERED IN NEW YORK

On the application of Assistant Corporation Counsel Burr, Justice Gildersleeve, in the Supreme Court, modified on July 14 the order made by Justice Truax which prevented the Board of Estimate from acting on the subway plans submitted by the Rapid Transit Commission. As soon as a copy of the modified order was received by the board it approved the spur of the present subway from Manhattan Street to Fort Lee Ferry, and also the extension from 230th Street to Van Cortlandt Park. These may be built at once under the original contract with the Belmont syndicate, although the other routes approved by the board on July 14 will be held up by the Truax order until the Appellate Division passes on the legislative act which took away the franchise-granting power from the New York Board of Aldermen.

Lawyer L. L. Kellogg, who obtained the Truax order, said that the modification would not permit the Board of Estimate to sign any contracts at present, and, even if they went ahead adopting the plans, all this might be upset if the higher courts held the new law to be unconstitutional. However, the board went ahead and approved all the subway extension plans.

When the Lexington, Third, Seventh and Eighth Avenue plans were taken up, President Littleton, of Brooklyn, moved that they be sent back to the Rapid Transit Commission, because they were only alternate routes. He said that the commission had sent them as the routes that contractors deemed most available. The law, he added, directed that the commission lay out definite routes which it considers best for the city, and the law should be obeyed.

The Brooklyn routes approved were Fourth Avenue, over the Manhattan Bridge, to Eastern Parkway, and from Fourteenth Street and University Place through Brooklyn and to Jamaica. Contracts cannot be signed for these routes until the litigation brought on by the Aldermen is settled.

The Board of Estimate of New York last week considered the franchise applications before it in so far as pending litigation permitted, but a dispute as to how the value of the franchises should be appraised prevented any action. The board voted favorably on the franchises it had inherited from the Board of Aldermen, and ordered the bridge department to go ahead with Mr. Ahearn's plan for an underground terminal for the Williamsburg Bridge.

Work on the routes approved cannot begin till the Appellate Division has passed on the law removing the franchise power from the Aldermen. The modified order of Justice Gildersleeve permits the board to approve the routes set by the Rapid Transit Commission and to consent to the construction of the roads, but does not permit it to make any contracts or to issue bonds.

When the board first took up the consideration of franchises on the passage of the Elsberg law a formal resolution was drawn referring each franchise application to the finance department to fix the value of the privileges. Borough President Littleton held that the president of the borough affected should be included with the Controller, and his opposition, sustained by the other borough presidents, prevented the adoption of the resolution. In the same way Mr. Littleton stopped action on other applications. Mr. Grout refused to accede in his amendment to the formal motion, and neither side could muster the twelve votes necessary to take action. Mr. Grout declared his office was equipped to do the work. It always had done the work, and there was no need for any assistance. No matter what report the Controller or a committee should make, the board could not act on it until after the litigation has been ended.

Orders for steel rails received recently by the United States Steel Corporation, it was learned Wednesday, are sufficient to keep the mills busy up to the beginning of next year. The fact that the rail mills are sold ahead for such a long period promises a big increase in this year's production of rails over last year's output, 2,284,000 tons. The record production was in 1903, when 2,992,000 tons of rails were manufactured. The meetings of steel manufacturers held in New York Wednesday, resulted in no change in the official schedules. As a matter of fact, premiums have been charged on a number of lines for early delivery, and the present status of the market points to an increase rather than to a decline in these premiums.

SAN FRANCISCO'S MUNICIPAL LINE

The Board of Supervisors, of San Francisco, has taken definite steps toward the inauguration of the actual work of transforming the Geary Street Railway for the city as a municipal line. At the instance of the chairman of the public utilities committee a resolution has been adopted calling on the city engineer to prepare at once the specific plans needed in order that bids may be advertised for the actual work of construction. A second resolution directs the city attorney to open negotiations with the owners of property suitable for the site of the new car house, that such a structure may be begun with as little delay as possible. To simplify matters for the city attorney and save him time, the resolution submits to him a number of available sites, among which he may make his choice. Both the resolutions were adopted by unanimous vote.

LACKAWANNA SAID TO HAVE SECURED TROLLEY LINE

The Elmira & Seneca Lake Railroad, the electric line 16 miles in length, connecting Seneca Lake, Watkins and Watkins Glen with Horseheads, the northern terminus of the lines of the Elmira Water, Light & Railroad Company, has been purchased by the Lackawanna Railroad Company, so it is said, and will be operated by that company. The Watkins line, according to report, will remain an electric line, but will be fully equipped with all modern appliances in every department. The principal object of the Lackawanna in the matter is to gain an entrance into the grape country, and by a line of modern freight and passenger boats which will be established on Seneca Lake to gain access to Northern New York and the freight and passenger business of that section.

NEW TUNNEL BEGUN FROM NEW YORK TO LONG ISLAND CITY

The Belmont tunnel to connect Long Island City with Manhattan Borough, New York, is under way. Work was started July 12 at the Long Island end, and is to be pushed rapidly. Operations began on a plot of land running from Fourth to Fifth Streets and between Front Street and West Avenue, Long Island City. The property is just across the street from the big power house of the Pennsylvania Railroad Company. The tunnel is to be built under the old Steinway franchise, which provided for the construction of a tunnel from Fourth Street and Jackson Avenue, Long Island City, under Forty-Second Street as far west as Eleventh Avenue, Manhattan. That tunnel was started in 1892. A shaft was sunk in Fourth Street, Long Island City, and in December, 1892, an explosion of dynamite at the mouth of the shaft killed six persons, injured fifty and destroyed several buildings. The tunnel work stopped, and was never resumed. The Belmont interests secured the franchise and paid off the obligations of the old company, resulting from suits for damages caused by the explosion.

The tunnel is to be much like that of the Pennsylvania Railroad, and will be in the form of two steel tubes. It will run under the Long Island Railroad freight yard, and have a passenger station in Fourth Street, between Jackson and Vernon Avenues, which is at a point directly opposite the viaduct entrance to the new bridge over Newtown Creek. There will be two branches to the Long Island City end of the tunnel. One will go under Newtown Creek and make an important connection, probably with a subway through Greenpoint, a part of Brooklyn, and the other will branch off toward the Queens County Court House, where the tunnel will come to the surface and make connections with the tracks of the New York & Queens County Railway Company.

A STAY FOR NEW BRITAIN THIRD-RAIL

The question of the removal by the New York, New Haven & Hartford Railroad of the third rail from its line between Hartford and New Britain will come before the Legislature at its next session, this being decided upon by the Legislators a few days ago. Thus the company will be given ample time in which to perfect plans for service over the branch. According to President Mellen, of the company, it is likely that before the body convenes again the overhead trolley will have been substituted. In the early weeks of the present session of the General Assembly, as previously noted in the STREET RAILWAY JOURNAL, a bill was introduced requiring the company further to protect the third rail. When the bill was called for a hearing, President Mellen, who was present, replied that the company had determined to remove the rail before July 1, when there would be no need for the proposed legislation. The company has always claimed that life was sufficiently protected, so far as the road is concerned, if the public would itself exercise ordinary care in keeping off company property; that since the disposition was to do otherwise, and in addition to hold the company legally responsible for the carelessness and recklessness of individuals, it had concluded to solve the problem by removing the cause of danger. When the time arrived for carrying into execution the radical plan forced upon the company by the public, a protest was raised against the action that has resulted in the armistice noted herein.

TRAFFIC CIRCULAR OF THE PUGET SOUND ELECTRIC RAILWAY

An elaborate railway folder has just been issued by the Puget Sound Electric Railway Company, containing sixteen pages of time-tables and views taken along the company's lines. The cover is in red and green, with a view of Mount Tacoma in the center. There are seventeen half-tones in the folder, six of which are views of Tacoma, while the others show views of Seattle and typical scenes along the route.

Maps of Tacoma and Seattle are shown, as is also a map of the territory over which the electric railway runs. Points of interest in the two cities are described, and time-tables are given of the railways with which the electric cars connect.

TWO IMMENSE TURBINES FOR THE NEW YORK EDISON COMPANY

With the successful closing of recent negotiations for two 7500-kw Westinghouse turbine-type generating units, the New York Edison Company has inaugurated an important epoch in the history of metropolitan electric lighting in this country by adopting generating units of such unprecedented size. The importance of this step is enhanced by the fact that these turbine units will be installed in the finest and largest of American central stations, Waterside Station No. 2, that ultimately will contain ten units of the same size. Waterside Station No. 1, it will be remembered, is equipped with Westinghouse vertical three-cylinder compound reciprocating engines, which, although installed only a few years ago, as then representing the highest type of large engine construction, have so soon been outclassed through the rapid advance of the steam turbine system. No less than eleven of these large engine type units are now in service in this station, each rated at about 6500-hp capacity and direct connected to a 3500-kw generator. The next step in the acquisition of larger units resulted in the installation of 5000-kw turbine units of the Curtis type.

The extreme compactness of the new generating unit is evidenced by the small space it requires in the new power station arrangement. Its overall dimensions are approximately: Length, 50 ft.; width, 17 ft.; height, 15 ft.; floor space, 850 sq. ft. per unit net, or .113 sq. ft. per kilowatt capacity. This is less than one-half the space occupied by the engine-type units, which are the most compact type yet built for central station work. A condenser of the surface type will be located beneath the turbine in the foundations proper.

The new turbines will operate under 175 lbs. steam pressure, approximately 28-in. vacuum and 100 degs. superheat, the normal speed of the unit being 750 r.p.m. Under these conditions the economy of the complete unit will be in the neighborhood of 16 lbs. per kw-hour at full rated load. Each unit will have an overload capacity of at least 50 per cent, or will be capable of developing full-rated load without the use of a condenser. The turbine gives its best economy around full-rated load, although a large overload capacity is at all times instantly available when required without material sacrifice of efficiency. At this maximum load each turbine will be developing over 15,000 hp at the shaft, which is by far the greatest amount of power ever developed in a single prime mover in stationary service.

The direct-connected turbo-generators will be of standard Westinghouse construction, delivering 6600-volt, three-phase current to the high-tension network at a frequency of 25 cycles per second. The generators will embody the new enclosed construction which constitutes an important advantage in the entire elimination of the hum peculiar to high-speed turbine generators. They will have an efficiency approximating 97½ per cent at full-rated load. Each generator will be able to sustain for several hours an overload of 50 per cent within reasonable temperature rise.

It is of interest in connection with this important installation that almost simultaneously three Westinghouse turbine units of the same size have been adopted by two large Brooklyn power stations, one for railway and the other for lighting service, making a total of over 50,000 hp in turbine machinery of this size. Two units will go to the Brooklyn Heights Railroad Company and the third to the Brooklyn Edison Company.

CIRCULAR ON EXHIBITS AT PHILADELPHIA

George Keegan, of 13-21 Park Row, New York, secretary of the American Street Railway Manufacturers' Association, has issued a circular to all members, outlining some of the features of the exhibit to be held in connection with the meeting of the American Street Railway Association at Philadelphia, Sept. 25-30. As already stated, the exhibits will be held in the south pavilion of the Philadelphia Museums and in an adjoining building. These buildings have about 75,000 sq. ft. of floor space, are well lighted and ventilated, and being located on Thirty-Fourth Street, near South Street, within fifteen minutes of the City Hall, are easily accessible. They also afford excellent facilities from a shipping standpoint, having a switch track (Pennsylvania Railroad) which enters the buildings, and 500 ft. of track under cover. There is also ample room outside the buildings for outdoor exhibits, with two railroad tracks, one 600 ft. long and the other 400 ft. long. Arrangements can be made for purchase of such electric power as may be necessary for exhibits.

The reservation of space for exhibition purposes is restricted to members of the association, the membership fee in which is $35 per year. This includes the privilege of floor space and four badges, each entitling holder and lady to all the privileges of the convention and to such entertainments as may be provided by this association. Application for space for exhibit purposes must be forwarded not later than Aug. 1, to the secretary, by whom any further information desired will be gladly furnished.

THE CENTRAL PASSENGER ASSOCIATION MEETING

At a meeting of the Central Passenger Association (steam) at Chicago last week, the question of interline steam and interurban tickets, which has been up for discussion at nearly all of the meetings for the past six months, was laid on the shelf for an indefinite period. General Passenger Agent Ross, of the Clover Leaf, against whom most of the complaints had been directed, informed the members that they might just as well call off the discussion as his road would not yield an inch unless all the roads in the association would agree to discontinue all relations with electric lines. The only difference between the Clover Leaf and the majority of the other lines is that the Clover Leaf made no bones about interlining with all the electric lines with which it could make alliances, and it has greatly increased its business thereby, whereas the other steam roads have been making such alliances, but have denied them in public.

STREET RAILWAY PATENTS

[This department is conducted by Rosenbaum & Stockbridge, patent attorneys, 140 Nassau Street, New York.]

UNITED STATES PATENTS ISSUED JULY 11, 1905

794,269. Automatic Electric Railway Switch; W. D. Woolley, Normandy, Mo. App. filed Aug. 3, 1904. A track switch in which a pair of insulated sleeves are placed upon the trolley wire and have connections to a pair of solenoids for moving the switch point in the usual way. The sleeves are preferably of iron, bent around and clamped by bolts upon the trolley wire.

794,277. Car Wheel and Process of Making Same; William B. Brayton, Cleveland, Ohio. App. filed Sept. 27, 1904. A car wheel consisting of a body having a rib on its outer periphery and a metal tire surrounding the body, and having a groove on its inner periphery receiving the rib, the groove being of greater depth than the rib.

794,404. Brake Beam; John Green, St. Louis, Mo. App. filed Nov. 19, 1904. Consists of a pair of channel-beams each having its web slit longitudinally intermediate of its ends and spread to form truss chords, and a strut interposed between the chords, the channer-beams being arranged so that the flanges of one beam oppose the flanges of the other beam.

784,508. Fare Register; William G. Kirchhoff, St. Louis, Mo. App. filed Nov. 29, 1901. Registers different classes of fares and indicates on one dial by means of separate indicator hands the total number of fares of each class registered for each trip.

794,509. Fare Register; William G. Kirchhoff, St. Louis, Mo. App. filed Sept. 27, 1902. This invention relates to the means for perpetuating a record of the number of fares of a single class, or of all classes indicated by a fare register, and has special reference to the devices used in printing or marking such record.

794,660. Third Rail; Edward R. Brodton, Atlanta, Ga. App. filed Sept. 3, 1904. Comprises three sections insulated from each other, and pairs of contact plates arranged between the sections and insulated therefrom.

MR. DALRYMPLE VOICES HIS OPINIONS IN A LETTER

The following extracts from a letter from James Dalrymple, general manager of the Glasgow municipal street railways, to Horace Andrews, of the Cleveland Electric Railway Company, is of interest. It will be remembered that Mr. Dalrymple was in this country as an advisor to Mayor Dunne, of Chicago, on the subject of municipally-owned street car lines, and that his opinions were a disappointment to municipal ownership advocates. In part he writes: "I enjoyed my visit to your country exceedingly, and gained a great deal of useful information. A considerable interest is apparently being taken in Cleveland regarding fares on street railways. From my observations I consider that the average ride in the United States is much longer than in this country. In Glasgow our average ride is about a mile and a quarter, while I believe in your cities it is much longer.

"I am also convinced that it would be a great mistake for your companies to attempt to lower your fare under five cents if you are going to give universal transfers. A five-cent fare with a transfer yields about the same revenue as a graded fare without a transfer.

"If you adopted our system of graded fares I think you would earn more money than you earn at present. I am afraid, however, that your people are wedded to the one-fare with the transfer."

PERSONAL MENTION

MR. HENRY A. EVERETT, of Cleveland, and his family are spending a two months' vacation in Alaska.

MR. A. B. DUPONT, of Detroit, has been employed by Mayor Dunne, of Chicago, as personal expert to advise with him regarding street railway matters in connection with his plans for the building of municipal street railway lines.

MR. DAVID C. MACWATTERS, general passenger and ticket agent of the Colorado Springs & Cripple Creek District Railway, has been appointed general passenger agent of the Cripple Creek Central Railway lines, comprising four roads with a total mileage of 130 miles. He succeeds Mr. Joseph B. Wiggenborn, resigned.

MR. WILLIAM P. BAILEY has been appointed auditor of the Indianapolis & Northwestern Traction Company to succeed Mr. R. M. Boykin, of Philadelphia, who returns to the East to become auditor of another Tucker-Anthony property. Mr. Bailey has been with the Indiana Company since it has been in operation. Beginning as a conductor, he advanced to train despatcher, and then to chief clerk. Subsequently he was made auditor.

MR. S. I. WAILES has been appointed manager of the sales department of the National Electric Company. Mr. Wailes is a graduate of the Clarkson School of Technology, Potsdam, N. Y., and entered the employ of the Electric Traction Company, of Philadelphia, in 1895, resigning in 1898 to accept a position as superintendent of electrical equipment of the Thousand Islands Navigation Company, which owned a fleet of seven steamers. In July, 1901, he was employed by the Brooklyn Rapid Transit Company as assistant to the engineer of equipment and line, and resigned in October, 1902, to accept a position with the National Electric Company as traveling engineer, covering territory in the Southwestern States. In July, 1903, he was appointed manager of the Cincinnati sales office. Following this he became the Pacific Coast sales agent, with headquarters at San Francisco, and in March, 1905, was appointed assistant sales manager of the air-brake department.

MR. E. G. CONNETTE, general manager of the Syracuse Rapid Transit Railway Company, was pleasantly surprised on the night of July 13 by the employees of the company, who presented him with a $500 diamond as a token of their esteem and their gratification that he is to remain in Syracuse. When it was first reported that Mr. Connette was likely to go to Worcester, Mass., as general manager of the Consolidated Street Railway, of that city, the men determined to give him a handsome remembrance. When it was finally decided that Mr. Connette would remain in Syracuse, the employees went right ahead with the plan, and the presentation was made accordingly. The affair took place in the club rooms of the Employees' Mutual Benefit Association. Mr. Connette was summoned from his home in Borden Avenue, and upon his arrival was greeted by about 200 of the men. Superintendent John E. Duffy in behalf of the men made the presentation speech, expressing the gratitude of the men for what Mr. Connette had done for them and their joy that he was to remain at the head of the system. Mr. Connette responded feelingly in a short speech. An orchestra was present, and when it struck up "For He's a Jolly Good Fellow," everybody joined in. The function concluded with a pleasant social hour, during which there were music and refreshments.

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office by 10 a. m. Monday preceding the date of publication, except the first issue of the month, for which changes of copy should be received two weeks prior to publication date. New advertisements for any issue will be accepted up to noon of Tuesday for the paper dated the following Saturday.

Of this issue of the Street Railway Journal 8000 copies are printed. Total circulation for 1905, to date, 245,350 copies, an average of 8178 copies per week.

Interurban Service on the Rock Island

The Rock Island Railroad has begun war on the electric interurban roads in Iowa by establishing frequent train service at two places. Between Cedar Rapids and Iowa City it is announced that hourly service will be maintained on week days, with numerous excursion trains on Sundays. Round-trip tickets between Cedar Rapids and Iowa City (28 miles) will be sold for $1, with a 50-cent rate on Sundays. Between Des Moines and Colfax also a similar competition will be made with the electric road. This service is of the same nature as that recently started in several points in Illinois by the Illinois Central and Chicago & Alton Railroads. Thus it appears that another steam road has some money to burn. This present wave of interurban competition by steam roads is like the chickenpox, rather uncomfortable for the parallel interurban roads while it lasts, but not likely to work any permanent injury.

Numbering Cars in Classes

All electric railway systems, whether for city or interurban service, accumulate sooner or later a large number of classes and kinds of cars. Open and closed motor and trail cars, freight motors and trailers, line cars, cinder cars are some of these, and often there are many others. Usually these are purchased at different times and are given numbers in sequence as they are purchased. However, much confusion is often avoided by following the practice of steam railroads and the larger street railways, and numbering the different styles of cars according to their classes. Where there are less than 100 cars of any one class, the number 100 may be taken as a basis. The closed motor cars might be given numbers between 1 and 100. The open motor cars could be numbered from 100 to 200. The closed trail cars, the open trail cars and the several other classes could be given a similar range of numbers.

The system might be extended further by taking into consideration the size of the car. Then those with the shorter bodies could be given the smaller numbers of each class. With such a system the mere mention of the number of a car carries with it more or less of a definite idea of the car itself and would often make unnecessary further description to identify it.

Mirrors in Cars

Mirrors have been used for decorative and useful purposes both in steam and electric railway coaches for some time. The placing of such mirrors has been somewhat a matter of the personal taste of the manager of the road. To some, mirrors appeal as a decorative feature, to others simply as conveniences for passengers, and to still others as necessary or unnecessary nuisances. It is easy to overdo the use of mirrors, especially for decorative purposes. While they are handsome when new, many of them are almost certain to have the backing flaked off in the course of time, after which they are an abomination in the eyes of everyone. The present tendency is toward simplicity and toward securing as much window space as possible. This has kept down the use of mirrors somewhat. Nevertheless, when a mirror or two is placed in an interurban car where it is of use to passengers, observation will usually show that it meets the approval of the public by the number of times it will be used in a day. An overdose of mirrors in a city car, however, is likely to be much of a nuisance before a car is many years old, and there is not likely to be any violent reaction from the present sensible tendency to simplicity in car interiors.

Track Gages on American Street Railways

It is a revelation to one who has never given attention to the subject to learn of the large mileage of electric railway track in the United States which is other than the standard 4-ft. 8½-in. gage. In four large cities, Baltimore, Philadelphia, St. Louis and Cincinnati, the street railway track gage is slightly wider than standard. In Eastern Pennsylvania, Western New Jersey, Delaware and Maryland, gages of 5 ft. or 5 ft. 2 ins. are almost universal, while in a number of Western cities a gage of 3½ ft. is frequently found. These gages caused little thought or annoyance, except on the part of manufacturers and supply men, until the era of interurban development began. Then there was trouble at once. In some cases where the interurban lines have been built out of cities as continuations of city tracks, the odd gage has been continued. In other cases where independent companies have built the interurban lines, standard gage has been adopted. In Cincinnati, where city tracks are 5-ft. 2½-in. gage, a part of the interurban lines built have adopted the same gage, while those connecting with interurban lines in other parts of the State have standard gage, necessitating a change of cars at the city limits. This change is an expensive nuisance, but is not as bad as it would be were it not that a special car marked like an interurban car connects with the interurban line at the city limits. In the East there is another confusion of gages which is beginning to make trouble, as the tracks from Baltimore to Trenton are wider than standard gage, while those in Jersey City and Washington are 4 ft. 8½ ins. This militates greatly against through service between Philadelphia and New York, and between Baltimore and Washington. In Los Angeles, when interurban construction was begun, the city gage of 3½ ft. was abandoned by the interurban and a third rail was laid to permit of the interurban cars coming over the city tracks. At Portland also the gage is 3½ ft., and until recently this gage was in use at Tacoma. The importance of the interurban and suburban lines, however, caused the changing over of gage in Tacoma a short time ago. In Denver, where the gage is 3½ ft., the interurban lines have been built for the same gage. In St. Louis, where the gage is 4 ft. 10 ins., the absence of long interurban lines has prevented any serious inconvenience from this odd gage, but unfortunately for the East St. Louis lines, the practice in St. Louis influenced the street railway construction of the city across the river, although there has not been any physical connection between the street railways of St. Louis and East St. Louis. The East St. Louis and bridge lines were also built with a 4-ft. 10-in. gage. Recently interurban roads from the north and east have sought entrance to East St. Louis, and we note elsewhere this week a change to standard gage on the East St. Louis lines, making it possible to enter into traffic agreements with whatever standard gage interurban roads may seek entrance to St. Louis over the East St. Louis tracks.

Switches at Sidings

At the last convention of both the Ohio and Indiana associations there was some discussion on the comparative merits of stub-end sidings and sidings leading to the main line at both ends. In Ohio it seems to be a very common practice to have double-end sidings at meeting points equipped with spring point switches, so that cars can pass each other without the necessity of the conductor throwing a switch at either end of the siding. As far as convenience of operation at regular meeting points is concerned, there would seem to be no doubt that this was the best plan, although for various reasons there are a number of roads where the practice is difficult. We have in mind one large interurban system where spring point switches normally set for the main line were in universal use, but the practice was abandoned in favor of fixed point switches on account of several wrecks which occurred to cars attempting to pass over facing spring points at high speed, one truck taking the switch and the other taking the main line, with results which can well be imagined. Nevertheless, some trackmen and managers maintain that with careful inspection and maintenance of spring point switches such a thing should never occur, and the long records of successful operation with such switches cited by some of the Ohio managers go to prove these claims. One plan, which certainly has safety as its strong point, even if awkward in many ways, is that of using stub sidings and making them all face in one direction, for example south, and having a rule that all cars going south or in a direction facing the switch points, shall take the siding at meeting points, leaving all cars going in the opposite direction to pass through on the main line without the necessity of stopping. In this way no car runs at high speed over a facing point switch at a siding where another car is waiting. Facing point switches on a high-speed track have been avoided for years by many railroad managers, and the recent accident at Mentor, Ohio, with the fast New York-Chicago train, simply emphasizes the desirability of doing away with them as far as possible.

Aside from the question of slightly greater safety, the practice with stub-end sidings just spoken of is certainly not desirable, because of the time lost at sidings by the cars which have to take the siding at all turn-outs. It is quite likely to be the case that cars which must take the sidings at all turn-outs will be the ones which are late, and that the cars in the opposite direction must wait for them at turn-outs and waste considerable time which might well be utilized in going on to the siding and clearing the main line for the belated car which needs to make up time. The same safety could be secured by making half the sidings face north and half south on a north and south road, making it a rule that cars facing the switch point at any siding shall take the siding. This will balance up the delays due to backing out of sidings, but the delay and nuisance still exists, although distributed between the cars going in both directions instead of concentrated on cars going in one direction as before. In the minds of many managers, the delays and dangers of backing out of sidings counterbalance the risks involved in double-end sidings.

Dinner Trips

The Detroit "United Weekly" recently published an attractive little editorial on "dinner trips." This does not refer to trips made by extra men and trippers while the regulars are getting dinner, but pleasure trips made by passengers to points on the suburban and interurban lines of the Detroit United Railway, where a good dinner can be obtained and a return to the city be made in the cool of the evening. The Detroit United Railway is fortunately situated in having numerous very attractive places on its line to which such dinner trips can be made. This brings to mind the fact that it is desirable for all interurban and suburban roads to encourage attractive eating places at points on its lines so as to make this kind of excursion business possible. An interurban road which does not give any kind of buffet or lunch service can well afford to look after such matters, not only on account of pleasure traffic, but because of regular business, which has been known to be well provided for in this respect in the past.

The Type of Car for City Use

Although we recently discussed at length the question of the proper type of car for city use, in connection with the report of the New York State convention, the importance of the subject and general interest in this matter by all city companies warrants further consideration of it. The discussion at the New York State convention covered mainly the engineering points involved, namely, the cost of operation and cost of maintenance. What has really determined the matter in the vast majority of cases has been public sentiment and the desire of railway managers everywhere to give the public the type of car it likes best. As to whether a car shall be single or double truck, the size of the road seems to have been and usually should be the governing factor. If the road has enough traffic to call for cars on short headway, so that lengthening the cars does not necessitate too long an interval between cars, the double-truck car has been selected because of public sentiment, the decreased cost of platform labor and the fact that the double-truck car on a poor or indifferent track rides much better than a single-truck car. As to whether a cross-seat car of the semi-convertible type, or a double equipment of open cars for summer and longitudinal seat box cars for winter is to be used is an independent question which depends also on local conditions, but the semi-convertible type is finding much favor, not only on account of the saving of the investment in a double equipment for summer and winter, but because of the ease with which it can be changed to suit the weather, and its freedom from accidents. Not a few managers are glad to get rid of the step accidents resulting from the use of the ordinary open car with running board the full length.

It is not, however, our purpose to discuss here the two sides of this question, but to call attention to the fact that, given a smooth riding car, the public cares little whether it is single or double truck. It does, however, prefer a cross-seat car, be it single or double truck. Even if cross seats are put in a single-truck car which is operated over a bad track, the riding is much more comfortable than on the same car equipped with longitudinal seats. The teetering motion of a single-truck car is less objectionable to passengers seated on cross seats than to those seated on longitudinal seats. A number of companies, previous to the introduction of double-truck cars, began to use single-truck cars with cross seats of practically the same type as the double-truck semi-convertible. The only objectionable feature of these cars was that frequently they were rather narrow for cross seats, making the aisle too narrow for comfort or for freedom of movement. Even if a double equipment for summer and winter is maintained, there are many points in favor of adopting cross seats in the single-truck cars used in the smaller cities. If these cars are made semi-convertible, another argument in their favor is added.

About the only advantage ever claimed for the longitudinal seat is that it accommodates a large standing load during the rush hours in large cities. In the smaller cities where double-truck cars are too large for the traffic, this argument in favor of longitudinal seats does not hold, as there is seldom much of a standing load in the cars any time of day, and the management in such small cities is usually glad to add enough cars at the rush hours to give every one a seat. In the small cities it is not a question of how to handle the people at the rush hour, but how to get the people to handle, and the management cannot afford to have people standing any time of day, except on special occasions, as it is likely to drive away traffic.

The point we wish especially to bring out here is that the advantages of the cross-seat semi-convertible car are not by any means necessarily confined to double-truck cars, as seems to have been assumed by the management of many roads and in many of the discussions which have taken place. The merits of the semi-convertible and the merits of the double-truck car should each be considered by itself. It is certainly a mistake to adopt heavy double-truck cars on a city road of little traffic simply for the sake of their superior riding qualities on bad track. It would be better in the long run to relay the track.

While it may be cheaper for a year or two for the company to buy new double-truck cars rather than relay its bad track, such a policy is only "robbing Peter to pay Paul." The company will have to pay continuously for the electric power required to haul around the greater dead weight of the long cars, and will also ultimately have to relay its track. Should the track be relaid in the first place, the easy riding qualities could be secured with the single-truck car, supposing, of course, the speeds to be moderate, such as are common in purely city service. In fact, this whole editorial is intended to apply to city service only, as suburban and interurban service introduce new considerations.

Noise as an Element of Damages

An interesting decision was recently handed down by the Massachusetts Supreme Court to the effect that the aggravation of the noise of surface cars running beneath an elevated railway structure, by the structure itself, constitutes an element of damage. It certainly is difficult to imagine by what occult mental psychic process this conclusion was reached, and still harder to realize how it is possible to base a definite award of damages upon so elusive a foundation. Granting that the structure causes a certain reverberation of street noises beneath it—and this is open to question—we should like to know what proportion of the sound can fairly be charged to the smoothly running trolley car and what to the endless procession of truck wagons, loaded with everything from loose steel plates to groceries, which caroms merrily over the cobble stones from hour to hour. It would not be very far amiss to state that the withdrawal of two or three beer trucks by Messrs. Schooner & Stein on account of a strike in their transportation department, or the placing in service of a half-dozen new storage warehouse vans by Holdup & Co., makes far more real difference in the total volume of noise in the street than the operation of a hundred surface cars an hour on a given piece of track.

Practically, the point is this: How can an operating company be fairly charged with producing a volume of noise which bears so small a proportion to the uproar of the entire street traffic that the variations of the latter far exceed in amount the magnitude of the former? By what scale of measurement can the percentage be obtained which will indicate the excess of noise which the structure presumably creates in connection with the surface car movement? It is impossible to escape the conclusion that the decision is grossly unfair, and that it was based upon the most indiscriminating guesswork. How little noise either at first hand or second hand the modern trolley car makes can be learned on any Sunday morning, when the streets are clear, provided the roadbed and track are in decent shape. As an example of legal hair splitting this decision bids fair to win the cup.

NEW INSTRUCTION CAR FOR THE BROOKLYN RAPID TRANSIT COMPANY

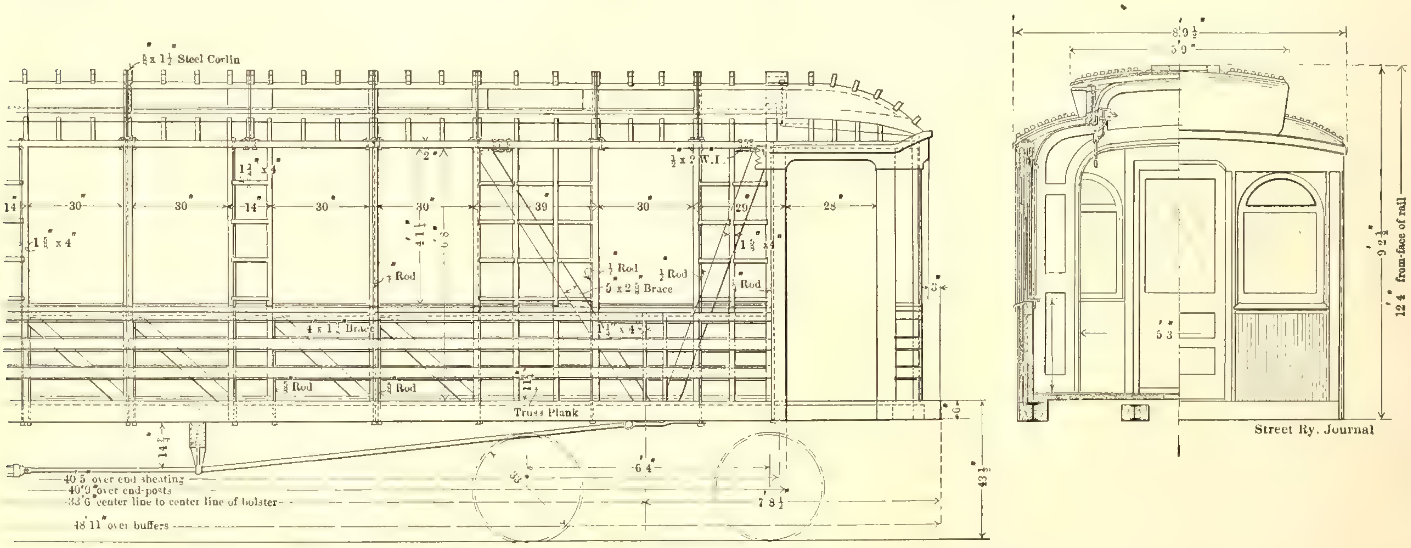
An ever-increasing problem has been experienced by the Brooklyn Rapid Transit Company in the selection and instruction of employees for the operation of trains since the inauguration of electric traction upon its elevated lines. Trains equipped with the multiple-unit control have been found to require much more care and more experienced handling than either the former steam locomotive equipment or the surface trolley cars. The recent extension of electrical operation to all elevated lines of the company and the inauguration of largely increased schedules have added greatly to the number of employees, and have made the securing of experienced men more and more difficult. To assist in the solution of this problem, and at the same time to raise the standard of the motormen, the company decided some time ago to equip an instruction car for the instruction of all present and future employees on its elevated division. The car that has resulted involves many features of novelty, not only as to its equipment for instruction, but also as to the constructional features of the car itself.

An effort was made in the design of the car, which was built new from sills to roof, especially to meet the requirements of the instruction work, to embody in it the most improved principles of passenger-car construction. The most radical of the features introduced consists in the use of entirely enclosed platforms and the abandonment of the usual end bulkheads and doors. In this particular the car is very similar to the new rolling stock of the Boston Elevated Railway Company, as illustrated in the Aug. 6, 1904, issue of the STREET RAILWAY JOURNAL. The side-door feature of the Boston Elevated car was, however, omitted, but other interesting features, such as a Pullman palace-car window design, the use of end vestibule doors sliding into concealed pockets in the sides of the car and operated by compressed air, and a new scheme of interior finish in light oak with semi-empire deck, have been incorporated, which give the car a striking and remarkably pleasing appearance.

CONSTRUCTION OF THE CAR

An accompanying drawing shows the details of construction and illustrates the method of securing the platform arrangement with omission of the usual end bulkheads. The car is 49 ft. in length over all, 40 ft. between the archways replacing the bulkheads, and is of the standard width of 8 ft. 7 ins. It has a heavy underframe construction consisting of 5-in. I-beams, which are built up for both center and side sills with heavy oak fillers, and are carried the length of the car. The platform decks are reinforced by supplementary sills, or platform arms, of similar construction, extending from the body bolster to the end buffer beam. The bolster construction and side framing correspond in detail to those of the standard reconstructed cars of this company, which were described in the Aug. 6, 1904, issue of this paper. The roof construction employs steel carlines with heavy side-post anchor bolts, consisting of ½-in. rods, which pass through the forged feet of the car-lines and extend down through the side sill. This permits a very light plate construction as well as of roof detail. The body end construction is notable for the carrying of the plate and all roof

THE NEW INSTRUCTION CAR FOR THE ELEVATED DIVISION OF THE BROOKLYN RAPID TRANSIT COMPANY



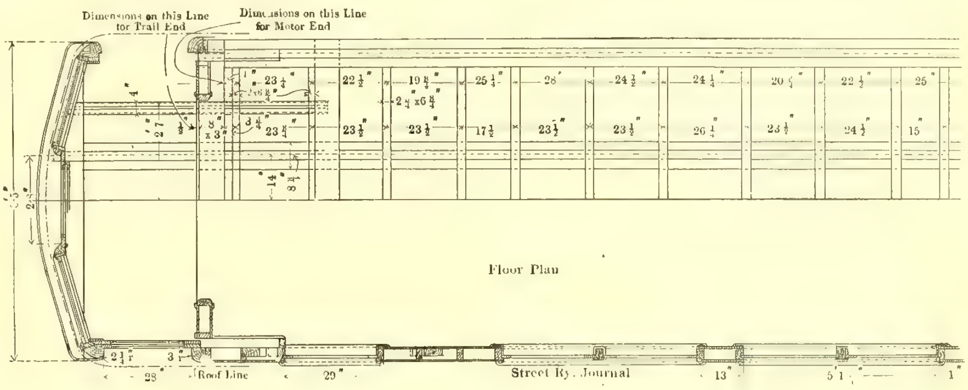
END AND SIDE ELEVATION, SHOWING CONSTRUCTION FEATURES OF THE INSTRUCTION CAR

members beyond the body proper to the end of the platform. This plan, while preserving the usual lines of passenger car construction, secures a great rigidity throughout the superstructure. The housing of the platform which, in this car, supplies the framing members to take the place of the bulkhead, is heavily built with strong corner posts and cross bracing beneath the end windows. The usual bulkhead, as described, is replaced by an archway of simple construction with panels on either side and above, which, while not interfering with ease of access to and from the car, adds a very attractive finish to the interior.

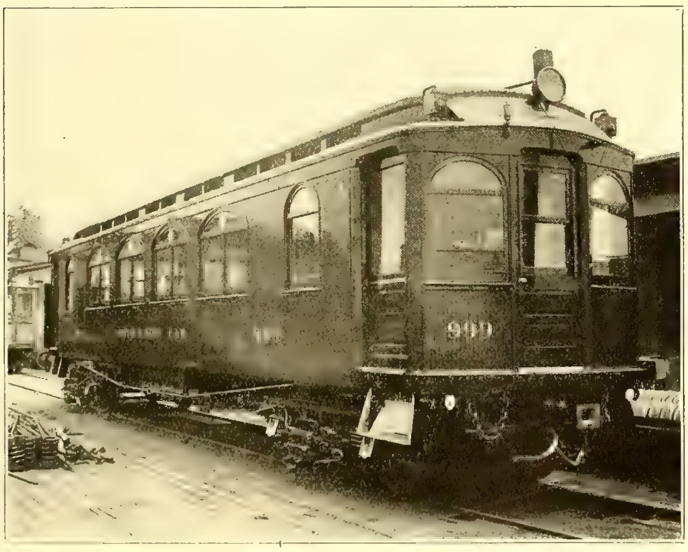
A striking exterior appearance is secured through the special window design, which closely resembles that used upon the latest designs of Pullman palace cars. There are four groups of such double-arched windows, with smaller single-arched windows at either end, upon both sides. The end windows are also of similar outline. The car is painted in maroon with gilt lettering, an entirely new color for the system. The interior finish is of light quartered oak. A smooth, well-rounded treatment of detail has been applied to the inside, so that simplicity and neatness are apparent throughout.

The construction of the side pockets for the sliding vestibule doors was easily secured by the hanging of the door runway, which is of the Coburn roller-bearing trolley type, within the car framing and housing it over. The casing of the pocket has been made removable for ease of access to door and runway at all times. The door-operating device consists of a long pneumatic cylinder with a piston travel equal to that of the door movement, the cylinder being located beneath the window sill at the rear of the pocket, and the piston extending inward through the pocket to the door. The controlling mechanism is located on the inside of the archway panel, convenient to the guard for opening and closing. The control valve consists of a simple three-way valve for admitting the compressed air supply from the air brake reservoir beneath the car into either end of the cylinder or exhaust for the operation of the door. The details of this device, which are clearly shown in an accompanying photograph, are very simple, having been built at the company's shops, and will be readily understood from the illustration. It may be noted that no effort was made to conceal the cylinder within the side pocket or side framing of the car, inasmuch as the company desired to demonstrate its construction, but it has been finished in highly polished brass, and corresponds with the general interior finish of the car.

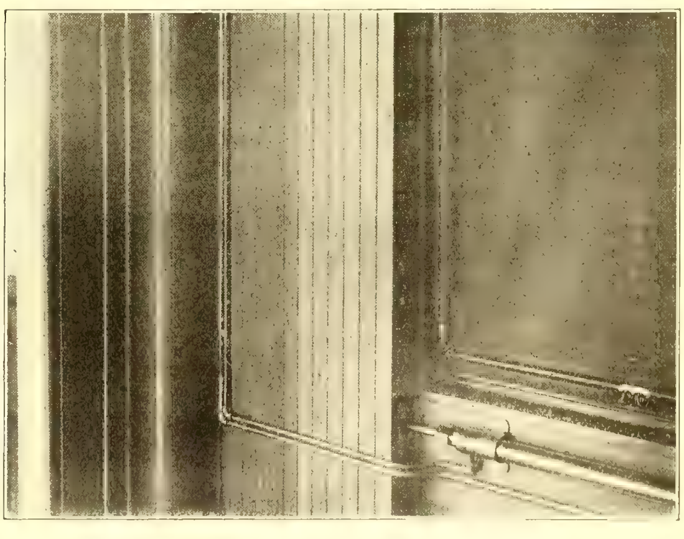
The car is equipped with Peckham trucks, one of the trail type and the other carrying two motors, in accordance with the standard practice of the Brooklyn Rapid Transit Company. The motors are both of the 50-L type of the Westinghouse Electric & Manufacturing Company, and the car is provided with the Westinghouse electro-pneumatic system of unit-switch-control, of which there are about 600 equipments in use upon the elevated lines of the Brooklyn Rapid Transit Company. The controller operating the motors is located within the car, so as to serve as a working model for instruction purposes, as will be described later. The low-voltage, multiple-unit operating connections of the control mechanism is entirely exposed to view for ease of examination and demonstration to the students, while they are protected from accidental contact with the higher voltage-line current under all circumstances by the usual arc detector casing about the drum proper, and a neatly finished boxing over the motor leads and other line-voltage wiring entering the controller from beneath the car. The air-brake equipment of the car corresponds with the standards of the road, namely, the New York brake cylinder and triple apparatus and the Christensen compressor and governor. The motorman's valves and gages are located, together with the master controllers for the multiple-unit control system, in the vestibules for regular operation upon the road. The car is



DETAILS OF FLOOR FRAMING



END VIEW OF THE NEW BROOKLYN ELEVATED INSTRUCTION CAR, SHOWING CLOSED PLATFORM

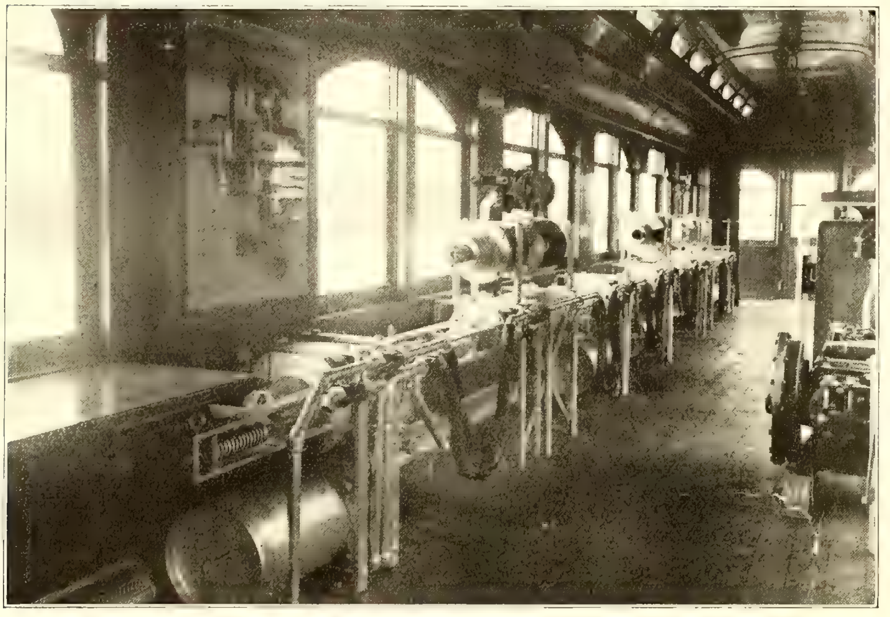


DETAIL VIEW OF THE PNEUMATIC SIDE-DOOR OPERATING DEVICE, WITH CONTROL VALVE

further equipped with the Dayton arc headlight and Earll trolley retriever for the control of the trolley rope when operating upon surface lines.

INSTRUCTION EQUIPMENT

The system of instruction for the training of the motormen includes a study of a new book of rules and regulations under a competent instructor and is supplemented by illustrations of the actual operation of all features of the air brake and electrical equipment by means of the working models in the car. The new rule book is a well-arranged 150-page pocket-size book with cloth binding, and contains rules governing the deportment of the men when in service, directions for the operation of the air brake and multiple-unit train control apparatus, and also for the signal and interlocking systems in use upon the elevated lines. The work will be handled in classes in which the men will be drilled upon the rules and will be systematically examined as to their efficiency. Every assistance possible has been secured for demonstrating the principles taught, including, beside the sectional apparatus, large colored charts and detail drawings for use in describing the functions of all the parts.



THE SIX-CAR TRAIN EQUIPMENT OF AIR BRAKE APPARATUS, WITH SECTIONAL PARTS

As will be seen from the interior views herewith, the electrical apparatus is arranged upon one side of the car and the air-brake equipment upon the opposite side, while at one end a working model of the Van Dorn automatic coupler has been installed for demonstrating its action in coupling. The air-brake apparatus consists of a complete six-car train equipment, including four motor-car and two trailer-car equipments, in accordance with the standard train arrangement of the company, in which the two trail cars are the second and fifth cars in the train. The equipment embraces working models of the car reservoirs and brake cylinders with their triple valves, piping, hose and all auxiliary fittings, the motor-car equipments including 10-in. cylinders with separate reservoirs, and that for the trail cars, 8-in. cylinders with attached reservoirs. The motorman's valve is located conveniently near for the proper demonstration of the apparatus by the lecturer, and the train line is provided with valves to enable it to be split up into sections of various lengths as desired. For securing the same action of the equipment as would be experienced under service conditions, extra lengths of pipe are connected in the various sections of the train line beneath the car in the form of coils. These extra lengths serve to introduce a total length of train line pipe exactly equal to that of the standard six-car train. The brake-cylinder pistons operate against spring blocks carried in extension riggings so that the effect of various train line reductions may be shown to a nicety by the compression of the springs.

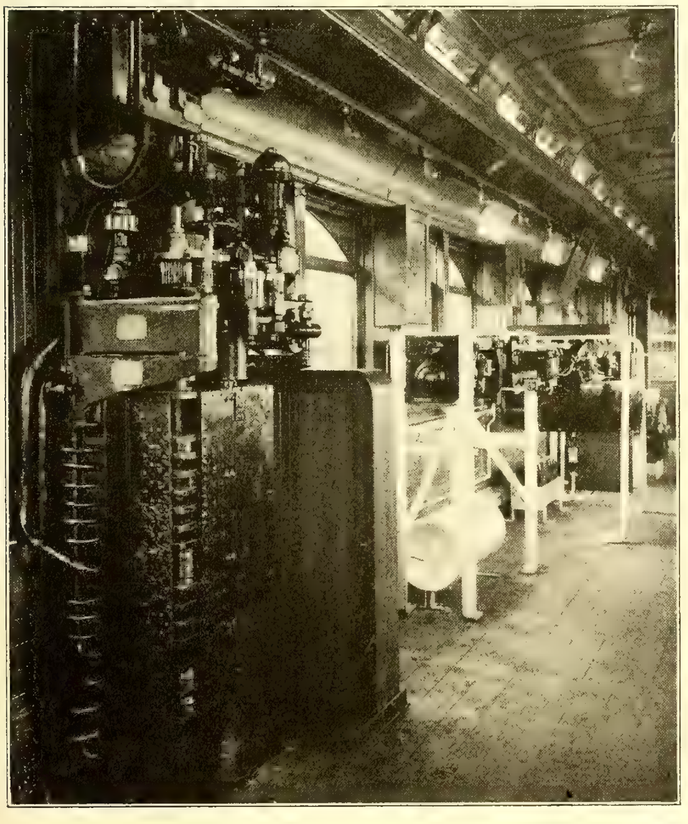
An important feature of the brake equipment is the sectional apparatus provided to illustrate the methods of operation. Located alongside of the motorman's valve there is a sectional motorman's valve, the handle of which is connected to the working model by a yoke in such a way that its exposed rotary valve follows the working valve exactly throughout its cycle of operations, and thus indicates the relative arrangements of ports for all effects, such as lap, release, service application, etc. Sectional triples are also installed for demonstration and an extra brake-cylinder equipment is provided with a special design of triple valve whose slide valve operates the slide valve of an adjacent sectional triple for demonstrating the triple under actual working conditions. This special cylinder is located above the six-car equipment near the motorman's valve.

Another interesting feature of the car equipment is a sectional air compressor, which is the type D-2-E-G of the Westinghouse Traction Brake Company, and which is fitted with corresponding sectioned governor. The compressor is sectioned in such a way as to show the interior of the compressor motor without at all interfering with its operation, and also to expose the compressing cylinder interiors, their pistons, valves, etc. The motor may be operated at speed so that the method of operation of the outfit may be readily followed. The air supply for the six-car train model equipment in the car is supplied by the regular Christensen compressor beneath the car. The governor for this compressor is located within the car so

GENERAL INTERIOR VIEW OF THE BROOKLYN ELEVATED INSTRUCTION CAR, SHOWING THE OMISSION OF BODY END BULKHEADS

that its operation may be more evident to the students in attendance.

Part of the elevated cars of the Brooklyn Rapid Transit Company is equipped with the Westinghouse electro-pneumatic drum controller and part with the later form of Westinghouse unit-switch-group controller. To properly give instruction on both forms the instruction car is equipped with full-sized models of each. The unit-switch-group controller, which is plainly shown in one of the accompanying illustrations, is mounted upon a framework for ease of access for examination, and while not used for operation of the car so that line current enters it to endanger those examining it, yet it is equipped for operation by a master controller through the various steps in acceleration, reversing, etc. For this purpose a special attachment to the limit switch is required. It will be remembered, from a recent description of the unit-switch-group control in these columns, that the controller provides for automatic acceleration of trains by means of a limit switch device



THE WORKING MODELS OF THE ELECTRO-PNEUMATIC DRUM, AND OF THE UNIT-SWITCH GROUP SYSTEMS OF CONTROL

whose action depends upon the amount of current passing through the motors. The absence of the motor current is provided for in the model of the limit switch by a special dashpot arrangement which succeeds in bringing the same conditions in the acceleration cycle as obtains under service conditions. The auxiliary apparatus used in connection with the unit-switch-group control is located conveniently near the main controller, and includes the reverser, the line switch or circuit breaker, the relay, the limit switch and the storage battery for supplying the low-voltage master-control current.

As described above, the drum-control equipment, by which the car motors are operated, is also arranged for demonstration purposes, being located near the end of the car and entirely exposed to view. All parts of the master-control mechanism are made readily accessible and sectional parts are provided to illustrate their construction. The sectional model of the unit-switch group illustrates the method of operation of the air cylinders, switch-contact arms and electro-pneumatic valves which are common to both systems of multiple-unit control of the Westinghouse Company. It is furthermore intended to install sectional jumper cables as well as other parts of the apparatus used upon the cars for use in explaining their action. Models of the two types of switchboards used in the motor cars for the control of their lighting, heat and power circuits are also installed, the later or cupboard type of switchboard, as used upon the newest cars and upon a large number of the reconstructed cars, employed for the control of such circuits upon this car, while the older type of board is installed merely for demonstration only.

Another interesting feature is to be noted in the compressed-air-operated coupler model, by which the method of operation of the Van Dorn automatic coupler, as used upon the system, is demonstrated in coupling and uncoupling. One of the coupler heads is mounted in a stationary position in a strong structural framework, as shown, while the other is attached to the piston of an air cylinder and slides to and fro between guides formed by the channel bars for the coupling process, a spring in the air cylinder holding the couplers normally apart. The air supply to the cylinder is controlled by a motorman's valve by which graduated application may be made for bringing the couplers together at any speed of impact desired.

Much credit is due the officials of the Brooklyn Rapid Transit Company for the novel features of design incorporated in both the construction of the car and its equipment. The car was built and equipped at the Eastern Division shops of the company under great pressure of work during the recent reconstruction of rolling stock equipment, and yet with extremely satisfactory results. Much that is novel in the design of the car is due Ferris A. Overfield, who is directly in charge of the Eastern Division elevated shops and had supervision over the construction of the instruction car.

ADVERTISING THE ROCHESTER & EASTERN RAPID RAILWAY THROUGH ILLUSTRATED POST CARDS

A novel and effective form of railway advertising has been instituted by the Rochester & Eastern Rapid Railway Company, which has taken advantage of the prevailing craze for illustrated post cards to familiarize the public with the interesting scenes along its line. Recently J. H. Pardee, general manager of the company, had a number of photographs taken at various places along the route, and arrangements were made with the local news company to have these views issued on postal cards. The news company issues the post cards and then sells them in quantities to the news dealers in that section of the State. Samples of these cards have been posted attractively in each of the company's ticket office and in many of the stores in the towns along our line, noting on the bottom that the cards are on sale at the ticket offices.

The cards are sold at a price of 3 cents each, or two for 5 cents. They cost the company 1 cent each in lots of 1000, and Mr. Pardee estimates that the profit on the sale of these will pay for the original photographs and for the expenses of displaying the samples.

Underground railways that will become elevated roads on leaving the city is a feature of a concession that has been asked of the City of Mexico, Mexico, by Lieut.-Col. Felix Diaz, chief of police; Lorenzo Elizaga, an attorney, and Francisco Ibarra, an engineer, to establish an electric street car system that will embrace this city and most of the suburban towns. It is proposed to extend the line from the city to Tialpam, Coyoacan, San Angel and Atzcapotzalco, touching the intermediate towns of Churubusco, Tacubaya, San Pedro, Tacuba and Popotla.

STEEL CAR FOR NEW YORK CITY RAILWAY COMPANY

A great deal of attention has been directed for several years past toward the construction of non-combustible cars by the replacement of wood by steel, but, with the exception of the New York Subway cars, very little has been done in the construction of non-combustible passenger coaches for use on either steam or electric roads. Frequent occurrences of fire through accident or short-circuiting and other causes have developed a demand for a non-combustible car.

One of the first people to appreciate the importance of a non-combustible car for surface railway work was H. H. Vreeland, president of the New York City Railway Company. Owing largely to his initiative, the engineers of his company, in connection with those of the Pressed Steel Car Company, have combined their efforts in the production of a steel car which for over a month past has been operated on Broadway, New York. There is no wood used in the construction of this car, except a portion of the window sash, roof and floor matting strips, and these have been thoroughly treated with fireproofing compound which makes them non-combustible. This metal car is modeled very closely after, and in general appearance is like, the standard double-truck wooden car now in operation on the New York surface lines.

The body is 28 ft. long, and the over all dimension is 37 ft. 1 in. The car complete with motor and trucks weighs about the same as a wooden car of the same type, but the builders state that in future construction they will be able to reduce the weight materially without sacrificing the strength— that is, that a steel car can be constructed of the same dimensions and not exceed the weight of a wooden car, and may be lighter.

As will be understood from the accompanying drawings, the underframing of the new steel car consists of angle-shaped sills, which are connected by pressed-steel channels. Each platform is made up of four channel members, which are bolted to the under side of the body underframing, the two outside platform members extending to the body bolster. Each platform structure is riveted up complete in itself, but it is attached to the underframe by bolts, and when necessary to make repairs either platform framing can be readily removed. The end sill or bumper is a pressed-steel channel, curved to shape. The floor, both of the car body and of the platform, is ⅛-in. steel plate, riveted to all the members of both the body framing and platform. Over the steel floor in the aisle are laid maple strip mats, treated, as previously explained, so as to be non-combustible.

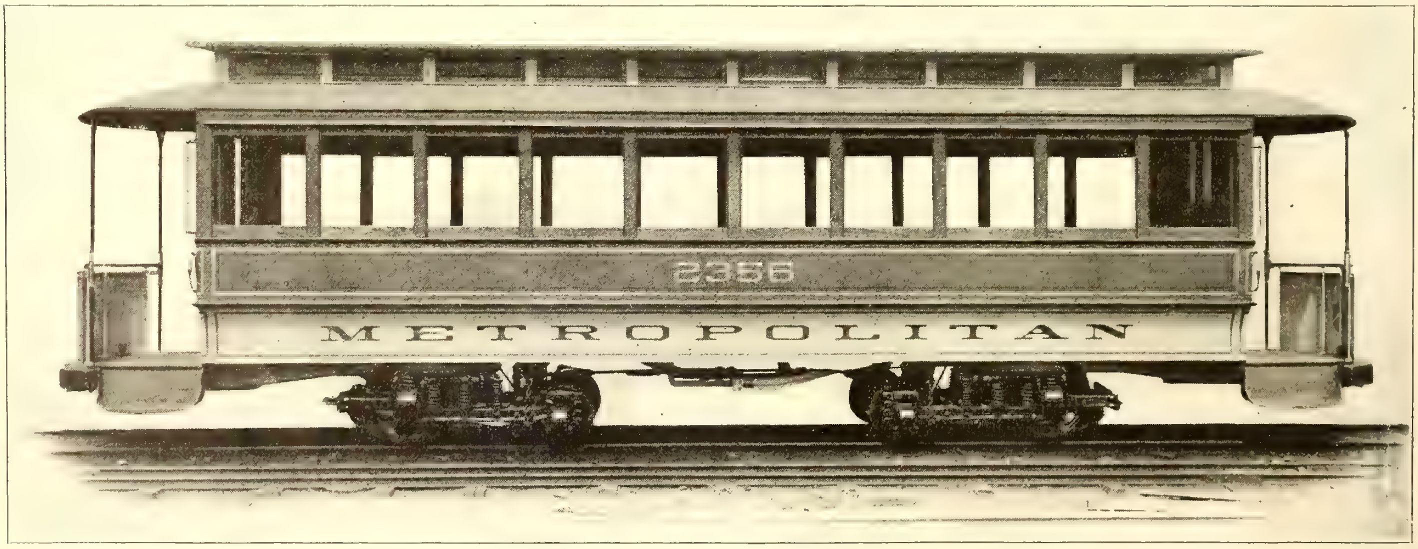
The side posts of the car are of channel section and run from the bottom of the side sill to the top of the eaves. The carlines consist of bent angles and run continuously from side post to side post across the car. The side posts are strengthened longitudinally by angle-iron bridge members between each two posts at the window rail and at the tops of the windows.

The outside panels are steel plates ⅛ in. thick. The lower set of panels, running from the guard rail to the bottom of the side sills, are riveted horizontally under the guard rail and vertically at each post, so that in case of damage any panel can be easily replaced. The guard rail is a special steel section, as

INTERIOR OF NEW YORK STEEL CAR

shown on the drawing, and is also divided into sections, but the joints are flush and do not show in the finished car. The guard rail is bolted to the side of the car.

The side posts are connected at their upper ends by a continuous pressed-steel member, which also forms a water shed over the windows. The upper and lower roofs are made of composite board covered with canvas.

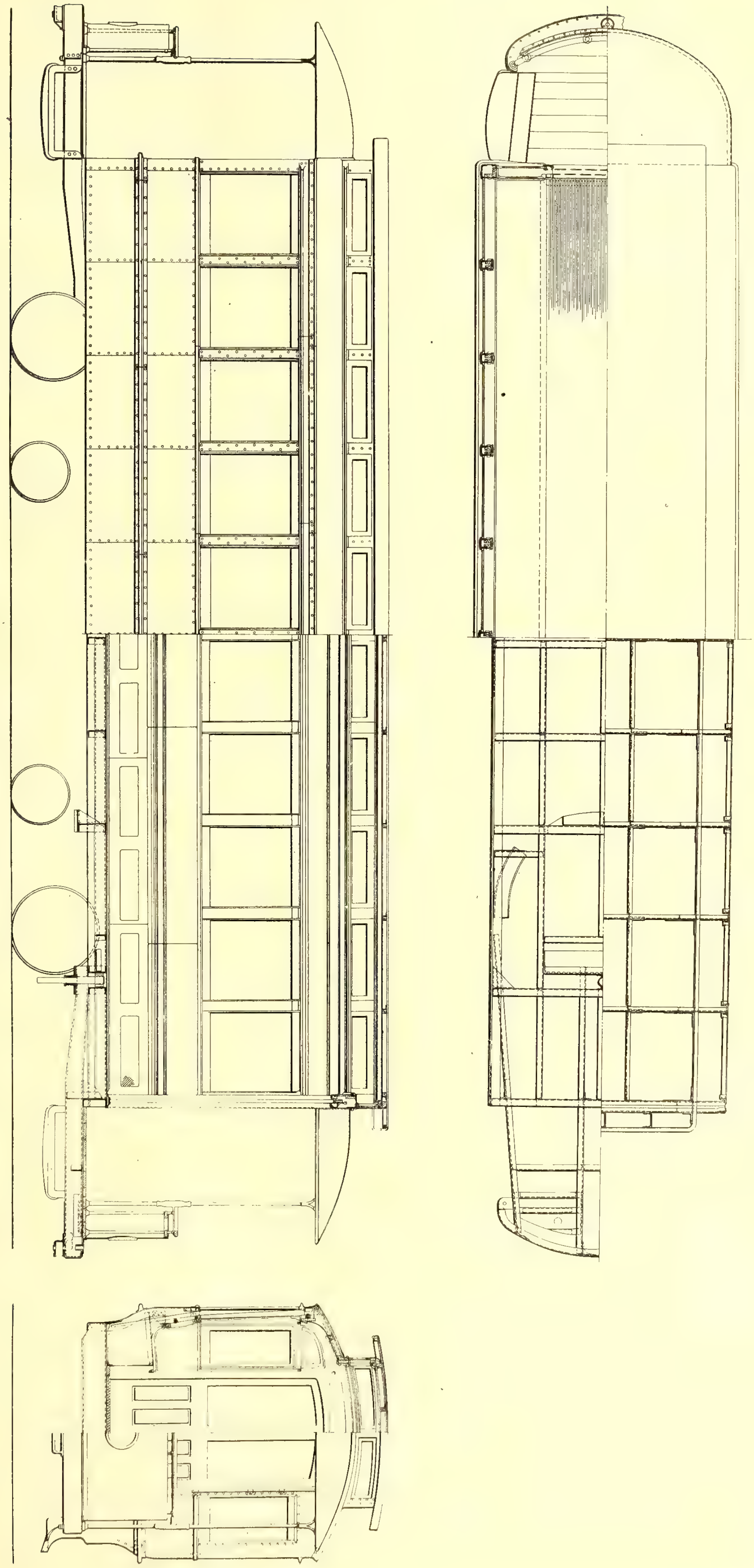


THE NEW STEEL CAR FOR THE NEW YORK CITY RAILWAY COMPANY, THE FIRST EVER USED ON A STREET RAILWAY

At the lower eaves a copper flashing is brazed to a brass eave running the length of the car. On the upper roof this copper flash is attached directly to the upper eave.

The hoods over platforms are made of steel plates, bent to shape, each hood being in three sections, riveted at the joints.

The windows are arranged to drop into the lower part of the car, as in the ordinary New York City standard car. The



PLANS, SECTIONS AND ELEVATIONS OF NEW ALL-STEEL CAR OF THE NEW YORK CITY RAILWAY COMPANY

upper and lower members of the window sash are fireproofed ash. The side members of the window sash are brass channels which slide in pressed-steel grooves.

The seats and backs are formed of thin sheet steel pressed to shape and stiffened with angles, the outside covering being carpet. Both seats and backs are removable and are held in position by overlapping cleats without the use of bolts.

As to the wiring, the motor cables are carried in split-iron pipes under the seats, and the branch-off wires to motors and controllers are run in iron-pipe conduits. This is the same practice as followed on the standard New York City wooden cars, except that on the latter the main cables are carried in transite moldings. In the case of the steel car, the iron pipes are attached directly to the sheet metal of the car by strap hangers. The motor cables are the same as adopted by the New York City Railway Company as standard for all cars. The specifications for wiring require that each conductor shall be made up of seven soft copper wires, stranded. The resistance of the conductors per 1000 ft must not exceed .07642 ohms for the No. 0 cables, and .1529 ohms for the No. 2 wire. Each conductor is insulated with rubber, according to the rule of the National Board of Fire Underwriters, and is further protected by a layer of approved flameproof braid at least 1-32 in. thick, the outside being saturated with an approved preservative water and flameproof compound. As an additional protection, each cable is wrapped with ⅛-in. thick strip asbestos paper, outside of which is applied a heavy cotton braid which is saturated with an approved preservative water and flameproof compound.

QUESTION BOX OF THE ACCOUNTANTS' ASSOCIATION

Elmer M. White, secretary of the Street Railway Accountants' Association of America, has published the list of twenty-two questions forming the Question Box of that association this year. All of these questions have been suggested by members. The secretary states that it is desirable that all replies be signed for publication, but if any member prefers not to have the name of his company appear, his wishes will be respected. As the questions and answers have to be printed for distribution before the convention, a request is made that replies be mailed to the secretary by Aug. 5, or earlier, if possible. They should be sent to P. O. Box 289, Hartford, Conn.

QUERIES FOR THE QUESTION BOX

1. What is the best method of establishing a "sinking fund account?"

2. What is the best method of filing canceled coupons?

3. In cases where the same company operates both railway and lighting plants, what is an equitable division of those expenses which are not directly chargeable to either plant?

4. What is the best method of computing car-mileage and car-hours? Reply in detail.

5. What is the best method of handling employees' transportation, as viewed by the operating as well as the accounting department?

6. Is it better practice to keep car, armature and wheel records at the shop or at the office?

7. What system do you consider best for keeping track of scrap material?

8. What is the best method of destroying used tickets after an accounting has been made?

9. What are the methods used by interurban roads in the accounting of cash fares paid on the car? If registers are used, how many classes of fares have you, and do you register tickets according to their value?

10. On roads where single and round-trip tickets are sold, is it the practice to carry, indefinitely, the value of the return coupon (not good after thirty days) in the ticket-sale account, or are the values transferred to profit and loss at set periods?

11. Where a company is obliged to sell round-trip and other tickets, through conductors on the cars, what system is employed to keep account of tickets supplied to conductors? How often is their stock of tickets checked up? Is a deposit required from conductors to protect the company against loss?

12. On an interurban line with collections made on the zone plan, what is the best way to obtain traffic statistics? For instance, a road 21 miles in length has six separate 5-cent fare collections; how can the company ascertain the actual number of passengers carried through from one terminal to the other, or between certain stations?

13. When a weekly pay-roll does not end with the calendar month, what is the best way to separate it for a charge?

14. Is an individual receipt for each person on the pay-roll considered better than the plan of signing in a book?

15. What is the best process of apportioning damages into operating accounts 33 and 34?

16. What method is employed in keeping record of the expense incident to each individual case of personal or property damage?

17. What is the best manner in which to treat "additions and betterments" account for a particular fiscal year?

18. What are the advantages of the voucher check over the old method of separate check and voucher?

19. What is the best form of voucher check? (If members will take copies of the one they think best to the convention, possibly one that could be called standard would be found.—Secretary.)

20. What operating expense accounts should be taken to get the cost of power per kw-hour? Should anything be added for interest or depreciation?

21. On a small road, is it necessary to separate the register checkers and ticket counters from the cash counters?

22. Should register totals be carried forward from day to day—that is, should a record be made so that the closing number can be compared with the opening number the next day?

THE EAST ST. LOUIS & SUBURBAN RAILWAY CHANGES TO STANDARD GAGE

The East St. Louis & Suburban Railway Company's system, which has heretofore been slightly wider than standard gage, being the same as that used in the city of St. Louis, across the river, is now being changed to standard gage, 4 ft. 8½ ins. The change was necessitated by the advent of interurban roads from the north and east, which could not bring their cars in over the East St. Louis & Suburban system. With an odd gage, it was manifestly impossible for traffic agreements to be made with any standard gage interurban line which might wish entrance over the East St. Louis & Suburban system, and it would have been necessary for these lines to build independent standard gage tracks through East St. Louis in order to reach St. Louis. Furthermore, a part of the lines controlled by the East St. Louis & Suburban Railway system were originally standard gage, and the existence of two gages on the same system naturally was a matter of considerable inconvenience.

EDUCATING THE PUBLIC AGAINST THE ACCIDENT FAKIR

In the August number of "Pearson's Magazine," Theodore Waters writes of the doings of street railway accident fakirs in some of the large Eastern cities. This installment in the series on "The Profession of Getting Hurt" is of special interest to claim adjusters, as the results of the cases cited show how the aggressive "no-compromise" methods of the Philadelphia Rapid Transit Company have succeeded in making the Quaker City a place shunned by this type of blackmailers.

THE QUESTION BOX

In the Question Box this week are discussed a variety of subjects, including the following: Fire insurance; sinking fund for settlement of accident claims; co-operation between the claim department and the operating department; the use of the camera in adjusting claims; handling fares; keeping records by means of diagrams, and various questions relating to the mechanical department, steam engineering, the engine room and the line department.

The occasion is taken to emphasize again that the Question Box is open to all readers for the asking of questions or the answering of any of the queries that have been published from time to time.

A.—GENERAL

A 8.—A company wishes to carry its own fire insurance, by setting aside a certain percentage of its gross receipts each year to cover fire losses. What would be a safe percentage to allow?

This necessarily would have to be determined by the character of the risk. This company stores its cars in various car houses equipped with sprinkler systems, standpipes and fire hose. Also, each car is equipped with one or more dry powder fire extinguishers. By close adherence to the underwriters' rules and specifications, our insurance is reduced to a very low percentage—about one-half of 1 per cent of the gross receipts.

Denver City Tramway Co.

A 9.—Under what conditions can an electric railway company venture to carry its own fire insurance on its various properties?

The risk should be put in the best possible condition. Every precaution specified by the underwriters should be taken, and thorough inspection made at frequent intervals by someone familiar with the underwriters' requirements. Rolling stock should be housed at various houses, in different parts of the city, and not concentrated at one point, if the company intends to carry its own risk.

Denver City Tramway Co.

A 11a.—Do you have a sinking fund for the settlement of accident claims? Please give details of the methods you use for handling this matter.

We do not have a sinking fund for the settlement of accident claims. When an accident occurs on one of our roads, it is fully investigated by the superintendent in charge of the property, and his report, together with the report of the conductor and motorman, are submitted to the local attorneys of the company, who in turn pass upon the same in regard to the liability of the company. When the accident is serious the company's physician always visits the patient and sends in his report. When these reports are all completed the matter is then handed to the claim agent, with the recommendations of the attorneys as to whether the case should be settled or allowed to go to trial.

D. A. Hegarty, Gen. Supt.,
Railways Company General, New York City.

A 13a.—How can the claim department best co-operate with the operating department in the prevention of accidents?

The claim department can co-operate with the operating department in the prevention of accidents to the mutual benefit of not only the company, but also the several departments. If the claim department, upon investigating accidents, finds anything in the operation of the road that would be detrimental to the good of the service, the matter should be immediately called to the attention of the man in charge of the operating department, so there will be no recurrence of the accident from that same cause, and it is absolutely necessary, in order to get the most efficient service out of both departments, for them to co-operate with one another.

D. A. Hegarty, Gen. Supt.,
Railways Company General, New York City.

The claim department's interests are best subserved by having in its force men having had practical experience in the operation of cars, and who are authorized to go among the men, riding with them, explaining the cause of certain accidents and how they could be avoided. Tactful agents can often treat with the men directly to a better purpose than can the operating department, although, of course, the operating department should act in conjunction with the agents.

F. H. Brooks, Supt., Lincoln (Neb.) Tract. Co.

A 13b.—Have you ever used the camera to good advantage in adjusting damage claims? Please give details.

We have used the camera in adjusting claim cases, by taking photographs of the place and locality of the accident, together with any special feature regarding the accident which we wish to appear prominently. We have also had surveys made for use in court so as to better illustrate the accident and give a better understanding to the jury. As a rule, preparations of street railway accident cases going to court have been very poorly made, and I think in matters of this kind too little attention has been paid to the details, and the street railways might well pattern after the steam railroads who go into court fortified with maps and plans and models and expert testimony to support their side of the case.

D. A. Hegarty, Gen. Supt.,
Railways Company General, New York City.

A 35a.—Can a fifteen-minute service be given successfully upon a single-track interurban road? If so, under what conditions?

Fifteen minutes, or even shorter headway on single-track suburban road can be operated successfully, even under heavy traffic. To accomplish this it is necessary to locate turnouts accurately with respect to running time, and turnouts should be of a length equivalent to 60 seconds in running time to allow for any slight variation in headways.

F. W. Bacon, Gen Mgr.,
New Jersey & Hudson River Ry. & Ferry Co., New York City.

A 36a.—Based upon experience, what is a proper rate per mile for interurban passenger business, and to what extent should these rates be reduced by the sale of commutation tickets, monthly tickets, coupon books, etc.?

In making up a schedule of fares for an interurban road, it is better to base the rates on mileage, and there must also be taken into consideration the fact that a great many of the ordinances granted to interurban roads by municipalities fix a rate of fare within municipal boundaries, which make it essential that reference be made to these limits. In regard to the proper rate per mile for passenger business, this all depends upon the territory through which the railway passes. From the manner in which an interurban road has to be operated, I think the proper rate per mile for passenger business should not be less than 2 cents. A reduction for round trip tickets should not be less than one-fourth of a cent, making the rate .0175 cent per mile.

D. A. Hegarty, Gen. Supt.,
Railways Company General, New York City.

A 36b.—How do you handle your half-fares?

We have no half fares on the interurban roads, but on the city roads half-fare tickets for children under ten years of age are sold at the company's offices in lots of ten tickets. Any child riding has to present one of these tickets, or otherwise must pay full fare.

D. A. Hegarty, Gen. Supt.,
Railways Company General, New York City.

We have no half fares on our system. Children under five are carried free, and over five pay full fare. We believe this is the best way of solving the half-fare difficulty.

Geo. O. Nagle, Gen. Mgr.,
Wheeling Traction Co., Wheeling, W. Va.

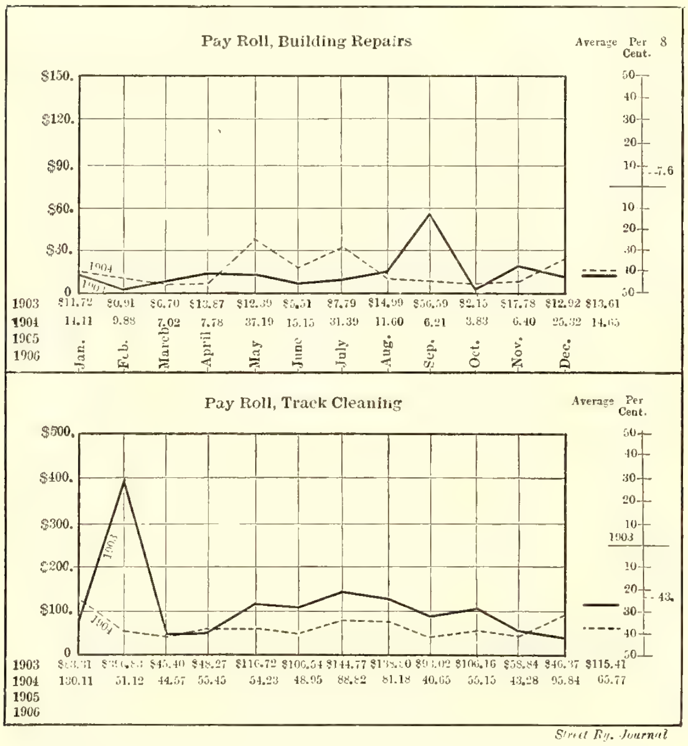
A 37.—What is the best method of collecting and checking fares on interurban roads?

The method used by our conductors in checking and collecting fares on our interurban road, which we have found satisfactory, is for the conductor to go through the car and take up all the tickets and issue cash-fare receipts to those paying cash fares. An identification ticket is put in the hat band or in the seat in front of the passenger, showing that he paid a cash fare. This ticket is printed in such a manner that the conductor punches out the date, trip, and the destination of the passenger. The checks are also in different colors, so they can be readily distinguished at a glance. At the end of each zone, the conductor also registers the number of passengers on his car. The registers on the cars are of the recording type and keep the total for the seven zones, which is the number of zones on each trip. Each zone covers a five-cent fare.

D. A. Hegarty, Gen. Supt.,
Railways Company General, New York City.

A 47.—Have you worked out any special form of hand book or note book by which the manager can keep in convenient shape for quick reference the various data and statistics relative to his property, such as comparative receipts, car mileage, station output, etc.? How do you keep this information? Sample pages or sheets from your book, with description, will be appreciated.

The accompanying sample sheet of curves illustrates the method followed by the writer for keeping records in diagrammatic form. It will be noticed the curves are plotted on perfect cross-section paper from which blue prints can be made. The curves and figures are



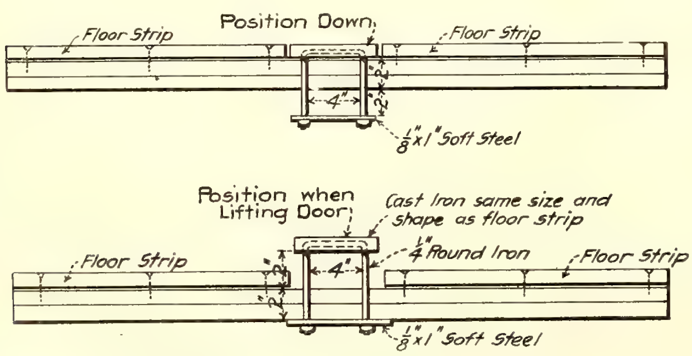
KEEPING DATA IN DIAGRAMMATIC FORM, LINCOLN TRACTION COMPANY

given; then the averages of the curves and the percentages of increase or decrease are indicated at the right. 1903 was taken as the basis of calculations. These can be changed to fit any requirements. Any number of combinations, as "total kilowatt-hour output" and "total cost per kilowatt-hour," etc., can be made. In fact, a complete record of what the company is doing in any branch can be kept in ready reference form in this way.

CHAS. H. COX, Gen. Mgr., Lincoln (Neb.) Tract. Co.

E.—MASTER MECHANIC'S DEPARTMENT

E 16.—What is the best form of handle for trap-door lifts in cars?



SUGGESTION FOR TRAP-DOOR HANDLE

Enclosed find a rough sketch of trap-door handle. This is the cheapest and most durable trap-door handle that I know of.

J. L. SULLIVAN, Foreman Motor and Truck Dept., United Rys. Co., St. Louis, Mo.

E 20.—What has been your experience in the use of car fenders?

Experience with fenders that project beyond bumper and those that do not makes possible the following comparison: The fender that is attached to the wheel guard and does not project beyond bumper of the car can be set at a minimum height above the rail, and in this position is most effective for picking up objects and is less liable to injury. With this type of fender fewer people and vehicles are struck and it does not interfere with coupling cars with short couplings. Although the projecting fender is more apt to strike persons, the person struck sometimes falls on the fender without serious injury, particularly in case of small children, whereas, persons struck by the bumper of the car are generally seriously hurt. A disadvantage of the fender on the wheelguard of double-truck cars is that it projects just about even with the bumper and offers a tempting place for a boy to stand and steal a ride, with the result that occasionally a small foot slips through and the boy is dragged. MASTER MECHANIC.

E 25.—In the use of a projecting fender, do you consider it desirable to have the fender so arranged that it can be dropped to the track, and if so, do you favor an automatic drop, or one worked by the motorman?

It does not seem practical for the motorman to drop his fender, as he needs the use of all his limbs for other purposes, particularly at the time when the fender should be dropped.

MASTER MECHANIC.

E 45.—A road is having trouble with motors becoming hot on hills. What can be done to keep motors cool under these conditions?

Use large motors, and increase size of feeder cables, so as to maintain voltage at hill to near normal.

J. CHAS. ROSS, Gen. Mgr., Steubenville (Ohio) Tract. & Lt. Co.

The motors are too light for the service required. I know of no remedy except to use heavier motors. (I had this same experience winter before last in Pennsylvania.)

J. L. SULLIVAN, Foreman Motor and Truck Dept., United Railways Co., St. Louis, Mo.

E 36.—For armature bearings, which form of lining do you prefer, babbitt or brass? Please give your experience with either.

We have some devices which we consider valuable, such as the use of brass for main motor bearings instead of babbitt. We cast the journal-box brass, allowing for shrinkage, and do away with the machine work by simply rattling the sand from the castings and pouring in a lead or tin lining for bearing purposes.

R. H. YOUNG, Master Mechanic, Lincoln (Neb.) Tract. Co.

E 42.—After the armature shaft has become worn, how do you insure good fit at the bearings?

After an armature shaft has become worn away between 1-32 and 1-16 of an inch, it should be turned down to 1-16 in. After it has worn again between 1-32 and 1-16 of an inch, it is turned down again and a sleeve shrunk on, bringing the shaft to its original size. By using two mandrels, one for the large size and one for small size, it will be readily seen that boring the bearing is not necessary. J. L. SULLIVAN, Foreman Motor and Truck Dept., United Railways Co., St. Louis, Mo.

E 46.—State experience with use of oil instead of grease for motor lubrication.

In the older types of motors we use oil instead of grease fed through a wick or a piece of cane tubing set in the oil-way. Grease gave us trouble in becoming so thin in warm weather that it would run down and collect on the commutator rings and cause them to be so saturated with grease that they would become conductors of current. R. H. YOUNG, Master Mechanic, Lincoln (Neb.) Tract. Co.

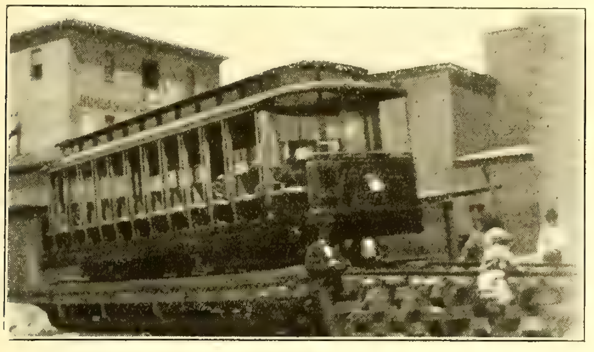
E 49.—In lubricating armature bearings, is there any advantage in using both grease and oil at the same time, feeding oil with a wick from below, and grease from cups above the bearings?

No. It is not practical, as the grease will form a coating over the wick that will not allow the oil to pass to the journal.

J. L. SULLIVAN, Foreman Motor and Truck Dept.,
United Railways Co., St. Louis, Mo.

E 157.—What is a convenient and satisfactory method of unloading cars from flat cars?

The illustrations herewith explain how a small road unloaded two heavy 15-bench open cars that came fully equipped from the



UNLOADING CARS, BLOOMINGTON & NORMAL

car builders. An incline was built up of ties connecting the steam railroad flat car with the street railway tracks. The car motors were connected by means of a flexible insulated wire to the trolley

INCLINED PLANE FOR UNLOADING CARS

line, thus utilizing the car motors to unload the cars down the incline as shown in the views. C. H. ROBINSON, Master Mechanic,
Bloomington (Ill.) & Normal Ry. Elec. & Heating Co.

F.—STEAM ENGINEERING

F 2.—When computing the overload capacity of a boiler plant, what percentage above rated capacity is it safe to rely on?

With clean boilers and tubes, fairly good water and furnaces that are equal to it—the water-tube boiler as now commercially rated can be relied upon to work at 100 per cent overload during night and morning "peak-work" on trolley loads.

D. F. CARVER, Supt.,
Rochester Ry. Co.

The overload capacity depends upon grade of coal used, condition of chimney, draft, whether forced or induced, method of firing, whether hand or stokers, etc. We have hand-fired boilers and weak draft, and hence cannot rely on more than full rating of boilers with mine run coal. E. G. HINDERT, Chief Engineer,
Cleveland & Southwestern Tract. Co.

F 3.—With reference to the relation between average and peak loads on an electric railway power station, what is the best size and what the best arrangement of boiler units?

I consider the following the ideal arrangement. Have one engine generator set that will take care of the ordinary load, and another set of same capacity to take care of heavy days and increasing load. A third unit should be installed when load increases to a point where a break-down would mean crippling of the service. For boilers I would have, if generating set is 500 hp or less, a single boiler unit large enough to take care of one generating set, and then one boiler for every additional generating set. If generating set is larger than 500 hp, get two boiler units of ample capacity to take care of one generating set, and two similar ones for each additional generating set, and one boiler set for service while cleaning and repairing any of the other boilers.

E. G. HINDERT, Chief Engineer,
Cleveland & Southwestern Tract. Co.

G.—THE ENGINE ROOM

G 1.—Discussion is invited pertaining to comparisons of the various system of power generation and distribution now available for electric railway purposes.

We have six water-power stations and one steam station all operating in parallel, giving a general supply for incandescent and arc lighting, power for various purposes, such as smelters, mines, cement works, brick works, mills, factories, etc., also for the entire railway system of Salt Lake City. The system is run at 60 cycles. The supply for the railway is transformed by means of rotary converters and synchronous motor generators. For 60-cycle work the motor generator is the most advisable, and of the induction and synchronous types of generators, the synchronous is for several reasons the best. We have perfect success with the rotaries, but it is only after a great amount of testing and experimental work, making necessary adjustments of transformer ratios, etc., to give proper running conditions for the rotaries.

O. A. HONNOLD, Opr. Engineer,
Utah Light & Ry. Co., Salt Lake City.

G 2.—What are your ideas, based on experience, regarding the use of several small generating units in place of one or two large units? Give details, cost and results secured.

In consideration of the fact that the railway business as well as lighting and power is growing faster than the engineers seem ever able to contemplate, there is certainly no reason for ever installing small generating units in place of an equivalent large unit. This is true in both steam and water-power work. More economy is obtained in space and in first cost, and efficiency is increased. Simplicity of operation, reduction of labor required, etc., are important factors favoring large units.

O. A. HONNOLD, Opr. Engineer,
Utah Light & Ry. Co., Salt Lake City.

This depends on what is meant by small units. My experience has shown me that two 250-kw units are better than one 500 kw, and two 500 kw are better than one 1000 kw.

H. A. TIEMANN.

Units should be so proportioned on a new road that two machines will carry the load and one be in reserve so that in case one engine is out of commission only one-third of the plant will be useless, instead of one-half if two larger engines had been installed in place of three smaller ones. FRANCIS G. DANIEL.

H.—THE LINE DEPARTMENT

H 12.—What is the most efficient method of tapping trolley wire to feeders?

The most efficient method of tapping trolley wire to feeders is to use the feeder tap as a span wire and attach the ear by means of a brass yoke. MECH. AND ELEC. ENGR.

With side pole construction solder feed tap on to feeders and out to the trolley, and solder it to an ear by itself, keeping it clear of bracket. On span-wire construction solder on to feeders and use a brass feed hanger.

Columbus, Buckeye Lake & Newark Tract. Co. and Columbus,
Newark & Zanesville Elec. Ry. Co.

H 21a.—What means, machines, devices or special rigged cars are you using for expediting or cheapening the work of the line department? Please send descriptions, with photographs or drawings, and statement of results secured.

Where it is necessary to string in a considerable length of wire, a very short flat-car can be used to great advantage. This car has a post on each side of the car, braced so that there is no danger of turning over, and high enough so that a reel of trolley wire will swing clear of the car floor. When the regular cars are stopped for the night, or even between cars on regular schedule, this flat-car can be drawn along by a motor-car on a team of horses, the line wagon following close behind and tying trolley wire to span wires temporarily. A. M. SMITH, Engineer,
Rapid Transit Ry. Co., Dallas, Tex.

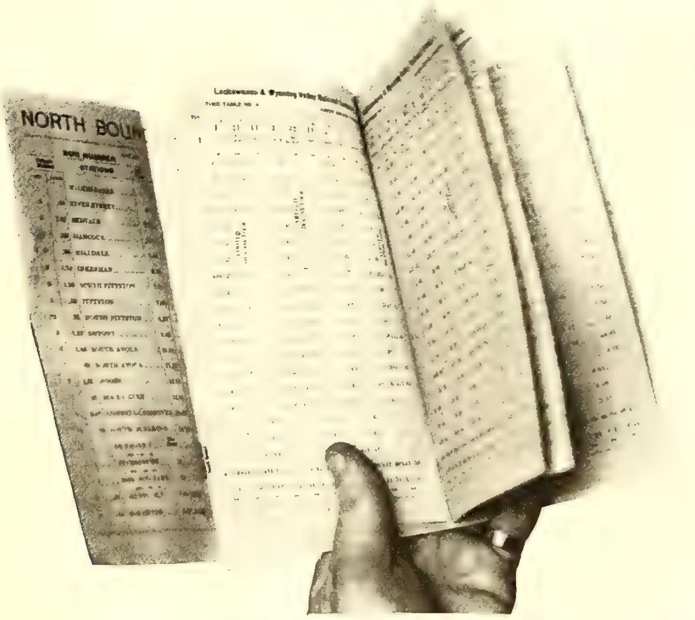
A NEW FORM OF TIME-TABLE FOR FAST INTERURBAN SERVICE

A valuable improvement in the form of time-tables for frequent interurban service has recently been introduced upon the Lackawanna & Wyoming Valley Railway Company, commonly known as the "Laurel Line," operating between Scranton and Wilkesbarre, Pa. The requirements of modern high-speed interurban service are similar to those of the steam railroads in that employees' time-tables should be easily read and understood; but the tendency is to make use of the form of timetable so long in vogue upon the steam railroads, namely, the long folder type, which sometimes reaches lengths of 20 ins. to 30 ins. A difficulty with this older form of time-table has always been its inconvenience of reading, especially out of doors and in bad weather, when it soon becomes torn and illegible. If, on the other hand, it is refolded frequently to bring forward the different times of day as needed, the portions creased in folding are very liable to become unreadable.

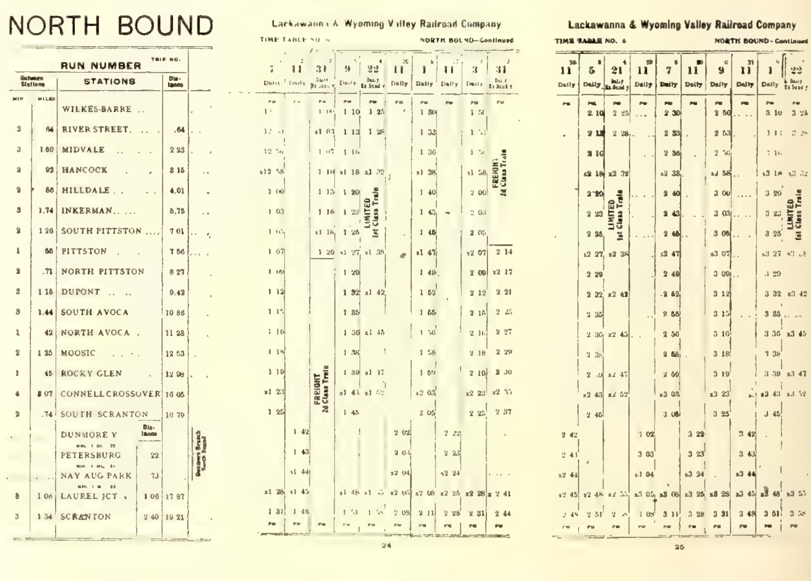
To overcome these difficulties, the Lackawanna & Wyoming Valley Railway devised the type of time-table illustrated herewith. The time-table consists of a pocket-size pamphlet, the present issue embracing forty pages beside the cover. Of these pages, thirty-two are devoted to train schedules, and the remaining eight and the cover to rules governing the deportment of trainmen and the care of apparatus. The names of all the stations upon the system are printed upon two flyleafs which project out so as to come opposite the corresponding station locations on all the following pages. The first half of the table is arranged for southbound trains, while the last half covers the northbound runs, there being over fourteen pages devoted to the runs in either direction. By means of this flyleaf arrangement of listing the stations, it is possible to bring any page of the time-table opposite the station list. The flyleafs are printed on but one side only, and the fold is made so that the page of which it is a part is narrower than the other pages in the time-table. Adherence to these two points prevents the use of either flyleaf with the wrong set of train schedules.

Another important feature of the arrangement of the table is to be noted in the scheme of run numbers and the arrangement of the train schedules in chronological order. With the large number of trains provided for the frequent service desired, difficulty was foreseen in any attempt to number the trains serially. Accordingly all trains which could be run with the same car have been given a run number, which number is also carried both on the front and the rear of the train for purpose of identification by all operators and roadway employees along the line. The large heavy type number at the top of each train schedule is a run number. For the purposes of the auditor, the round trips made by each run number are numbered consecutively. This is the small figure shown in the upper right-hand corner at the head of each train schedule. For the purpose of operating department reports, a train is identified, for example: "Run No. 3, north, leaving Wilkesbarre 10:30 a. m." The advantage of this scheme for frequent service like this will be readily appreciated; the various trains in operation retain their original run numbers throughout the day and are marked accordingly, the only difference in designation necessary throughout the day for accounting purposes being with reference to the number and direction of the trip.

The time arrangement of schedules in the table provides that all trains throughout the book shall be in consecutive order of time, so that if a train lays over at any station along the line for any length of time for switching or passing purposes, this is apparent. Another important practice in use by this company is that of changing the color of the time-table paper for all new editions of the table. This prevents confusion between old and new tables, and minimizes the possibility of trouble from this direction.



APPEARANCE OF OPENED TIME-TABLE WHEN HELD IN THE HAND



NORTH BOUND

Lackawanna & Wyoming Valley Railroad Company

Between Stations	Miles	STATIONS	Distances
		WILKES-BARRE	
3	.64	RIVER STREET	.64
3	1.60	MIDVALE	2.25
2	.93	HANCOCK	3.18
2	.86	HILLDALE	4.01
3	1.74	INKERMAN	5.75
2	1.26	SOUTH PITTSTON	7.01
1	.55	PITTSTON	7.56
2	.71	NORTH PITTSTON	8.27
3	1.15	DUPONT	9.42
3	1.44	SOUTH AVOCA	10.86
1	.42	NORTH AVOCA	11.28
2	1.25	MOOSIC	12.53
1	.45	ROCKY GLEN	12.98
4	2.07	CONNELL CROSSOVER	15.05
2	.74	SOUTH SCRANTON	15.79
		DUNMORE Y	
		PETERSBURG	
		NAY AUG PARK	
3	1.06	LAUREL JCT	17.87
3	1.34	SCRANTON	19.21

REPRODUCTION OF PAGES 24 AND 25, WITH THE NORTH-BOUND FLY-LEAF

There are other features of the new book worthy of attention. In addition to the rules which are printed in the last eight pages of the book, special instructions are given for the operation of cars with the new Westinghouse unit-switch-group system of multiple-unit control which has been applied to a large number of the cars of the system. These instructions include methods of cutting out a motor, of cutting out cars, and in general as to the handling of disabled control equipment if such difficulties are encountered. There is also a list of the whistle signals in use, the list of telephones at all stations, cross-overs and switches, the distances of all of these points from either end of the line and the running time and distance between any two adjacent stations. The front cover carries the regular third-rail warning of the company, in which the employees are forbidden from touching the third rail, etc. Two other notices are incorporated upon the front cover at the top and bottom, as well as also upon all rule pages of the book, as follows:

> The safety of passengers and trains is of first importance, and all operations of working, repair or construction must be subservient thereto.

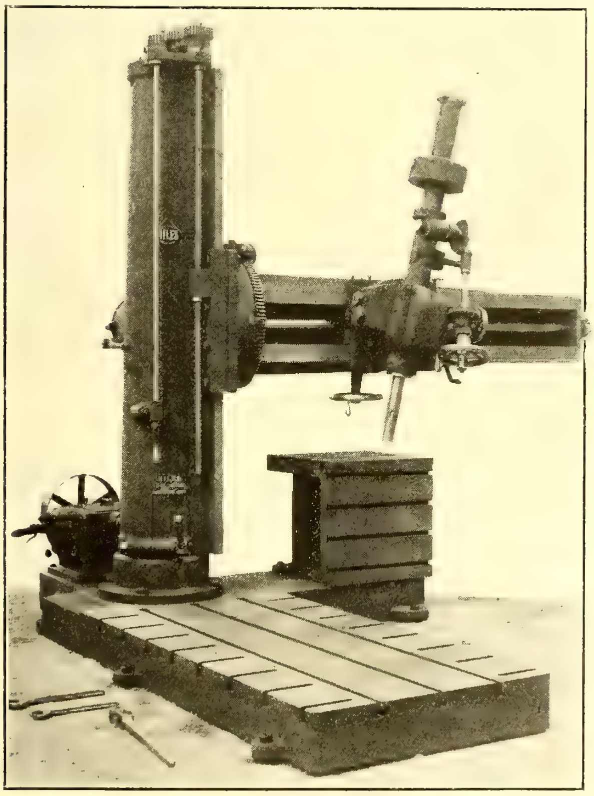
Every person in the service of this company is expected to be courteous and obliging toward the public and his associates.

The inside of the front cover is devoted to instruction regarding accidents, in which reference is made to the rules of the company in regard to them. This is supplemented by the names and addresses of the company's surgeons in Scranton, Pittston and Wilkesbarre, and also the locations of the hospitals in these cities.

The new table was developed by Chester P. Wilson, the superintendent of the company.

NEW SIX-FOOT UNIVERSAL RADIAL DRILLING MACHINE

The Niles-Bement-Pond Company has recently brought out the improved 6-ft. radial drill shown in the accompanying illustration. It is built to use high-speed drills to their fullest capacity. The drill-head saddle fits between as well as outside of the arm guides, which completes the double-box section of the arm and insures great rigidity. The column saddle is strongly gibbed to flat scraped bearings on the column, and the post about which the column revolves extends to the extreme top of the sleeve. The use of large shafts, steel gears, bronze bushings and ring oiling bronze bearings for all fast running shafts makes a strong, durable machine, capable



IMPROVED RADIAL DRILL

of standing the hardest service. The principal feature, however, of this machine is its convenience and ease of manipulation. All the feeds and speeds are changed by means of levers, and great care has been taken to arrange the levers and hand wheels so that they shall be within easy reach of the operator. The column rests on ball bearings. An idea of the simple, compact design of the machine can be gained from the illustration.

The machine is adapted for use with either carbon or high-speed drills, the range of spindle speeds being sufficient for this purpose. Friction clutches are used for starting and stopping the machine at high speeds, so as to prevent shock and consequent wear. The speed box is planed on the top, in order that the drill may be easily changed from a belt-driven machine to a motor-driven machine by the simple substitution of two gears for the pulley. Reversing gears for tapping are provided. All speeds and feeds may be changed while the machine is running at its highest speeds.

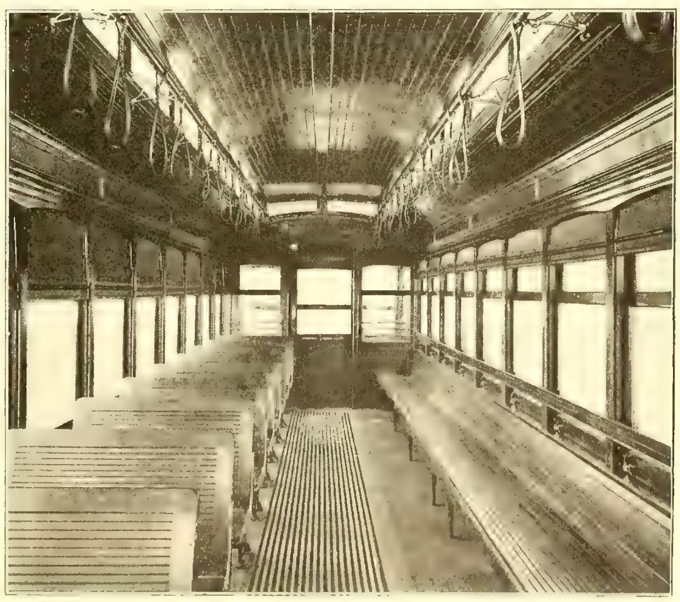
This radial drill is a full universal machine—that is, both the arm and the saddle swivel. This fact should be borne in mind in considering the design. The dimensions of the machine are as follows: Drills to center, 12 ft.; maximum distance from face of column to center of drill, 77½ ins.; least distance from face of column to center of drill, 22½ ins.; greatest distance from spindle to base plate, 72 ins.; and traverse of spindle, 20 ins.

CLOSED CARS FOR THE DES MOINES CITY RAILWAY

Fifteen cars of the type illustrated have lately been delivered to the Des Moines City Railway Company by the American Car Company. The railway company operates over 100 cars

DOUBLE-TRUCK CLOSED CAR USED IN DES MOINES

on its 65 miles of trackage in and about the city. The new cars are 28 ft. over the bodies and 8 ft. wide over the posts at belt. Longitudinal slat seats are along one side of the cars and eleven transverse seats are on the other side. This seating arrangement is evidently very satisfactory, as over fifty cars, counting this present order, have been built for the rail-



INTERIOR OF DES MOINES CAR, SHOWING THE COMBINED CROSS AND LONGITUDINAL SEATING ARRANGEMENT

way by the American Car Company. The purpose is to obtain the largest seating and standing capacity possible to the area of the floor. Having the seats longitudinally placed on one side gives an unusually wide aisle, which facilitates the movement of passengers in and out, an important consideration in city service. The entrances of the vestibules are both on the same side, as the cars are to be run in one direction only. The

upper sashes in the cars are stationary, and the lower sashes are arranged to be raised. The vestibule sashes are arranged to be dropped into pockets. The interiors are finished in cherry, with ceilings of the same make of tongued and grooved boards. The cars are equipped with automatic folding wooden gates at the entrances to the rear platforms, which are operated by the motormen. Three-bar guard rails are used, and as an extra precaution a wooden strip extends the entire length of the side of the car having the longitudinal seat. The cars are mounted on No. 27-G trucks for fast and heavy city and suburban service. The specialties include Brill angle-iron bumpers, steps, vestibule doors, and American Car Company's sand boxes, gongs and brakes.

The general dimensions are as follows: Length over the crown piece, 37 ft., and from the panel over the crown, 5 ft. at the rear and 4 ft. at the front. The width over the sills, including the sheathing, is 8 ft. The distance between the centers of the posts is 30 27-40 ins. The side sills are 4¾ ins. x 7¾ ins., and the end sills are 4 ins. x 7¾ ins. The sill plates are 8 ins. x ⅝ in. The thickness of the corner posts, 4½ ins., and of the side posts, 2¼ ins. The length of the seats is 32½ ins., and the width of the aisle, 36 ins. The height of the steps is 18 ins., and of the risers, 14 ins. The trucks have a 4-ft. 2-in. wheel base and 33-in. wheels.

THE GRAND RAPIDS RAILWAY COMPANY'S NEW CARS

Strength, beauty and convenience characterize the ten new cars built for the Grand Rapids Railway Company after its own specifications. These cars are of the semi-convertible, double-truck type. The main dimensions are as follows: Length of the car body over the end panels, 30 ft.; length over the platform nose pieces, 43 ft.; width at the sill, 8 ft. 3¼ ins.; width at the belt rail, 8 ft. 9 ins.; height inside the center, 8 ft. 9 ins.; at the plates, 6 ft. 3 ins.; from under side of sill to the top of the trolley boards, 9 ft. 11 ins. The side sills are of yellow pine and the end sills of oak, covered with 14-gage sheet steel inside of the vestibule. The center cross sills are of oak and the two sub-sills of yellow pine for the full length of the car.

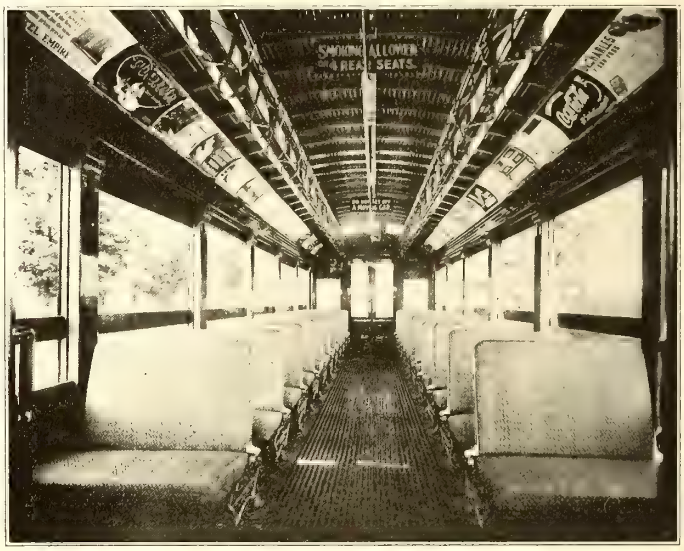
The body framing is of white ash and yellow pine. The length of the platform is 6 ft. 6 ins., with steps and openings on both sides, with doors for the full width of the openings. When open, the doors lock against the end of the car body with the company's special lock. A steel plate attached to the inside of the door closes the step opening and folds behind the door when it is open. The doors are fitted with removable sash. Floors are of oak and platform timbers are reinforced with ½-in. steel plates. The portion of the vestibule below the windows is closed with one piece of 14-gage sheet steel extending from one corner post to the other. Each vestibule is enclosed with three drop glass windows and two single hinge side doors. The interior of the vestibule is of reinforced steel. The windows are of the large observation type, 32 ins. x 48 ins.

The cars are equipped with twenty-four rattan walkover seats, arranged crosswise, and having a double pedestal base. The car bodies were built by the G. C. Kuhlman Car Company, and run on Brill 27-G trucks, which carry GE 70 motors, four on each car. Each car is equipped with the Garton-Daniels automotoneer and K-28 controllers.

The company is in the market for ten more cars of this type for fall delivery, concerning which information may be secured from W. W. Butler, engineer and superintendent.

WEST PENN RAILWAYS ADOPTS A TRADE MARK

Steam railroads for the greater part have a distinctive design which appears on schedules, advertising matter and frequently on rolling stock. Almost everyone recognizes the dome of the Capitol at Washington as the emblem of the Baltimore & Ohio, while the Pennsylvania Railroad has chosen the Keystone as its trade mark. The Maltese Cross of the Big Four, the railway track running into the setting sun of the Southern



INTERIOR OF ONE OF THE NEW CARS DESIGNED BY THE GRAND RAPIDS RAILWAY COMPANY

Pacific and the triangle of the Chicago & Alton are also well known designs. Quite a number of electric railways have adopted a trade mark, and one has just been chosen by the West Penn Railways. The names of the three counties of Fayette, Allegheny and Westmoreland are inscribed on a triangle,representing the strength and solidity of that portion of the State, while the name of the West Penn Railways appears

ONE OF THE GRAND RAPIDS RAILWAY COMPANY'S NEW CARS, SHOWN COMPLETELY EQUIPPED FOR SERVICE

on the encircling ring, representing the splendid facilities for travel throughout the enclosed counties furnished by the West Penn Railways.

The street car line in Gautemala City is to be equipped with electricity. General Manager Ricardo Echeverria is now in the United States, and may be addressed in care of the Consul of Costa Rica, at New York.

LEGAL DEPARTMENT*

DUTY TO PERSONS IN STREETS

In the legal department of the STREET RAILWAY JOURNAL for April 1, 1905, there was considered the decision of the Supreme Judicial Court of Massachusetts in Duchemain vs. Boston Elevated Railway Company (71 N. E., 780), in which it was held that the technical relation of carrier and passenger does not commence until a person has touched the step, or the hand rail, or some other part of a car with the purpose of boarding it. The abstract principle there laid down was approved, but it was suggested that the practical scope of the decision would probably not be very great, because, while theoretically a higher degree of care is owed to persons who have become passengers, a street car company is nevertheless liable for the exercise of reasonable care to all passers-by in the street. In that case the injury was to a person who, intending to become a passenger, had approached so near a car as to be injured by the fall of the trolley pole, which, striking a sign upon the car, caused it to fall upon the plaintiff. Outside of the question of the relation of passenger and the duty of extraordinary care, it seemed to the writer that a prima facie case of lack of reasonable care was made out, so that the plaintiff might have been permitted to recover if the trial court had not incorrectly charged the jury to the effect that the relationship of passenger had begun. Among other things, we said:

"The trial court had instructed the jury that the plaintiff was entitled to rely upon the technical status of a passenger, and therefore the company owed him the obligation of extraordinary care of a common carrier. Conceding that this instruction was erroneous, and that a reversal of the judgment in favor of plaintiff was therefore correct on this ground, the fact still remains that a street railway company owes reasonable care to any pedestrian in the street, and, further, that the practical situation of the plaintiff was necessarily different from that of an ordinary pedestrian. Although he was not technically a passenger, he unquestionably had the right as an intending passenger to approach so near the car that he was liable to be injured by the falling trolley pole. This consideration would bear very cogently, perhaps conclusively, upon the issue of his freedom from contributory negligence. The fall of a sign and trolley pole upon a person rightfully standing within their reach might result from neglect of reasonable and ordinary care, and be actionable even at the suit of one who was not a passenger."

A more recent decision that bears out this view is that of the Supreme Court of Illinois in Chicago City Railway Company vs. Bruley (June 1905, 74 N. E., 441). The important facts are stated as follows in the opinion:

"The accident took place about 7:30 on the evening of the 24th day of February, 1898. There were several inches of snow upon the ground, and from three to five minutes prior to the accident a sweeper, propelled by electricity, passed east upon the south track upon Thirty-First Street, and turned south upon the west track on Center Avenue. One witness, who was near by and saw the sweeper turn into Center Avenue, testified that, after the sweeper passed from Thirty-First Street to Center Avenue, it did not stop, nor did any one leave the car, but that it continued south upon Center Avenue. The appellee was going east upon Thirty-First Street. She saw a car coming from the west upon the south track upon that street, and started across Center Avenue to the southeast corner of that avenue and Thirty-First Street for the purpose of taking said car at that point. The car was moving rapidly, and when it reached a point a few feet west of Center Avenue it left the Thirty-First Street track, and ran in a diagonal direction to the southeast corner of Thirty-First Street and Center Avenue. Appellee attempted to reach the sidewalk, but was overtaken by the car and knocked down, the fore part of the car passing over her body. She remained beneath the car from twenty to thirty minutes, and sustained serious and permanent injuries."

The court held that the injured woman was entitled to recover and that the evidence sufficiently conformed with the plaintiff's pleading to the effect that the damages occurred through the railroad company's negligence in leaving a switch open at a curve. The proof as to the open switch was not direct and was not so conclusive but that the jury might have found otherwise. The case is significant as recognizing the duty of a street railway company to exercise reasonable care toward all persons rightfully in the street and as illustrating the judicial tendency to permit judgments to stand if there be a reasonable sufficiency of evidence in support of a company's negligence. In both the Massachusetts case and this Illinois case, the person injured intended to become a passenger. As above suggested, that factor would have a bearing upon the question of contributory negligence in cases where the intending passenger had approached very close to the car. But, according to the circumstances of each case, a street railroad company may be held liable for injury to any person in the street if, without contributory negligence, the latter be injured through the negligent operation of cars. Many cases have emphasized the concurrent rights of a street car company and the public in that part of a street occupied by the roadbed, and important distinctions have been drawn between street railways and steam railroads as to the right to drive vehicles on the roadbed and to cross the tracks. The duty to guard persons using other parts of the street from injury from derailed cars and similar mishaps would seem to be, if anything, still more clear than towards persons on the roadbed.

* Conducted by Wilbur Larremore, of the New York Bar, 32 Nassau Street, New York, to whom all correspondence concerning this department should be addressed.

CHARTERS, FRANCHISES, ORDINANCES, ETC.

CALIFORNIA.—Street Railroads—Franchises—Construction—Issuance of Transfers—Assignment of Rights.

1. A grant, assignment, lease, or transfer of a street railway franchise carries with it and imposes upon the grantee or assignee all the duties and obligations which rested upon the original holder of the franchise.

2. An assignee of a street railway franchise, a condition of which required the holder thereof to issue transfers to other lines in the city operated by it or its assigns, which assigned its rights in the franchise to another, and ceased operating cars under the franchise, could not be compelled to interchange transfers with its assignee from and to its remaining lines operated under other franchises.—(Reynolds vs. Pacific Electric Ry. Co. et. at., L. A. 1642, 80 Pac. Rep. 77.)

CONNECTICUT.—Appeal—Mandate—Disposition of Cause in Trial Court—Pleading — Amendment — Municipal — Corporations—Public Improvements—Assessments.

1. Where a new trial was not awarded on appeal, but, under Sup. Ct. Rules, p. 109, Sec. 63, the case was returned with a mandate defining the duty of the trial court, the mandate was controlling, and the trial court had no authority to permit the plaintiff to present new grounds for relief.

2. On the application of a street railway company to be relieved from an assessment for paving, it was held that the railroad company was not liable for that proportion of the cost of the paving contract which was for prospective repairs; and the court found that the cost of construction was $2.95 per square yard, and the cost of the agreement to repair 37 cents per square yard. Held that the finding that the cost to the city of the agreement to repair was 37 cents per square yard was not inconsistent with the fact that the work was done under a contract which called for construction and maintenance for a gross sum.

3. When an appellant, whether required to do so or not, sets out his reasons of appeal, he will be limited in his evidence to the matters so set out.

4. When one party to a cause, by his silence when it was his duty to speak, has naturally induced conduct on the part of his adversary, he is estopped to take advantage of any act or omission so induced to the latter's disadvantage.

5. Evidence offered and admitted for a limited purpose, and facts found upon such evidence, may not be used for another and totally different purpose in the cause.

6. Where, on appeal in an application by a property owner to be relieved from an assessment for a public improvement, the question of the constitutionality of the assessment, under the statutory provisions governing it, had been presented for decision on the plaintiff's bill of exceptions, and fully argued, the question was no longer an open one in the case, and plaintiff could not, on a second appeal, gather aditional facts, and frame new reasons to secure a revision on the ground of the unconstitutionality of the proceedings.—(Fair Haven & W. R. Co. vs. City of New Haven, 60 Atl. Rep., 651.)

ILLINOIS.—Eminent Domain—Street Widening Proceedings—Partial Destruction of Buildings—Damages—Benefits—Assessment — Theory—Evidence—Instructions—Verdict—Objections—Appeal.

1. Where the front 35 ft. of defendant's building and lot were taken to widen a street, and it appeared that in case of reconstruction it would be necessary to have the walls remaining reenforced to comply with an existing building ordinance, it was error for the court, in a proceeding to determine defendant's damages, to refuse to charge that, if the remainder of the building was susceptible to reconstruction, it would have to be reconstructed subject to the building ordinances of the city.

2. Where the front 35 ft. of defendant's lot and building were taken to widen a street, a verdict assessing damages, allowing only a portion of the value of the building, was sustainable only on the theory that the remaining portion of the building would be of value by building a new front wall and other reconstruction and rearrangement.

3. Where the front part of a building and lot was taken to widen a street, the jury, in assessing the owner's damages, should either consider the remainder of the building worthless and allow its value, or consider what could be done with the remainder of the building, and the cost of doing it.

4. Where the front of defendant's lot and building was taken to widen a street, and a witness testified that the improvement would benefit the remainder of defendant's property by bringing produce and commission business into the street as widened, defendant was entitled on cross-examination to ascertain whether witness considered that defendant would be compelled to pay for repaving the street and a new sidewalk.

5. Where the only objection relating to the appointment of the cost of street widening proceedings between the public and the property owners was that the improvement was a public one and a public benefit, such objection was insufficient to raise the question that the statute prohibiting a review on error or appeal applies only to special assessments proper, and not to a proceeding for condemnation of property.

6. Where there was no hearing or any evidence introduced on the subject of the apportionment of the cost of the widening of a street between the public and the property owners, such apportionment could not be reviewed on appeal.

7. In proceedings for condemnation of land to widen a street, evidence held insufficient to sustain a verdict arbitrarily allowing a certain sum for the land taken, assessing an equal amount for benefits to land not taken, and allowing a part only of the value of the building for the taking of the front 35 ft. thereof.—(West Chicago Masonic Association vs. City of Chicago, 74 N. W. Rep., 159.)

ILLINOIS.—Eminent Domain—Condemnation—Damages—Evidence—Sufficiency—Pleadings—Issues—Judicial Notice—Instructions.

1. On proceedings by a railroad company for the condemnation of a right of way, evidence considered, and held to warrant the damages awarded.

2. The petitioner in a condemnation proceeding is required at his peril to ascertain and name in the petition the true owner of the land sought to be condemned and taken, and the person so named is not required to prove title.

3. In condemnation proceedings the petitioner in a cross-petition praying for an award of damages to land which is not taken must allege in the cross-petition that he is the owner of the property alleged to be damaged.

4. Where, in condemnation proceedings, a landowner files a cross-petition praying for an award for damages to land not taken, if the original petitioner desires to contest the allegation of ownership the issue must be raised by an appropriate pleading.

5. In condemnation proceedings the issue of ownership of land, if any, is preliminary to the submission of the question of damages to the jury, and is to be determined before the jury is impaneled to assess the damages.

6. Where, in condemnation proceedings by a railroad to acquire a right, both litigants proceeded in charging the jury on the theory that damages to lands not taken had been established by the evidence, neither could complain of instructions which assumed that such damages were to be assessed.

7. An appellant cannot complain of error in an instruction where the same ruling was contained in an instruction given at his request.

8. On proceedings by a railroad company to condemn land for a right of way, an instruction that under the statute the railroad company was not required to fence its road until six months after it had completed the same, and that the damages, if any, attending the keeping open of the right of way during that time, were proper for the consideration of the jury as an element of damage, was proper.

9. Judicial notice cannot be taken that the rights of way of railroad companies are fenced as the track is constructed.

10. On proceedings by a railroad company to condemn land for a right of way, an instruction that the jury must be confined to the market value of the land was not erroneous for not confining the jury to the "fair cash market value," they having been informed that the only measure of damages was the fair cash market value in another instruction, and the court in the examination of witnesses having restricted the proof to the fair cash market value of the land.

11. Where, on proceedings by a railroad company to condemn lands for a right of way, the jury visited and viewed the premises of D., one of the property owners, on whose land there was no building, an instruction that the element of danger by fire and increased cost of insurance on buildings should be considered on the question of damages was applicable to the proof of damages to the other property owners, and was not prejudicial as to D., because of the fact that there was no building on her premises.

12. On proceedings by a railroad company to condemn land for a right of way, an instruction that in estimating the compensation for land actually taken no deductions could be made because of any benefits which would accrue to other portions of the lands not proposed to be taken was not erroneous on the theory that it should have gone further and informed the jury that benefits to lands not taken were proper to be considered in estimating the damages to land not taken, other instructions having clearly shown that benefits to land not taken were proper to be considered on the question of damages to land not taken.

13. Where the charter of a railroad company authorized it to use steam or other motive power, and on proceedings by it to condemn land for a right of way it was not willing to stipulate that it would not use steam, it could not complain that the court instructed the jury that he property owners had the right to have their damages estimated with reference to any motive power that the railroad company might use under its charter.

14. On proceedings by a railroad company to condemn land for a right of way, an instruction that in arriving at the value of the land the jury might consider its value for the purpose for which it was shown by the evidence to be most available was no ground for reversal.—(Chicago & M. Electric R. Co. vs. Diver et al., 72 N. E. Rep., 758.)

IOWA.—Taxation—Assessment—Executive Council—Street Railroads—Interurban Railroads—Certiorari—Motion to Dismiss—Statutes—Implied Repeal.

1. A motion to dismiss a petition for a writ of certiorari is in the nature of a special demurrer.

2. Under code supp., sec. 2033a, declaring that any street railway operated by other power than steam, which extends beyond the corporate limits to another city or village, shall be known as an interurban railway, a corporation operating a line connecting three different municipal corporations and organized under code, sec. 2026, authorizing street railway corporations to extend their lines beyond the limits of a city along public roads, is an interurban railway.

3. Code supp., sec. 2033a, defines an interurban railway as any railway operated upon the streets of a city or town by other power than steam, and extending beyond the corporate limits to another city or town, and section 2033b provides that such roads and companies operating them shall be governed by the same laws that govern railroads and railroad companies. Section 2033c provides that any interurban railway shall, within the limits of any city or town, upon such streets as it shall use for transporting passengers, etc., be deemed a street railway, and be subject to the laws governing street railways. Held, that this latter section operates merely to render an interurban company liable to the obligations and entitled to the rights of a street railway as to those portions of its line within city or town limits, but does not give those parts of its line the character of a street railway so as to require them to be assessed in the manner prescribed by law for street railroads, instead of the manner prescribed for railroads.

4. Code supp., sec. 2033a-c, provides that street railroads, portions of whose lines extend beyond the limits of a city or town into another city or town shall be known as interurban railways, and all the statutory provisions applicable to steam railways shall be also applicable to interurban railways. Code, sec. 1343, provided that the property of street railroad companies either within or without the limits of a municipal corporation should be assessed by local assessors, while code, sec. 1334, provides that all railways shall be assessed by the executive council. Held, that section 1334 impliedly repeals section 1343 as to the method of

assessing the property of interurban railway companies.—(Cedar Rapids & M. C. Ry. Co. vs. Cummins, Governor, et al., 101 N. W. Rep., 176.)

KENTUCKY.—Contract to Erect Depot—Damages for Breach—Evidence.

1. Where plaintiff conveyed a right of way through his land to defendant in consideration of its agreement to erect a depot on his land and stop its cars there, the measure of damages for its breach of the agreement is the difference between the market value of the residue of his land with and without the depot.

2. In an action for breach of defendant's agreement, in consideration of the right of way conveyed it, to erect a depot on plaintiff's land and stop its cars there, evidence of the prices for which other lands contiguous to his, and situated, like it, on the defendant's road, sold, and as to the advantages of plaintiff's land for business and suburban purposes, and also as to what value the location of the depot would give the land, is admissible—(Louisville, A. & P. V. Electric Railway Co. vs. Whipps et ux., 80 S. W. Rep., 507.)

KENTUCKY.—States—Statute Regulating Use of Interstate Bridge—Limit of Jurisdiction—Federal Courts—Jurisdiction Enforcing Rights Under Statute of Another State—Railroads—Kentucky Statutes—Rights of Foreign Corporation—Subjecting to Use Property of Another Company.

1. A statute of Indiana cannot give a right to use a bridge across the Ohio River beyond low-water mark, which constitutes the boundary line of the State.

2. A Federal court in Kentucky cannot enforce rights given by a statute of Indiana with respect to the use of so much of a bridge across the Ohio River as is situated within the State of Indiana.

3. Const. Ky., sec. 211, provides that no railroad corporation organized under the laws of another State, doing or proposing to do business in the State, shall exercise the right of eminent domain or acquire right of way or real estate until it shall incorporate under the laws of the State. Ky. st., 1903, sec. 841, provides that any such corporation "may, for the purpose of possessing, controlling, maintaining or operating" a railway in the State, incorporate by filing its articles of incorporation as therein specified; section 763 provides the manner of organizing railroad corporations in the State, and section 765 provides that no railroad corporation of another State shall exercise the power of eminent domain, or acquire right of way, or purchase or hold land for railroad purposes, until it shall have become organized as a corporation of the State in conformity with section 763. Held, that under said provisions, as construed by the highest court of the State, a foreign railroad corporation, which has merely complied with the provision of section 841 by filing its articles of incorporation, acquired thereby only the right therein given to "possess, control, maintain and operate" a railroad in the State, and that it had no power to exercise the right of eminent domain or to have the property of another subjected to its use by legal proceedings, unless it became a full Kentucky corporation, by organizing as such under section 763.

4. While a public service corporation, like a railroad company, is bound to render to the public certain services appropriate to its particular functions, it is not bound to permit its property to be subjected to use by a rival corporation, unless by express statutory enactment and by due process of law thereunder.—(Evansville & H. Traction Co. vs. Henderson Bridge Co., 134 Fed. Rep., 973.)

LOUISIANA.—Municipal Corporations—Paving Streets—Liability of Abutting Owner—Estoppel—Nonsuit.

1. Act No. 10, p. 9, of 1896, empowering cities and towns (the city of New Orleans excepted) having a population exceeding 10,000 to pave streets and to levy special taxes and contributions on abutting property owners of real estate and railroads occupying a portion of the street, was, as to the city of Baton Rouge, repealed by Sec. 35 et seq. of Act No. 169, p. 340, of 1898, incorporating said city, which provides that the cost of paving any street shall be borne by the city of Baton Rouge and the abutting owners of real estate in certain proportions.

2. The mere silence and inaction of a street railway company while streets traversed by its tracks are being paved do not estop it to plead the absolute want of power and jurisdiction in the city council to levy a special tax against the company for street improvement. See Elliott, Roads and Streets, Sec. 689. This doctrine is especially applicable to a case where the contract was let on the basis of payment by the city and abutters, and the evidence shows no benefits accruing to the railway from the work.

3. Where a contractor for street improvements sues a street railway and a city on certificates of a city engineer that such railway owed certain amounts for paving, and no ordinance is shown authorizing the transfer of such certificates to the contractor, his alternative demand against the city will be dismissed as in case of nonsuit. (Syllabus by the court.)—(Louisiana Imp. Co. vs. Baton Rouge Electric & Gas Co. et al., 38 S. Rep., 444.)

MICHIGAN. — Street Railroads — Establishment—Regulation—Change in Road—Manner of Granting Authority.

Though, under the express provisions of Comp. Laws 1897, Sec. 6446, a municipality can grant the right to a street railway company to operate a line on the streets only by an ordinance regularly passed and accepted by the company, a city which has by ordinance granted to a company the right to operate a car line, subject to a provision that the location of poles, side tracks, spurs and switches shall be under the control of the council, may, by a mere motion adopted by the council, authorize the company to change the location of a curve in the track connecting a street with a cross street.—(Mannel vs. Detroit, Mt. C. & M. C. Ry., 102 N. W. Rep., 633.)

MICHIGAN.—Street Railroads—Repaving—Use of Old Material.

Where a street railway company is required by the city to relay the pavement of a street, and, when it was engaged in tearing up the pavement for the purpose of relaying it, the city removed such material, requiring the railway company to replace it by new material, the city was liable to the railway company therefor.—(City of Detroit vs. Detroit Ry., 99 N. W. Rep., 411.)

MISSOURI.—Municipal Corporations—Street Railroads—Franchise—Conditions Imposed in Franchise—Acceptance—Estoppel—Condemnation of Way for Street.

1. An appeal lies to the Supreme Court in proceedings for the condemnation of real estate, since title to real estate is thereby affected.

2. Where a city granted a franchise to a street railway company "on the terms and conditions" in the ordinance specified, among which conditions was a requirement that the railroad plank all crossings of streets then existing or that should afterwards be laid, and, if required by the city, maintain signboards, etc., the railroad must do such acts at its own expense.

3. Where a street railway company, in accepting a franchise, agrees to certain conditions imposed by the municipality, it is estopped from thereafter saying that the conditions are not reasonable.

4. An ordinance granting a franchise to a street railway company required the company to keep the space between the tracks and 18 ins. outside of the outside rails planked with oak planks; to keep the street for a distance of not less than 6 ft. from the outside rails in good condition; if required by the city, to erect and maintain at crossings signboards, and to perform all duties devolved on the company by statute; and provided that, if the city should at any time cause a part of any street crossing the railroad at grade to be paved, the railway company should grade, pave, and keep paved the part of the street or avenue so crossed. Held, that such requirements were not unreasonable.

5. Where a crossing was condemned across the tracks of a street railway company for the opening of a street in Kansas City, there was no error in excluding evidence as to the cost of grading, proceedings for condemnation and for grading being entirely distinct under the city charter.—(In re Topping Avenue, 86 S. W. Rep., 190.)

NEW JERSEY.—Law of the Road—Right of Way at Crossings—Legislative Enactment—Custom—Pleading—Evidence.

1. The law of the road with relation to vehicles approaching a street crossing, that the first to reach the crossing traveling at a reasonable rate of speed has the right to pass over first, applies to vehicles of all kinds, including fire engines and trucks driving to fires, and trolley cars.

2. Fire engines and trucks while driving to fires may by legislative enactment be granted the right of way at street crossings, and compel all other vehicles to yield to such right.

3. Evidence that fire engines and trucks, while driving to fires, have by local custom the right of way at street crossings, cannot be given in an action against a street railway for injuries sustained to the driver of a fire truck in a collision with a street car at a crossing, where it was not pleaded that the trucks had the right of way by reason of local custom, though the trolley car reached the crossing first.—(Knox vs. North Jersey St. Ry. Co., 57 Atl. Rep., 423.)

NEW JERSEY.—Pleading—Charter Provisions—Demurrer—Street Railroads—Conditions.

1. The charter of the Jersey City & Bergen Railroad Company, approved March 15, 1859, and its supplements, being private acts, their provisions cannot, on demurrer, be noticed, except as they appear on the face of the pleadings.

2. The provision in that charter by which the company was

empowered to construct and operate a street railroad in Jersey City, provided that in constructing the railroad the company first obtained the consent of the city council; the ordinance of the council giving such consent on condition that the company should pay an annual fee for each car run on the railroad; the acceptance of the ordinance by the company, and the construction of the railroad in pursuance of the consent; and the supplement to the company's charter approved March 17, 1860, declaring that, in constructing and maintaining its railroad in Jersey City, the company should be subject to the conditions imposed in the ordinance—placed upon the company a legal obligation to pay the stated fee.

3. If a claim long dormant be not discharged by statutory limitation, the lapse of time is not legally a release, but is only evidence of a release, and therefore will not, on demurrer, defeat the claim. (Syllabus by the Court.)—(Mayor, etc., of Jersey City vs. Jersey City & B. R. Co., 57 Atl. Rep., 445.)

NEW YORK.—Street Railroads—Operation—Statutes—Application to Existing Railroad—Repair of Streets—Liability of Street Railroad—Contract with City—Construction—Paving Between Tracks—Liability of Company—Constitutional Law—Obligation of Contract.

1. Laws 1884, p. 313, c. 252, provides in Sec. 9 that every street railroad corporation extending or operating a railroad under the provisions of the statute shall, whenever required by the local authorities, keep in repair the portion of every street between the rails, within an incorporated city, and another section, relative to fares, provides that such section shall not apply to any part of any road previously constructed, unless the corporation shall acquire the right to extend the road under the statute, in which event its rate of fare shall not exceed its authorized rates prior to the extension. Held, that Sec. 9 applies to the tracks of companies incorporated under its provisions, and to the tracks of an extension of the lines or branches of the railroad of an existing street railroad company, but does not apply to the road of an existing street railroad company.

2. Laws 1869, p. 54, c. 34, required the Rochester Street Railroad Company to keep in repair the streets inside the rails of its tracks, but provided that, whenever any of such streets should be permanently improved, the company should not be required to bear any part of the expense. Railroad Law, art. 4, Sec. 98 (Laws 1890, p. 1112, c. 565, as amended Laws 1892, p. 1404, c. 676, Sec. 98), provides that every street railroad shall keep in repair the street between its tracks, under the supervision of the local authorities, and that on neglect to pave or repair, after notice, the authorities may do so at the expense of the corporation. After the enactment of Sec. 98, under an ordinance of the Rochester city council, the city ratified the location of all lines of the railroad company, and it was provided that the provisions of article 4 of the railroad law should be complied with, but that all agreements between the city and the railroad company should remain in full force, and the railroad company was required to give free passage to firemen and policemen, which it had not previously been required to do. Held, that the street railroad company did not by such contract assent to a right of the city to exact payment from the railroad for paving between its rails, since the provision as to the railroad law was modified by the provision that all agreements should continue in force, and the provisions for furnishing transportation had no consideration, except the approval of the location of the railroad and its tracks as the same were then used and operated.

3. Laws 1869, p. 54, c. 34, relating to the Rochester Street Railroad Company, provided that the company should maintain the surface of the streets inside of its rails in good repair, but that, whenever any of the streets should be permanently improved, the company should not be required to bear any part of the expense. Thereafter such agreement was embodied in a contract between the street railroad company and the city, and ratified by a resolution of the common council on a new consideration moving from the railroad. Held, that special acts of the legislature authorizing the municipal authority to assess on the property of the railroad the expense of paving between the tracks, and Railroad Law, Sec. 98 (Laws 1890, p. 1112, c. 565, as amended Laws 1892, p. 1404, c. 676, Sec. 98), requiring street railroads to make such pavements or defray the expense thereof, were, as concerned the railroad in question, inoperative and void.—(City of Rochester vs. Rochester Ry. Co., 91 N. Y. Sup., 87.)

LIABILITY FOR NEGLIGENCE.

ARKANSAS.—Carriers—Street Railroads—Injuries to Passengers—Time to Alight—Premature Start—Care Required—Actions—Instructions.

1. It is not sufficient that a street car should stop for a reasonable time for passengers to alight, but it is the duty of the carrier's servants to see that no passenger is in the act of alighting or in a dangerous position before putting the car again in motion.

2. A carrier of passengers is not bound absolutely to carry passengers safely, nor to provide measures to protect them against accidents and injuries caused by their own acts or omissions which the exercise of reasonable care would not anticipate, but it is bound to exercise a very high degree of care and skill to secure safety to passengers and prevent accidents.

3. In an action for injuries to a passenger on a street car, an instruction that if defendant's conductor knew of plaintiff's negligent conduct in alighting from a street car, and by the exercise of proper care could have avoided the consequences of such negligence, and failed so to do, and the conductor's failure was the immediate cause of the injury, defendant could not rely on plaintiff's contributory negligence as a defense, was erroneous, for failure to define plaintiff's "negligent conduct."

4. In an action for injuries to a passenger, the court charged that though plaintiff was negligent and the conductor knew of his negligent conduct, such negligence was not a defense, if the conductor's failure to avoid the consequences thereof was the immediate cause of the injury, and that if such injury was caused by plaintiff imprudently attempting to alight from a moving car, or from his effort to alight in an unskilled or unsafe manner, the jury would find for defendant, unless they found that the conductor knew of plaintiff's negligence in so attempting to alight in time to have prevented the injury, and could by the use of ordinary care have prevented the injury and failed to do so. Held error, as excluding the point whether, in the exercise of reasonable foresight, the conductor should have anticipated that plaintiff would be injured by alighting when the car was in motion.—(Little Rock Traction & Electric Co. vs. Kimbro, 87 S. W. Rep., 122.)

CALIFORNIA.—Street Railroads—Injuries at Crossing—Contributory Negligence—Presumptions—Duty to Stop, Look and Listen.

1. In an action for death caused by a collision with a street car at a crossing there was evidence that the horse deceased was driving approached the crossing at a gallop, whereupon the motorman immediately applied the brakes and did everything in his power to stop the car, and so far succeeded that deceased almost got across the track before the cart was struck. Immediately after the collision the horse appeared to be "sweaty," but stood quietly with two of his feet on the curbing of the sidewalk. The cart, when struck, was in a position indicating that deceased saw the car and took a diagonal course to cross ahead of it. Held, that such facts justified a finding that deceased was guilty of contributory negligence, so that it was error to charge that, in the absence of all evidence tending to show whether deceased stopped, looked and listened before attempting to cross, it would be presumed that he did.

2. A person about to cross a street railroad track in an incorporated city is not bound, as a matter of law, to stop, look and listen.—(Los Angeles Traction Co. vs. Conneally et al., 136 Fed. Rep., 104.)

GEORGIA.—Carriers—Regulations—Injury to Passenger—Instructions.

1. A railway company has the right to make reasonable rules and regulations prohibiting passengers from occupying positions on its cars considered to be dangerous, except at their own risk; but when, notwithstanding such rules, passengers are permitted, and in some instances required, to occupy such positions, the company is still under the duty to exercise extraordinary care and diligence for their safety.

2. On the trial of a suit for damages alleged to have been occasioned by the negligence of the defendant, it is always error, requiring the grant of a new trial, for the court to charge the jury that given acts constitute negligence, when such acts are not declared by statute to be negligent.—(Augusta Ry. & Electric Co. vs. Smith, 48 S. E. Rep., 681.)

GEORGIA.—Evidence—Compromise—Street Railroads—Injury to Animals—Damages.

1. Evidence of compromise is excluded, because inherently harmful and calculated to leave the impression on the minds of the jury that the settlement was an admission of responsibility, even though coupled with a denial of liability.

2. The rule which excludes the propositions of compromise between the parties also excludes evidence of compromise between the defendant and third persons damaged in the same casualty.

3. The error in admitting incompetent evidence as to a settlement was not cured by the fact that the defendant itself offered the writing in evidence to show that it contained a denial of liability.

4. The charge as to the right to recover for the hire of the

animals injured, while abstractly correct, was harmful to the defendant, in that the jury were not instructed that they could not in any event allow more for injury and loss of hire than the sound value of the horses at the time of the injury.—(Georgia Ry. & Electric Co. vs. Wallace & Co., 50 S. W. Rep., 478.)

GEORGIA.—Trial—Instructions—Street Railroads—Injury to Traveler—Diligence—Mistrial—Evidence.

1. When the court properly instructed the jury as to the respective rights of the parties on a question in the case, the refusal to give in charge a request containing a general proposition of law, though pertinent to the question, was not cause for a new trial.

2. What particular means or measures of diligence would be appropriate for use under the circumstances should be left to the jury. Accordingly, it was not incumbent on the court to give, as requested, a charge that one who drives on and along a street railway track laid in a public highway "should be careful to look and listen with ordinary care to avoid a collision."

3. An exception to a correct charge because of failure to give, in the same connection, some other pertinent legal proposition, is not a good assignment of error.

4. It was erroneous to instruct the jury that, in passing upon the credibility of the witnesses, "their bias or impartiality, as the same may legitimately appear from the evidence," might be considered.

5. A motion for a mistrial was not the appropriate remedy when, upon a poll of the jury, the party against whom the verdict was rendered contended that it appeared from the answers of one of the jurors that it was not his verdict.

6. There was evidence to authorize the verdict, and the court did not err in refusing a new trial.—(Macon Ry. & Light Co. vs. Barnes, 49 S. E. Rep., 282.)

GEORGIA.—Credibility of Witnesses—Instructions.

1. The rule of evidence, "Falsus in uno, falsus in omnibus," is applicable only to cases where a witness swears to a falsehood willfully and knowingly; but in a case where the only testimony to which it could apply must, in the nature of things, be either true or knowingly false, it is not error requiring the grant of a new trial for the court to charge the jury that "the principle of law to be applied to the testimony of witnesses is that, if you find them false in one thing, the presumption is they are false in everything testified."—(Glenn vs. Augusta Ry. & Electric Co., 48 S. E. Rep., 682.)

ILLINOIS.—Street Railways—Negligence—Contributory Negligence—Question for Jury—Instructions.

1. In an action against a street railway company for death resulting from a collision it appeared that deceased was driving behind a large covered wagon, and that when he reached a street intersection he pulled out from behind the wagon, and drove upon defendant's track and his vehicle was struck by a car coming from the opposite direction. At the time he drove upon the track the car was between 100 ft. and 200 ft. distant, and there was no evidence tending to show that the bell was rung or that he was conscious of any warning. Held, that the question whether deceased was guilty of contributory negligence was one for the jury.

2. In an action for negligent injuries it is not error for the court to define the meaning of the phrase "ordinary care" as applied to the conduct of either party.—(Chicago City Ry. Co. vs. O'Donnell, 70 N. E. Rep., 294.)

ILLINOIS.—Negligence—Injuries—Future Damages—Instructions.

1. A plaintiff in an action for personal injuries cannot recover for future suffering unless it is reasonably certain to result from his injuries.

2. In an action for personal injuries, an instruction that in determining plaintiff's damages the jury should consider such future suffering and loss of health as they may believe she would sustain was not erroneous, on the theory that it did not limit the jury to such future damages as were shown by the evidence, but permitted them to speculate.

3. Where, in an action for personal injuries, the evidence was conclusive that at the time of trial plaintiff had not recovered from her injuries, it was proper to instruct on future suffering.—(Chicago & M. Electric Ry. Co. vs. Ullrich, 72 N. E. Rep., 815.)

ILLINOIS.—Damages—Personal Injuries—Duty to Employ Physician—Inherent Tendency to Disease—Evidence—Expert Testimony.

1. Any person injured by the negligence of another is bound to use reasonable care to effect a speedy cure, and must exercise reasonable care to employ physicians of ordinary skill, but such person is not an insurer of the skill of the physicians employed, or required to employ the highest medical skill available, and the fact that the physicians employed make a mistake in the treatment, and thereby fail to effect a cure, does not preclude the person injured from recovering for the entire injury sustained, so long as the requisite care has been used in the employment of a physician.

2. The question whether or not injuries were the result of defendant's negligence, or of an inherent disease or tendency to disease, in plaintiff, is a question of fact.

3. The fact that injuries caused through the negligence of another were aggravated by an organic tendency to disease existing in the person injured, which was developed by the injury, or the treatment applied to the injury by the physicians, does not preclude a recovery for the injuries.

4. In an action for injuries, where plaintiff had fully testified as to the circumstances of the accident, the refusal of the court to strike out an answer in which she stated that she was upset in every particular, and thought every function of her body was out of order from the shock, was not reversible error.

5. In an action for injuries, the evidence showed that plaintiff was thrown to the ground and struck upon her left side; that prior to the injuries she was in good health, and that she sustained an injury to the hip, which subsequently involved the knee. A physician testified that the night of the injury he discovered visible evidence of trouble with the knee, and further stated that the knee was very painful from the time of the injury. Held, that there was sufficient evidence that the knee was injured at the time of the accident to permit evidence that tuberculosis, which developed in the knee, might be occasioned by violence.—(Chicago City Ry. Co. vs. Saxby, 72 N. E. Rep., 755.)

ILLINOIS.—Personal Injury—Damages—Evidence—Admissibility—X-Ray Photographs as Evidence—Trial—Taking Papers to Jury Room.

1. In an action for a personal injury, evidence showing the salary of plaintiff for a period ending years before the injury, for services in an employment different in nature from that in which he was engaged when injured, and for five years before, is inadmissible on the issue of damages.

2. The testimony of an X-ray expert, regularly engaged in taking X-ray photographs, that he took the negative from which an X-ray photograph of the portions of the body of a person was developed, that he developed the photograph, and that it was a correct representation, rendered the photograph admissible in evidence.

3. The fact that a witness for the adverse party testified that the photograph had not been properly taken, and that it was of little or no value as a representation of the person's body, did not require the court to exclude it.

4. 3 Starr & C. Ann. St., 1896, page 3054, chapt. 110, par. 56, authorizing the jury to take to the jury room "papers read in evidence," other than depositions, empowers a jury to take to the jury room an X-ray photograph received in evidence.—(Chicago & J. Electric R. Co. vs. Spence, 72 N. E. Rep., 796.)

ILLINOIS.—Street Railroads—Negligence—Injuries—Action—Instructions.

1. Where, in an action against a street railroad company for injuries to plaintiff in a collision between the vehicle he was driving and defendants' car, defendants' evidence tended to show that plaintiff turned onto the track almost in front of the car, an instruction that if plaintiff, while in the exercise of ordinary care, was injured through the negligence of defendants, defendants should be found guilty, was not erroneous on the theory that it limited the duty of plaintiff in the exercise of due care to the time of the accident.

2. If such instruction was erroneous, it was cured by other instructions, one of which stated that the question whether plaintiff exercised ordinary care before and at the time of the occurrence was a question of fact, and another having called the jury's attention to plaintiff's conduct before the accident, and stated that, if he turned the horse in front of the car without looking, he could not recover.

3. In an action for injuries to plaintiff in a collision between the vehicle he was driving and a street car, the court refused an instruction that, if the jury should find that plaintiff was not entitled to recover, then they would not have occasion to consider the character or extent of his injuries at all. Held, that such ruling was not erroneous, another instruction given for defendants having told the jury that if they believed from the evidence that there was no negligence in the operation of the car, though plaintiff was injured, they should find for defendants.—(Chicago North Shore St. Ry. Co. et al. vs. Strathmann, 72 N. E. Rep., 800.)

ILLINOIS.—Injuries to Passengers—Evidence—Instructions—Review.

1. In an action against a street car company for an injury to a passenger resulting from the car on which he was riding coming in contact with a vehicle which it was passing, evidence as to the right of way of street cars over vehicles was properly excluded.

2. Refusing an instruction the substance of which had already been given is proper.

3. The Supreme Court will not review the conflicting evidence where there is evidence to support the judgment.—(Chicago City Ry. Co. vs. Lannon, 72 N. W. Rep., 585.)

ILLINOIS.—Master—Injury to Servant—Act of Third Person—Negligence—Assumption of Risk—Contributory Negligence—Questions for Jury—Appeal—Trespass—Several Defendants—Unity of Interest—Judgment.

1. An electric lighting company cannot be charged with negligence in maintaining a pole for its wires so near the right of way of a railroad company while in the performance of their duties for the railroad company, where the pole was shown to have been in place for two years prior to the injury of an employee of the railroad company, for which both the railroad and the electric company were sued .

2. A judgment in an action in trespass, as well as in all other action at law, is a unit, and hence, in an action against several defendants for personal injuries, reversible error as to one defendant requires a reversal of the judgment as to all of the defendants.

3. Where the close proximity of the pole of an electric lighting company to the right of way of a railroad constitutes a source of danger to the employees of the railroad company, it is not essential to the liability of the railroad company for injuries to an employee caused by the pole that it be proved that the railroad company in any way participated in erecting the pole, when it is shown to have knowledge of the location of the pole for two years.

4. Where a railroad company has knowledge of the existence of the pole of an electric lighting company in such close proximity to its tracks as to endanger the employees of the railroad while in the performance of their duties, or where notice may be presumed from the length of time the object has been so placed, it is negligence on the part of the railroad company to continue to operate its trains in such dangerous proximity thereto.

5. In an action by a railroad employee against his employer for injuries caused by an electric lighting company's pole in too close proximity to the railroad tracks, evidence examined, and whether plaintiff assumed the risk of injury and whether he was in the exercise of ordinary care, held questions for the jury.—(South Side Elevated R. Co. vs. Nesvig; Cosmopolitan Electric Co. vs. Same, 73 N. E. Rep., 749.)

ILLINOIS.—Street Railroads—Vehicles—Collisions—Injuries to Occupants—Negligence of Driver—Actions—Request to Charge—Refusal—Prejudice.

1. Where plaintiff was injured in a collision between a street car and a closed carriage in which she was riding, the railway company was not relieved from liability for its negligence merely because the driver of the carriage, over whose actions plaintiff had no control, was also negligent in turning across the track.

2. Where, in an action for injuries to plaintiff while riding in a closed carriage, in a collision with a street car, the court charged that, if there was no negligence on the part of the defendant in operating the car, it was not liable, and, if the sudden turning of the horses and carriage across the track in front of the car was not reasonably to be expected, then it was defendant's duty to stop the car only as soon as its servants had notice that the horses were being so turned, etc., defendant was not prejudiced by the refusal to charge that, if the sole cause of the injury was the negligent manner in which the horses were driven, defendant was not liable.—(Chicago Union Traction Co. vs. Leach, 74 N. W. Rep., 119.)

ILLINOIS.—Carriers—Injuries to Passengers—Boarding Train—Failure to Stop—Sudden Jerk—Negligence—Actions—Evidence—Failure of Proof—Right to Object—Peremptory Instruction.

1. In an action for injuries, the refusal of the court to instruct to find defendant not guilty raises the question whether there is any evidence in the record fairly tending to support the cause of action, and, if there is such evidence, it is not error to refuse such request.

2. In an action for the death of a boy 10 years and 8 months old while attempting to board a street car, evidence held sufficient to establish negligence on the part of the carrier.

3. That intestate attempted to board a train of slowly-moving street cars was not negligence per se.

4. While, in an action for death of a boy while attempting to board a street car, defendant introduced a witness who testified that deceased and his companion were attempting to steal a ride, and that the conductor was chasing the boys therefrom, evidence that intestate's companion had 20 cents in money at the time was admissible as tending to show that the boys had sufficient money to pay therefor.

5. Where, in an action for death of a boy while attempting to board a street car with a companion, defendant claimed they were stealing a ride, but, after evidence had been introduced showing that the mother of deceased's companion, before the start, had given him 20 cents in money, the court, on defendant's objection, excluded evidence as to what she said when the money was given, defendant could not thereafter object that there was no evidence that the money was given the boy to pay car fare for both.—(Chicago Union Traction Co. vs. Lundahl,, 74 N. W. Rep., 155.)

ILLINOIS.—Carriers—Injury to Passenger—Speed of Street Car—Negligence—Question for Jury—Remarks of Counsel—Appeal.

1. Where there is any evidence which, with the inferences that the jury may justifiably draw therefrom, is sufficient to support a verdict for plaintiff, a peremptory instruction to find for the defendant at the close of all the evidence is properly refused.

2. In an action against a street railroad for injuries to a passenger, evidence examined, and whether defendant was negligently propelling its car at the time of collision with a loaded vehicle, held a question for the jury.

3. In an action for personal injuries, it appeared that, on the night of the accident, defendant caused a physician to go to the home of the plaintiff; that he found her in bed, in her nightdress, talked with her, and made a careful external examination of her person. For that purpose it was necessary to remove the covering and draw up the garment in which plaintiff was attired. Counsel for plaintiff, in his argument to the jury, charged the physician with having, in an objectionable manner, turned down the bedclothes and pulled up the plaintiff's garment, and, in very vigorous language, the attorney characterized the physician's conduct as improper and unlawful. Counsel for defendant objected, and the court sustained the objection. An answer made by the physician furnished some ground for the attack made on him. Held, that the remarks of counsel for plaintiff were not cause for reversal.—(Chicago City Ry. Co. vs. Bennett, 73 N. W. Rep., 343.)

INDIANA.—Carriers—Injury to Passenger—Street Cars—Standing on Running Board—Negligence—Contributory Negligence—Verdict—Special Findings—Inconsistency—Instructions.

1. Under the express provisions of Burns' Ann. St., 1901, sec. 556, special findings control the verdict only when inconsistent therewith.

2. A passenger on a crowded street car, who stands on the running board and supports himself by the guard-bar, does not, as a matter of law, fail to exercise such ordinary care as the circumstances require, especially when the representative of the carrier, charged with the duty of seating and directing the passengers, expressly authorizes him to stand there.

3. Where a passenger standing on the running board of a street car was injured by being struck by another car passing on another track, held that the question whether defendant was negligent in running its cars so close together was one for the jury.

4. It is not the province of the Supreme Court on appeal to review the facts and weigh the evidence.

5. Where a passenger on a street car, while standing on the running board, was injured by being struck by another car passing on another track, in an action by him for the injuries, evidence considered, and held to sustain a verdict for plaintiff.

6. Where a passenger on a street car, while riding on the running-board, was injured by being struck by another car passing on another track, in an action by him for the injuries, an instruction that plaintiff's injuries were due to his violation of the rules of the defendant, and if a guard-rail was placed on the car, so that passengers were warned not to stand on the running-board, and plaintiff ignored the presence of the guard-rail, he could not recover, even though the conductor permitted him to stand on the running-board, was properly refused, in that it omitted to inform the jury that notice of the existence of the rules must be shown before plaintiff could be bound by them.

7. In an action against a street railway company for injuries to a passenger, the question whether the conductor of the car had authority to permit a passenger to stand on the running-board was for the jury.—(Fort Wayne Traction Co. vs. Hardendorf, 72 N. E. Rep., 593.)

INDIANA.—Servant's Injuries—Assumption of Risk—Promise to Repair Defect—Proximate Cause—Pleading—Complaint—Sufficiency—Evidence—Instructions.

1. Where, in an action for the death of a servant, the complain-

ant discloses the relation of master and servant, the existence of a defective appliance, rendering the servant's work unnecessarily hazardous, a promise to repair the defect, and an injury caused by such defect, a prima facie case is shown.

2. In an action for the death of a motorman on defendant's street car, an allegation that the air brakes of the car, which were necessary to its safe operation, were defective and out of repair, was sufficient to show a breach of duty on the part of the master, as against a demurrer.

3. A motorman of a street car reported the air brakes as defective, and the repair thereof was promised. Repairs were made, and the motorman took the car out, but found that the trouble had not been remedied, whereupon he ran the car back to the barn, and reported that it was no better, but the superintendent stated that the car would have to be used, and that the trouble would be remedied the next afternoon. The next morning the motorman took the car out and was killed in an accident due to the defective brakes. Held, that a finding that the motorman continued to use the defective car in reliance on a promise to repair was warranted.

4. Where all the cars of a street railroad company were equipped with air brakes, and there were heavy grades on the road, in an action for the death of a motorman owing to a defective brake on a car which weighed 12 tons, and which was carrying a load of 10 tons, a finding that the air brake was a necessary appliance was warranted.

5. Where an electric car ran down a grade, and on taking a curve a flange of the wheel broke, whereby the car was derailed and the motorman killed, in an action for the death, if the jury believed that the rate at which the car was running was due to the defective air brake, they might find the defective brake to have been the proximate cause of the injury.

6. An instruction that it was the master's duty to exercise reasonable care and diligence to provide and maintain a "safe place" and safe appliances for deceased to use in performing his duties was not misleading, though the breach of duty alleged related only to appliances.

7. Where, in an action for the death of a servant, the court, in the first instruction given, charged that before plaintiff could recover she must prove by a preponderance of all the evidence all the allegations of her complaint, criticisms of instructions for failing to include the statement that the finding in plaintiff's favor upon various points therein enumerated required a preponderance of the evidence were without merit.

8. It is not error for the court to assume in instructions the existence of uncontroverted facts.

9. In an action for the death of a motorman owing to a defective air brake on the car, it was proper to admit evidence that the brake had been out of repair before deceased worked on the car, which had been three or four days.

10. Where, in an action for the death of a servant, the physician who attended deceased testified to the character of his injuries, and pending the examination defendant offered to admit that the death was caused by the injuries received in the accident in question, it was proper to overrule a subsequent objection of defendant to a question to the witness, since defendant might not in such manner limit plaintiff's method of making proof.—(Terre Haute Electric Co. vs. Kiely, 72 N. E. Rep., 658.)

INDIANA.—Street Railroads—Injuries to Persons on Track—Care Required of Motorman—Instructions—Mental Capacity of Person Injured—Contributory Negligence of Parent.

1. In an action against a street railroad company to recover for the wrongful killing of plaintiff's infant son, an instruction that if the motorman could have discovered the child's presence on the track by proper diligence, and could have known of his peril in time to have avoided the injury, it was his duty to do so, was not misleading as to the amount of care required of the motorman, when considered in connection with another instruction that it was the duty of those in charge of street cars to use ordinary care to prevent accident, and that, if the motorman saw plaintiff's son on or so near the track that there was a reasonable probability that an attempt to pass would result in a collision, it was his duty to stop the car if he reasonably could have done so with the means at hand.

2. Where, in an action against a street railroad company for the killing of plaintiff's infant son, the complainant does not allege that the child was not sui juris, that question should not be submitted to the jury.

3. In an action by a parent to recover for the wrongful killing of his infant son, the contributory negligence of the parent is a defense.—(Indianapolis St. Ry. Co. vs. Antrobus, 71 N. E. Rep., 971.)

INDIANA—Street Railways—Negligence—Collision with Teams—Contributory Negligence.

1. The running of a street car, without a headlight, on a dark and foggy night, at the rate of 25 or 30 miles an hour, and without warning, was negligence, or at least presented a question for the jury on the issue of negligence.

2. Whether one driving a buggy along a street on a dark and foggy night was guilty of contributory negligence in arranging with his companion to confine his own attention to the driving and let his companion look out for approaching cars was a question for the jury.—(Indianapolis St. Ry. Co. vs. Slifer, 74 N. W. Rep., 19.)

INDIANA.—Street Railroads—Injury to Passenger—Standing on Running-board—Contributory Negligence—Settlement—Burden of Proof—Complaint of Pain—Conclusions—Payment of Doctor's Bills.

1. It is not negligence as matter of law for a passenger to stand on the running-board of a street car, the seats being filled.

2. An instruction that defendant has the burden of proving the plea of settlement, and that, to sustain it, it must appear that a definite and distinct proposition was made on the part of defendant which in its terms was accepted by plaintiff, when followed by an instruction that if the jury find the parties came to an agreement as to plaintiff's claim, that plaintiff agreed to accept $200 in settlement, and that defendant accepted said offer and tendered said sum and has paid it into court, will be held not to have misled the jury to understand that to constitute a compromise the proposition to take the $200 must have come from defendant, insead of plaintiff.

3. An instruction that defendant has the burden to prove the plea of settlement by a preponderance of the evidence, and that to sustain the plea it must "clearly appear" that a definite and distinct proposition was made and accepted, will not be held to have placed too great a burden on defendant, the meaning of "preponderance of the evidence" having been properly defined by another instruction.

4. Plaintiff in an action for personal injury may show that he complained of pain after the accident.

5. Plaintiff, in an action for injury received by him while a passenger on a street car, having pleaded that he was compelled to ride on the running-board because there was no room elsewhere on the car, and having testified that passengers said: "Look out for the poles!" and that he tried to get between the seats to avoid them, may testify, as a reason why he did not get in the car, that it was so crowded it was impossible for him to get there before he was hurt, this not being the statement of a mere conclusion.

6. It is immaterial, in an action for personal injuries, whether plaintiff had paid his doctor's bills for treatment of his injuries.—(Indianapolis St. Ry. Co. vs. Haverstick, 74 N. W. Rep., 34.)

KANSAS.—Railroads—Stock on Track—Fences.

1. In an enclosed field through which there was located and operated an unfenced railroad, a cow rightfully in the field passed directly upon the railroad, and was struck and killed by a car without any fault of the employees of the railroad company in charge of the car. At the time, the general herd law was in force in the county wherein the cow was killed. Held, that the cow was not trespassing or running at large when she went upon the right of way of the railroad compny, and, as she was killed because of the omission of the railroad company to fence its railroad as the law required, it is liable for the loss.

2. Where a railroad passes through an enclosure, it is the duty of the railroad company not only to build fences on each side of the track, but also to complete the enclosure by building end fences and cattle guards across the right of way where the railroad enters and leaves the enclosure.

3. A portion of the enclosure on one side of the railroad was platted, and lots, blocks, streets and alleys were staked out, but as no lots or blocks were sold, nor streets and alleys used as such, and as the platted portion was still used for agricultural purposes only, the platting did not relieve the company from the duty of fencing its road, nor absolve it from liability for the loss.—(Iola Electric R. Co. vs. Jackson, 79 Pac. Rep., 663.)

KENTUCKY.—Street Railways—Collision with Team—Negligence — Contributory Negligence — Evidence — Damages—Punitive Damages—Question for Court.

1. In an action against a street railway company for injuries to one driving a team, in consequence of a collision with a car, evidence held sufficient to show negligence on the part of defendant's servants in charge of the car.

2. In an action against a street railway company for injuries to one driving a team, caused by collision with a car, plaintiff could recover if defendant's servants in charge of the car saw that there was danger of the car striking plaintiff's horse or wagon, and

could have stopped the car in time to have prevented the collision, and failed to do so; but if the car was stopped, and, after it became stationary, plaintiff's wagon was, by the motion of the horse, brought in contact with defendant's car, and plaintiff's injuries were caused by such contact of the wagon and car, there could be no recovery.

3. In an action against a street railway company for injuries to one driving a team, caused by collision between the team and a car, where the answer alleged, and some of the evidence tended to show that the collision was the result of plaintiff's mismanagement of his horse while the car was stationary, an instruction on contributory negligence, being asked, should have been given.

4. The question of whether there is any evidence in a case to justify the assessment by the jury of exemplary damages is one for the court.

5. In an action against a street railway company for injuries to one by a collision of his team with a car, where there was no evidence that the car was running at an unusual rate of speed, and plaintiff's evidence, which was contradicted by defendant, merely showed that his horse became frightened and uncontrollable, and he called to the motorman to stop, but he nevertheless kept his car in motion, the submission to the jury of the question of punitive damages was improper.—(Lexington Ry. Co. vs. Fain, 80 S. W. Rep., 463.)

KENTUCKY.—Street Railway Companies—Injury to Passenger Furnishing Safe Place to Land—Pleading .

The petition in an action against a street railway company for injury to a passenger by turning her ankle over in alighting in the day time states no cause of action, it alleging the car did not stop at the usual place where the street was smooth, but was negligently stopped where the street was paved with rough and uneven granite stones, which made it an unsafe place to alight, that she had no means of observing and was not warned of the unsafe condition, and that the conductor knowingly failed to warn her of the danger of alighting there, and urged her to haste; there being no averment that the stones were more rough and uneven than was usual on streets so paved, that there was a hole there, that the conductor knew it was unsafe for her to alight there, or that the condition of the stones were not obvious to her.—(Murnhan vs. Cincinnati, N. & C. St. Ry. Co. et al., 86 S. W. Rep., 688.)

KENTUCKY.—Carriers—Negligence—Question for Jury—Action—Instructions.

1. In an action against a street railroad company for injuries to a passenger by a shock received from the controller box of a car, evidence examined, and held that the questions of plaintiff's contributory negligence and of defendant's negligence were for the jury.

2. Plaintiff suffered an electric shock, which rendered him unconscious until the next day. His arm was paralyzed and his hand clenched so that he could not open it for some weeks, and at the time of trial he had about one-fifth of the strength in the arm that he had had before. The medical testimony was doubtful as to whether the injury would be permanent, and it was shown that he suffered a great deal, and could not work at all, and his capacity to earn was reduced from $9 to $7 a week. Held, that a verdict of $4,000 was not excessive.—(South Covington & C. St. Ry. Co. vs. Smith, 86 S. W. Rep., 970.)

LOUISIANA.—Railroad Crossings—Danger—Precautions—Contributory Negligence—Action—Wrongful Death.

1. If a railroad company, in the management of its traffic, causes unusual peril to travelers, it shall meet such peril by corresponding precautions. So, where the crossing is especially dangerous on account of its locality or mode of construction, or because the view is restricted or the track is curved, it is the duty of the company to exercise such care and take such precautions as the dangerous nature of the crossing requires. If the City Council fails to pass ordinances called for by existing conditions, the company should, of its own motion, make a regulation to that effect, and notify their employees; but the latter are held, without notice, to have had knowledge of the visible dangerous conditions, and bound, without specific directions, to take the steps necessary for the public safety.

2. Where trainmen have reason to believe there are persons in exposed positions on the tracks, as over unguarded crossings in populous districts in cities, or where the public are wont to cross with such frequency and numbers as to be known to them, they will be held to a knowledge of the probable consequences of not taking proper care and precautions, and their employees will be responsible for injuries received in consequence thereof, notwithstanding there was negligence on the part of the person injured, and no fault on the part of the servant after seeing the danger.

3. The general public are not called upon to know or take in at a glance that the space between parallel tracks in a city is not wide enough to afford protection to persons standing on that space, or to know the length and width of the cars used upon the road. A person has the right to assume that the width is sufficient, and to assume that it was not likely that two cars would pass each other, moving, while he was in that position.

4. Under the provisions of act No. 71, page 94, of 1884, amending and re-enacting article 2315 of the revised civil code of 1870, two causes of action arise when the deceased left a widow and minor children—one to recover the damages which the father might have recovered if he had survived the injury, and the other founded on his death. Before the adoption of act No. 71, page 94, of 1884, the first cause of action was joint, but that act provides that it shall survive in favor of the "minor children or widow, or either of them."

5. Hence, when the widow sues alone a judgment in her favor exhausts the first cause of action, leaving to the minors only a right of action to recover the pecuniary loss sustained by them by reason of the death of the father.—(Eichorn vs. New Orleans & C. R. Light & Power Co., 36 S. Rep., 335.)

MAINE.—Street Railways—Negligence—Duty of Traveler at Crossings—Evidence.

In an action on the case for negligence on account of a collision between a team and an electric car, it is held:

1. That between street crossings the car, from the fact that it must pursue one course, and cannot turn out, necessarily has a paramount right, to be exercised in a reasonable and prudent manner.

2. That, when approaching a public street junction, the rule is that the motorman shall be held to anticipate that any person approaching such junction from either side may turn his team into it, and shall then exercise all due care to have his car under such control as to be able to stop it at the crossing, if necessary, to avoid an accident.

3. At such crossings the car has not right superior to that of other vehicles.

4. The rule of caution required in approaching the crossing of a steam road does not fully apply to the crossing of an electric road.

5. In approaching such crossings, it is not incumbent upon the traveler upon foot or with a team, as a matter of law, to look and listen. He must be in the exercise of reasonable care.

6. Whether a traveler, as above, is in the exercise of reasonable care is a question of fact for the jury, depending upon the circumstances of each particular case.

7. The speed of a car is a fact from which an inference of negligence may be drawn.

8. In crossing a car track at the junction of a street, the traveler is not required to look the whole length of the visible track to see if a car is coming, but along the track far enough to warrant an ordinarily prudent man, having in mind his own safety, under like circumstances, to conclude that no car was in such proximity as to endanger his safety in crossing.—(Marden .vs Portsmouth, K. & Y. St. Ry., 60 Atl. Rep., 530.)

MARYLAND.—Carriers—Injury to Passenger—Duty of Passenger—Contributory Negligence—Evidence.

1. Where a passenger in an open street car was entirely within the car, though his elbow rested on a rail at the side, his injury by a collision with a passing wagon raised a presumption of negligence on the part of the street car company, and placed on it the burden of showing contributory negligence.

2. In an action for injury to a passenger in an open street car, from being struck by a marble slab projecting from a passing wagon, a witness' testimony that, in his opinion, the noise of the wagon scraping against the car before the passenger was struck was loud enough to be heard by any one in the car who had any hearing, was admissible.

3. A passenger in a street car is not bound to be constantly on the lookout for danger, but has the right to presume that the company will use the high degree of care for his protection which the law requires.

4. Where, in an action for injury to the plaintiff while a passenger in an open street car, a witness testified that the wagon carrying the slab which struck plaintiff scraped the side of the car, making a noise that could be heard by any one in the car, before the accident, but the plaintiff testified that he did not hear it, it was a question for the jury whether he was guilty of contributory negligence.—(Jones vs. United Railways & Electric Co., of Baltimore, 57 Atl. Rep., 620.)

MASSACHUSETTS.—Street Railways—Collision with Team—Negligence—Question for Jury.

Along the south side of an east and west road, running through the woods, was an electric car track. The part of the road wrought for travel was 12 ft. to 15 ft. wide, and to the north.

While plaintiff, in the evening, when it was so dark, as he testified, that one could see only 8 ft. or 10 ft. ahead, was driving east, with the off wheels of his cart, back over phich he could look only by standing up, on the track, he was struck by an electric car coming down a grade, without any headlight; he, as he testified, having heard no gong or signal, but merely a buzzing on the wire, on hearing which he, as soon as he could, attempted to turn to the left. Held, that the questions of negligence were for the jury.—(Sexton vs. West Roxbury & R. St. Ry. Co., 74 N. E. Rep., 315.)

MASSACHUSETTS.—Street Railroads—Injury to Passenger—Negligence.

1. In an action by a passenger on an elevated railway for injuries sustained by getting her foot through the space between the car and the platform while alighting, it appeared that the car was constructed with a door on the side through which passengers passed out of the car, and that the platform was on a level with the floor of the car. The space betwen the car and the platform was 3 ins. when the car stood still, while when in motion there might be an oscillation causing the space to vary from 1 in. to 5 ins. in width. The oscillation was a necessary incident to the operation of the car, and it would not be safe to have the platform nearer. Held insufficient to show negligence in the construction of the car or platform.

2. It is not negligence to ask passengers leaving an elevated railway car to move quickly.

3. In an action by a passenger on an elevated railway for injuries sustained by getting her foot through the space between the car and the platform while passing out of the car at a side door, plaintiff testified that she was passing out in a crowd so great that she could not turn around, that she went out practically sideways, and that in this way her foot went down between the car and platform. Defendant had no reason to expect anything unusually dangerous. It did not appear that the passengers were disorderly, or that they were doing anything calling for interference by it. Held not to show that defendant was guilty of actionable negligence in not taking measures to prevent the crowding.—(Willworth vs. Boston Elevated Ry. Co., 74 N. E. Rep., 333.)

MASSACHUSETTS.—Master and Servant—Injuries to Employees—Contributory Negligence—Reliance on Orders—Questions for Jury—Evidence—Dying Declarations.

1. Under Rev. Laws, chapt. 175, sec. 66, authorizing the admission in evidence of declarations of deceased persons made in good faith before the commencement of the action, and upon the personal knowledge of the declarant, a declaration of an injured motorman, in response to a question of the conductor as to whether he got orders to proceed as he did, to the effect that he did get such orders, was admissible in an action for the death of the motorman resulting from the injuries, notwithstanding the leading character of the conductor's question.

2. Where there was evidence that a motorman injured by a collision received orders to proceed along the single track on which the collision occurred, and that such orders could have been given only by the starter, the weight to be given to the starter's positive denial that he gave such orders was for the jury.

3. In actions for injuries to motormen on colliding street cars, where there was evidence that one of the cars was running in accordance with a general order to pass the other at a certain point where there was a double track, and the other car was running under a special order given by the starter not to wait at the passing point, questions whether it was negligence for the motormen to run their respective cars at the rate of 8 miles an hour on the day in question, which was very foggy, upon the single track, which was greasy because of the dampness and the fallen leaves; whether the motorman running under general orders was negligent in view of his knowledge of, and failure to report, a disobedience of the general orders by the persons in charge of the other car on previous days, and whether it was negligence for the motorman to rely on the special order without taking further precautions to protect his car from collision—were for the jury.—(Nagle vs. Boston & N. St. Ry. Co., 73 N. E. Rep., 1019.

MASSACHUSETTS.—Carriers—Injuries to Passengers—Negligence of Conductors—Liability of Carrier—Interrogatories—Time of Filing—Discretion of Court—Contents of Answers—Disclosure of Defense.

1. The conduct of the conductor of a street car while in the car is in a sense official conduct for which the street railway is responsible to a passenger injured thereby if such conduct—as in carelessly falling against the passenger and injuring him—is negligence, regardless of whether the conductor is, in general, competent or incompetent, or whether or not the street railway might reasonably know of his incompetency.

2. Orders granting leave to file additional answers to interrogatories or extending the time within which to answer are within the discretion of the court, and not the subject of exception.

3. A party interrogated who desires to avail himself of the protection of Rev. Laws, chapt. 173, sec. 63, providing that a party interrogated shall not be obliged to disclose the names of witnesses by whom or the manner in which he proposes to prove his own case, must fully state under oath in his answer that the matters inquired of are within the protection of the statute.

4. Under Rev. Laws, chapt. 173, sec. 63, providing that a party interrogated shall not be obliged to disclose the names of the witnesses by whom or the manner in which he proposes to prove his case, a street railway, sued for injuries to a passenger, need not disclose, in answer to interrogatories, the contents of a report containing the names of witnesses to the accident and the time and manner in which it happened, submitted by the conductor of the car.—(Spinney vs. Boston Elevated Ry. Co., 73 N. E. Rep., 1021.)

MASSACHUSETTS.—Street Railroads—Personal Injuries—Contributory Negligence.

Where a pedestrian had the whole highway, including a sidewalk devoted to foot passengers alone, to choose from, he was not in the exercise of due care in stooping over for even seven seconds to pull down the leg of his trousers while standing on a street car track at a point that might be reached by an electric car in eight seconds after it came around a corner, especially when he did not look up again after stooping until he was run over by a car.—(Jordan vs. Old Colony Street Ry. Co., 74 New England, Rep., 316.)

MICHIGAN.—Carriers—Street Railways—Negligence—Defective Appliances—Incompetent Servants—Questions for Jury—Contributory Negligence—Apprehension of Danger—Instructions—Damages—Expectancy of Life—Appeal—Errors in Charge—Failure to Except.

1. A street railway company owes to its passengers a high degree of diligence and care in respect to the character of its rolling stock.

2. In an action against a street railway for injuries to a passenger, where there was testimony that the brake rod had broken the day previous to the accident, but was repaired so that the brakeman had no reason to doubt the efficiency of the brake until he tried to use it, and it was found that after the accident the brake rod was useless for want of a bolt, the question of negligence, when taken in connection with the fact of the accident, was for the jury.

3. In an action against a street railway for injuries to a passenger, where there was testimony that the motorman did not know that he could stop the car by reversing the motor, and that his tutelage had been brief, although there was proof of the opposite, and that he did not turn off the current and lost his judgment, the question of his competency and the character of his conduct was for the jury.

4. A passenger on a street car is entitled to protection against imminent and unexpected danger, and it is not necessarily a defense that in the face of such danger the motorman lost his usual ability to control the car.

5. A passenger on a street car who jumps therefrom under the danger and excitement incident to an imminent collision is not guilty of contributory negligence.

6. In an action against a street railway for injuries to a passenger who left the car just before the occurrence of a then imminent collision, where her evidence was that she was thrown therefrom while the car was going around a curve by its centrifugal force, which broke her hold, and there was no evidence that she jumped from the car, there was no occasion to submit the question of her jumping from the car to the jury.

7. In an action for personal injuries, permanent in their nature, the jury may include damages for prospective suffering for such time as they find that plaintiff will suffer them, based on her expectancy of life at the time of the trial, and not on the basis of that expectancy before she was injured.

8. In an action for injuries permanent in their nature, a charge that the jury in assessing damages should determine the probable period that it might reasonably be expected that plaintiff "might have lived in the condition she was at the time of this injury," and that the jury would decide her expectancy of life "having in mind what the evidence discloses regarding the plaintiff's health previous to the accident," was open to the construction of erroneously permitting the jury to allow damages on the basis of expectancy of life before the injury.

9. Under the statute permitting counsel to assign error upon a charge without having taken exception thereto, the Supreme Court has no alternative but to reverse the judgment for error in a charge, though raised for the first time on appeal—(Howell vs. Lansing City Electric Ry. Co., 99 N. W. Rep., 406.)

FINANCIAL INTELLIGENCE

WALL STREET, July 26, 1905.

The Money Market

The money market developed a decidedly easier tone this week, despite the comparatively low bank reserve and the preparations making by the local institutions to meet the demands soon to be made upon them for crop-moving purposes. The offerings of funds, although only moderate, was largely in excess of requirements. Call money was under pressure, bankers generally being disposed to place their funds in this department rather than to commit themselves for fixed periods. As a result, rates for demand funds fell off considerably, practically all of the week's business being transacted at 1¾ and 2 per cent. Sixty and ninety-day funds were offered more freely also, at ¼ per cent under the rates heretofore prevailing. For the longer periods, however, the market was held firm at 3½ per cent for four months and 4 per cent for over the year maturities. Mercantile paper continued in good demand at 3¾ to 4 per cent for the best names, but the volume of business was limited. Sterling exchange displayed pronounced weakness early in the week, as a result of a liberal supply of loan bills, but subsequently there was a recovery to 4.8675 for prime demand sterling. The bank statement published a week ago was disappointing. There was an unexpectedly heavy increase of $19,058,600 in loans, and an increase of $18,380,000 in deposits. The gain in cash amounted to only $21,700. Reserve requirements were $4,595,000 larger, which resulted in a decrease in the surplus reserve of $4,573,000. The surplus now amounts to $14,949,950, as against $19,523,250 in the preceding week, $50,609,600 in the corresponding week of 1904, and $18,915,400 in 1903. United States deposits were $17,081,575, as against $22,372,950 in the previous week. There were no material changes in the European markets during the week. Discounts at London remained easy at 1⅝ per cent. At Paris the rate declined ⅛ per cent to 1⅝ per cent, and at Berlin the quotation was unchanged at 2⅛ per cent. At the close there was nothing in the situation calculated to disturb the present easy condition of the market. Disbursements by the sub-treasury continue in excess of collections. Currency from the interior and new gold from the Klondike are also being received in moderate amounts. The supply of foreign money awaiting employment in this market was materially increased during the week by the placing of loan bills, and it is expected that the offerings of these funds will be sufficient to check any advancing tendency which might develop from an increased demand for money.

The Stock Market

The stock market has been exceedingly dull during the past week, and the dominant influence in checking speculation has been the conflicting character of the reports regarding the spring wheat crop, and the obvious efforts on the part of the bulls in wheat to create a crop scare. On Friday and Saturday there was rather free selling of stocks by the Western element, on the reports of black rust in Minnesota and the Dakotas; but these reports were flatly contradicted. On Monday the bottom practically fell out of the wheat market, and the stock market developed considerable firmness, but the only buying had been for the short account, with the exception of the Eries, which were bought in anticipation of the dividend action on the second preferred stock. The foreign situation has improved, and a conference between the two Emperors, it is believed, tends to an early peace between Russia and Japan. The Steel Corporation statement for the second quarter of the year was about what had been expected, and the buying of these stocks has been good, and was based upon the very favorable trade conditions. The important price movements were in the Northern Securities group of stocks and in a few of the specialties. Considerable attention is being paid, however, to the copper stocks as a result of the remarkably strong position of the copper metal market. The stock market, as a whole, is a waiting one, and no great activity or decided improvement in prices is looked for until uncertainty regarding the spring wheat crop is eliminated and the critical point has been passed.

Little interest has been shown in the local traction stocks, which have been under a moderate selling pressure, the purpose of which is believed to be an accumulation of Brooklyn Rapid Transit and Metropolitan.

Philadelphia

Extreme dullness characterized the local market for traction stocks this week. Dealings included a fairly large number of issues, but the individual transactions showed a marked falling off as compared with previous weeks. The general tone of the market, however, was firm. United Gas & Improvement was the active as well as the strongest feature of the trading, upwards of 1500 shares changing hands at prices ranging from 94½ to 95¼, a net gain of 1¼ points. Philadelphia Rapid Transit was dull and a trifle easier, notwithstanding the reported increase in the company's earnings. From 28 at the close of last week the price ran off to 27½, and closed within ⅛ of the lowest. About 1000 shares changed hands. It is said that the gross earnings for the month of June showed an increase of $95,000 over June, 1904, and that the gross earnings and other income for the fiscal year will be about $16,400,000, or $470,000 larger than in 1904. Philadelphia Company common sold to the extent of about 650 shares at 43½ to 43, while an odd lot of the preferred brought 48⅜. Philadelphia Traction was steady, about 400 shares changing hands at 100 and 99⅞. Union Traction was firm, upwards of 600 shares selling at 60¼ and 60. Other transactions included American Railways at 51, Consolidated Traction of New Jersey at 82, Fairmount Park Transportation at 17, United Traction of Pittsburg preferred at 50½ to 50, Reading Traction at 33, and United Companies of New Jersey at 269½ to 269¼.

Chicago

The local market was practically neglected. The demand for stocks was limited to a few issues, but at the same time there was no evidence of pressure to sell. About the weakest feature of the group was North Chicago, which sold to the extent of about 300 shares at 56½ to 57, a loss of a point as compared with the previous week's close. South Side Elevated continued firm, 350 shares changing hands at 95. Northwestern Elevated jumped up a point to 22½ on reports of increased earnings. Metropolitan Elevated sold at 65 to 64⅛ for 120 shares, and Chicago & Oak Park brought 18 for fifty shares. West Chicago sold at 40 for one share.

Other Traction Securities

Trading in the Baltimore market was only moderately active, but prices generally displayed a firmer tendency. United Railway 4s were in better demand, about $50,000 selling at 94 to 93¾, an advance of ⅛ per cent. The incomes rose 1½ per cent in the early dealings to 59¾, but subsequently eased off ¾, and closed at 59⅛, with a net gain of ¾. About $35,000 of the bonds changed hands. The stock was unchanged, 225 shares selling at 13½ to 13, while trust receipts, representing 100 shares of stock, sold at 13⅜. Norfolk Railway & Light 5s developed more activity, about $16,000 changing hands at 93½. Other sales were as follows: City Passenger 5s at 106, Knoxville Traction 5s at 104¾, Norfolk Street Railway 5s at 109 to 109½, Washington City & Suburban 5s at 107¼, Charleston Consolidated Electric 5s at 96, Baltimore Traction 5s at 117, City & Suburban 5s at 113⅝, and $15,000 Macon Railway & Light 5s at 98. The Boston market was dull and heavy. Boston & Worcester sold at 30 to 30½ for 103 shares, while 275 of the preferred brought 75 to 75½. Massachusetts Electric common opened up a point at 20, but subsequently lost all the improvement on sales aggregating 800 shares. The preferred stock fluctuated between 63¾ and 63, closing at the lowest. Other transactions included Boston Elevated, at from 157¾ down to 157½, and back to 157⅝; West End common at 98, preferred at 113½ to 114, and Boston & Suburban at 23½. In the New York curb market transactions have been upon a much larger scale, and prices fluctuated sharply. Interborough Rapid Transit developed considerable strength in the early dealings, the price advancing to 208½, but subsequently there was a sharp reaction to 203½, with a subsequent recovery to 207¼, a net gain of 3¾ per cent; about 5000 shares were dealt in. New Orleans Railway stocks was unusually active, and prices for both issues fluctuated violently. The common opened at 34 and dropped to 27, but later rallied to 31, while the preferred broke from 74 to 70, and rallied at the close to 72. Upwards of 8000 shares of the common and 2000 shares of the preferred were traded in. The 4½ per cent bonds were quiet but firm, $30,000 selling at 90. The reorganization of the company has been completed, and the securities of the New Orleans Railway & Light Company, the new company, will be ready for distribution this week. Washington Railway & Electric common sold at 39¾ for 100 shares, and $3,000 of the 4 per cent bonds brought 91¾.

Security Quotations

The following table shows the present bid quotations for the leading traction stocks, and the active bonds, as compared with last week:

	July 19	July 26
American Railways	51	51
Boston Elevated	157	157
Brooklyn Rapid Transit	69½	67¾
Chicago City	—	—
Chicago Union Traction (common)	7⅛	8¼
Chicago Union Traction (preferred)	33	34½
Cleveland Electric	78	78
Consolidated Traction of New Jersey	82	82
Consolidated Traction of New Jersey 5s	108½	108½
Detroit United	92⅝	92¼
Interborough Rapid Transit	203½	205
International Traction (common)	26	—
International Traction (preferred) 4s	64	—
Manhattan Railway	165	164½
Massachusetts Electric Cos. (common)	18	18
Massachusetts Electric Cos. (preferred)	63	62¼
Metropolitan Elevated, Chicago (common)	23⅞	23⅞
Metropolitan Elevated, Chicago (preferred)	65	64
Metropolitan Street	127¼	125½
Metropolitan Securities	82½	81¾
New Orleans Railways (common), W. I.	31½	29½
New Orleans Railways (preferred), W. I.	73⅛	70½
New Orleans Railways 4½s	90	88½
North American	98⅛	98
North Jersey Street Railway	25	25
Philadelphia Company (common)	43	43
Philadelphia Rapid Transit	27½	27¼
Philadelphia Traction	100	99¾
Public Service Corporation 5 per cent notes	97	—
Public Service Corporation certificates	68½	—
South Side Elevated (Chicago)	94½	94½
Third Avenue	127	127
Twin City, Minneapolis (common)	112½	111½
Union Traction (Philadelphia)	60	60
West End (common)	97	98
West End (preferred)	114	a114

a Asked. W. I., when issued.

Iron and Steel

The "Iron Age" says there has been an active movement in many branches of the iron and steel trades, and manufacturers are facing the future with increasing confidence. Apparently the buying of pig iron is over for the present. It is estimated that the total sale during the two weeks of lively purchasing will aggregate 500,000 tons for the whole country. It has led Southern makers to advance their prices to $11.75 and $12 for No. 2 Birmingham, some of them holding for more. A number of the railroads have bought steel rails during the last ten days, the total figuring up close to 100,000 tons. In the structural trade the question of deliveries is the all-absorbing topic. During the past ten days there has been some heavy selling of steel bars. One interest has booked 70,000 tons, largely for makers of agricultural machinery.

OPERATIONS OF THE HUNTINGTON SYNDICATE

All of the property of the Los Angeles & Redondo Railway Company has been sold to Henry E. Huntington at a price approximating $2,500,000, and the entire stock of that company has been transferred. Prior to the purchase, Mr. Huntington had acquired all of the property at Redondo belonging to the Redondo Land & Improvement Company, comprising 4000 town lots at a price reported to be $1,000,000. Mr. Huntington now owns the railways, wharves, water-front and about three-fourths of the area of the city of Redondo. It is officially announced that Mr. Huntington will greatly improve his new electric railway. It is narrow gage, and hourly service is maintained. Mr. Huntington will double-track and standardize the present system as soon as possible, introducing fifteen-minute service between Redondo and Los Angeles. In Redondo Mr. Huntington succeeds the Garnsey-Ainsworth syndicate.

The Huntington system out of Los Angeles is pushing into the San Bernardino Valley. The surveyors have run a line for a new road between Riverside and Colton. This will connect the Huntington system at Riverside with the lines of the San Bernardino Valley Traction Company at Colton, thus making a through connection between San Bernardino and Riverside. The projected road covers a distance of six miles. The route begins at the corner of Eighth and J Streets, runs south on Eighth Street to O Street, thence through orange groves and fields about one mile over a bluff to Colton Avenue, thence following the arroyo through old Spanishtown to North Orange Street, passing the Elliott Springs, which are one mile from Riverside, thence to the end of the double track of the Huntington system of Riverside.

CLEVELAND CROSS-TOWN ORDINANCE

Mayor Johnson, of Cleveland, has announced that a Woodland-Hills Avenue street car line extension ordinance has been drawn up in the rough, and that the ordinance is satisfactory to both parties. Solicitor Baker, representing the city, and Secretary Henry Davies, for the Cleveland Electric Railway, have been authorized to make a specific draft of the new ordinance, which will be formally accepted by the Mayor and Mr. Andrews as soon as completed, and will be submitted to the Council at the next meeting. The new ordinance is designed to meet the Mayor's desire for the Woodland-Hills crosstown road under safe restrictions, and follows to great extent the lines of the Felton ordinance which the Mayor vetoed.

From the very beginning of the agitation for a crosstown line on Doan Street and Woodland-Hills Avenue, Mayor Johnson has been for it. But he feared that the Felton ordinance which he vetoed would extend the life of other franchises, the company's attorneys having made the claim that a transfer clause in any franchise makes connecting lines take on new life. While the terms of the agreement are not fully made public, the chances are that there will be no mention of transfers in the new ordinance. But the right of the public to have transfers is guarded by a special and private agreement by which the company will give transfers just as though it were required in the franchise.

ANNUAL REPORT OF MANCHESTER TRAMWAYS

The tramways committee of the Manchester (Eng.) Corporation presented the following report for the year ended March 31 last, The report states that at the date of the last report the routes open for traffic aggregated 137 miles, 1602 yards of single track, and that the aggregate length of single track open for traffic on March 31, 1905, was 146 miles, 343 yards.

The revenue account may be summarized as follows:

	1904-05 £	s.	d.	1903-04 £	s.	d.
Traffic revenue	628,529	4	2	603,182	6	10
Other revenue	3,426	8	2	8,693	16	10
Total	631,955	12	4	611,881	3	8
Working expenses	411,597	3	11	391,853	13	11
Balance, being gross profit	220,358	8	5	220,027	9	9
Add bank interest	1,869	9	1	3,079	10	6
Leaving a sum available of	222,227	17	6	223,107	0	3
Out of which the following charges have been met:	£	s.	d.	£	s.	d.
Interest on mortgage debt, etc.	52,120	7	11	52,711	2	11
Redemption of debt	35,379	6	5	26,902	16	4
Rent of tramways	10,000	0	0	20,000	0	0
Leaseholds—proportion of outlay	794	14	5	1,136	17	0
Income tax	2,983	5	1	550	13	9
	101,277	13	10	101,401	10	0
Leaving a net profit, which has been appropriated as under:	£	s.	d.	£	s.	d.
Renewals and depreciation account	70,907	0	0	59,693	2	10
Contribution in aid of the rates	46,000	0	0	50,000	0	0
Street improvements round Infirmary—interest, etc.	4,043	3	8	2,012	7	5
Total net profit	120,950	3	8	121,705	10	3

During the year the number of passengers carried was 126,900,875, an increase of over 6,000,000 on the previous year, when the figures were 120,722,368. The car mileage shows an increase of considerably over 1000 miles, the figures being 14,123,124 during last year, and 13,617,448 during 1903-04. The percentage of passengers' fares show that 71.94 paid 1d. for the journey, 11.01 paid 1½d., 7.10 2d., and 5.40 ½d. Of the total number of passengers carried 91,281,804 paid penny fares. The average traffic revenue per car-mile was 10.68d., against 10.52d., and the average traffic revenue per mile of single track was £4,299, as against £4,468 in 1903-04. The average working expenses per car-mile, including power cost, was 6.99d., against 6.78d. The amount of the sinking fund is now £60,987, against £27,224 in the previous year. The renewals and depreciation fund now amounts to £185,085, against £119,844 in the previous year.

PITTSBURG RAILWAYS PURCHASES BEAVER VALLEY SYSTEM

The Pittsburg Railways Company has purchased the Beaver Valley Traction Company, and the following officers and directors representing the new control have been elected: President, J. D. Callery, vice Sydney L. Wright, resigned; vice-president, S. L. Tone, vice W. Frederick Snyder, resigned; secretary, W. B. Carson, vice Walter T. Bilyen, resigned; treasurer, C. J. Braun, Jr., vice Walter T. Bilben, resigned; assistant secretary and assistant treasurer, J. C. Lightfoot, Jr.; general manager, Gaylord Thompson; new board of directors, J. D. Callery, S. L. Tone, W. B. Carson, J. L. Foster, C. S. Mitchell, John M. Buchanan, William Redwood Wright, T. P. Simpson and Gaylord Thompson. The Pittsburg Railways Company pays approximately $1,000,000 for the $1,095,000 (par value) Beaver Valley Traction Company stock and guarantees principal and interest on outstanding bonded indebtedness, as follows: $150,000 first mortgage 6s, maturing 1911; $100,000 second mortgage 6s, maturing 1915; $675,000 first consolidated 5s, maturing 1950; $500,000 general mortgage 5s, maturing 1953. There are also $75,000 of subsidiary 6 per cent bonds out. On Sept. 30, 1904, the company had loans outstanding amounting to $235,000. Its fixed charges last year were $79,791. The Beaver Valley Traction Company has 32 miles of track, and owns 50 cars with power houses, etc. It is a consolidation of several small properties with the old People's Traction Company, of Beaver.

THE QUESTION OF A TERMINAL FOR TRENTON

The practice in Trenton, N. J., of shifting cars from one track to another in the center of the city, which has become pronounced recently, is causing considerable discussion before the Council. The first foreign car ran upon the streets of Trenton in November, 1902, when the New Jersey & Pennsylvania Traction Company brought its Princeton cars off the private right of way into North Willow Street, and later to the corner of Warren and Hanover Streets, about two blocks from the City Hall. The Camden & Trenton lands its passengers at State and Warren Streets, a block further south, and one full block from the City Hall, while the Yardley, Morrisville & Trenton, Trenton, Newhope & Lambertville and Philadelphia, Bristol & Trenton Street Railways run their cars into the former's terminal, and the Trenton & New Brunswick Railroad into the latter's terminal. The Trenton Street Railway Company shifts its Princeton and Pennington cars, as well as those on the Princeton Avenue line (to city line only) at State and Broad Streets, opposite the City Hall.

East State Street is narrow at the point where the cars are shifted, while Broad Street, at a point around the corner, to the left, where the South Trenton and Yardville cars of the Trenton Street Railway are shifted, is quite wide. About ten cars an hour are shifted from one track to the other (trolley poles turned, etc.) on State Street, four on Broad, three on State and Broad, and eight on West Hanover Street, at Warren.

Very recently there was an agitation for a change, the City Council urging that there was no excuse for cars lying on the streets, and an ordinance was passed, which, among other things, prohibits cars from remaining at a terminal, in the street, more than four minutes. This did not quite satisfy the members who were playing to the grandstand, so they passed a resolution directing the Trenton Street Railway to lay curves at once at State and Broad Streets, and construct a connecting track between North Broad and North Warren Streets, two blocks further north, so that the Princeton and Pennington cars of the Trenton Street Railway might pass down Warren, into State, into Broad, up Broad to Perry, and through Perry to Warren again. This scheme was nipped in the bud early by a protest from the chief of the fire department, who said that a railway track through that section of Perry Street would very seriously handicap the department, owing to its headquarters being located there. Residents of the street also registered a kick, because no franchise had been sought, nor had any consents been given, as plainly required by the State laws, which the Council forgot in the excitement of pushing the thing through. The Trenton Street Railway Company hesitated, not unwilling to build the Perry Street loop, having already expressed a desire to do anything that would alleviate the trouble, but anxious to please the property owners and also doubtful of the legality of a street railway built under simple resolution of Council.

Councilman James Buchanan, a recent candidate for Mayor in opposition to Frank S. Katzenbach, Jr., who is counsel for the New Jersey & Pennsylvania Traction Company, came forward with a complicated loop scheme, which proposed tracks through various streets and alleys for the joint use of all the electric railways centering in the city. Aside from the dangers and delays of narrow streets, sharp curves and numerous crossings of each other's lines, three different gages would have had to be provided for—the Trenton Street Railway and all the Pennsylvania lines are 5 ft. 2¼ ins.; the Camden & Trenton 5 ft., and the Princeton line of the New Jersey & Pennsylvania Traction Company 4 ft. 8½ ins. The Liberty Street line of the Camden & Trenton Railway is also 4 ft. 8½ ins., to permit the cars of the Trenton & New Brunswick Railroad to run over it.

One of the daily papers is acting as sponsor for the terminal advocates, and the fusillade keeps up without intermission. The New Jersey & Pennsylvania Traction Company has an extensive terminal of its own upon West Hanover Street, and arrangements will be made shortly to run the cars direct into a station to be erected, so that the street will not be occupied, and this company will, probably, have less to fear than any of the others, although a regular mystic maze of curves has been suggested for the use of its cars running into the center of the city.

Trenton streets do not offer much room for the electric cars, most of those in the center of the city being narrow, with the exception of North Broad Street for two blocks, and East Hanover Street for about two blocks. East Hanover Street has no car tracks, probably will not have if the property owners can prevent it, as it lies one block away from State Street, and is considered an especially desirable location, because of its proximity to and at the same time freedom from the electric cars.

AFFAIRS IN CHICAGO

The local transportation committee of Chicago has agreed to accept the offer made by the Chicago City Railway Company in the way of a settlement between the company and the city of existing controversies over the question of compensation for operating rights. The agreement finally decided on requires the company to pay the city $35,400 in full settlement of all claims for past compensation, and a flat rate of $5,000 per month in future, beginning July 1. The company refused to pay compensation from March 20, the date Mayor Harrison executed his famous coup abrogating all existing agreements with the company, and attacking its rights in the streets. One of the agreements abrogated required the company to pay $100 per annum for each car in use. The committee will attempt to make an agreement with the Union Traction Company similar to that of the Chicago City Company, substituting the flat rate of compensation for the payment of a car license of $50 a car, as it is now doing under the ordinance of 1883. The committee regards the license system as tending to restrict the number of cars put into service.

As has been previously stated in these columns, the negotiations between the city and the companies looking to a settlement of the entire question of street railway service is to be resumed on Aug. 14. With the approach of that date interest in the problems in hand is aroused. Naturally opinion diverges as to what will be the outcome. Receiver Lampsell, of the Union Traction Company, seems to be of the opinion that a settlement will be effected along the lines proposed by Mayor Dunne in his contract plan. At least, the "Inter Ocean" quotes Mr. Lampsell to this effect. The contract plans provide that, instead of organizing a company composed of five citizens, the companies form a corporation for the purpose of rehabilitating and reconstructing their lines and then turn them over to the city at the end of five years.

The directors of the Metropolitan Elevated have decided not to accept the ordinance passed by the City Council July 10, giving the company the right to carry express matter. The reason given was the amendments requiring the company to place an arc lamp under its structure at each street crossing, and pay 10 per cent of its gross receipts to the city by way of compensation. The directors said the express business is a new thing for elevated roads, an experiment at best, and that they cannot assume the burdens imposed by the ordinance.

A special dispatch to the East from Chicago dated July 26 says that on that date the Chicago City Railway Company filed a bill in the United States Circuit Court for an injunction to restrain the City of Chicago from interfering with any of the company's lines. The municipal ownership ordinance passed by the City Council last March, so the dispatch says, is declared to be unconstitutional. The court is informed that the company now has possession of 119 lines within the bounds of the city, on which the franchises run until 1958.

STONE & WEBSTER MAKE SOUTHERN PURCHASE

The public service utilities of Paducah, Ky., controlled by the Paducah Steam Heating Company, have been purchased by Stone & Webster, of Boston. The purchase price is said to have been $1,440,000, divided as follows: The Paducah City Railway Company, capital $300,000, bonds $650,000, 14.9 miles of track; Paducah Gas & Fuel Company, capital $200,000, bonds $100,000; Paducah Steam Heating Company, capital $100,000, bonds $50,000. The new owners are said to plan improvements that will aggregate several hundred thousand dollars.

CANADIAN POWER INTERESTS IN RAILWAY SCHEME

Toronto Niagara Power Company interests have in contemplation a pretentious scheme for the development of electric railway lines in the Niagara Peninsula with St. Catherines as a center. Frederick Nichols, president of the company, and Col. Pellatt, a director, have recently been in consultation with the Mayor of St. Catherines, and have outlined to him their plans as far as they have been matured. The company will build between St. Catherines and Stony Creek to connect with Hamilton, and eventually Toronto, while the main line will run from Stony Creek to Buffalo, touching at Allanburg. A line also will be built south from St. Catherines to Pelham Township and the town of Welland. In order to get into St. Catherines from the west the company will construct a high level bridge for railway, foot and vehicle traffic over the old canal, something St. Catherines has been agitating about half a century.

BAY CITY CAR STRIKE ENDS

The strike ot the employees of the Bay City Traction & Electric Company in Bay City, Mich., inaugurated seven weeks ago, was ended July 23 at 1:30 o'clock, when an adjustment of the matters in dispute was reached. The adjustment applies only to Bay City, and does not include the Saginaw and Interurban lines.

OUTING OF NEW ENGLAND STREET RAILWAY CLUB

The July outing of the New England Street Railway Club was held Thursday, July 27, 1905, at Canobie Lake Park, Salem, N. H. The event was known as ladies' day, and for this occasion the committee arranged a most elaborate itinerary. Through the courtesy of the New Hampshire Traction Company, the party were taken from Haverhill to Canobie Lake Park, where they were entertained. The start was made from the North Station, Boston, over the western division of the Boston & Maine at 9:25 a. m. At 10:50 the special train reached Haverhill, and at 11:00 o'clock the party boarded special cars of the New Hampshire Traction Company for transportation to the park. En route a brief stop was made at Salem, N. H., to give the party an opportunity to inspect the car house, rotary converter station and car shops of the New Hampshire Traction Company. Dinner was served at the Canobie Lake Park Restaurant about 12:15. At 3:15 the party attended "The French Maid," given in the theater on the shore of Canobie Lake. The return to Boston was made at 5:15 p. m.

AN IMPORTANT INDIANA PROJECT

The Huntington, Columbus City & Northwestern Railway Company has in contemplation a pretentious plan for building an electric railway out of Indianapolis. The road as projected will extend from Indianapolis through Elwood, Marion, Huntington, Columbus City, Syracuse and Goshen. The plan is to begin the work of grading this fall, and to push the actual work of construction early next spring. The company has been voted 10 successive subsidies amounting to $122,500 on 60 miles, and has deeds to 40 miles of private right of way 50 feet wide. The company also has favorable county and city franchises. Construction will be up to the standard of modern practice. Wawasee, the largest lake in the State, which is upon the line, will be converted into a pleasure resort. The contract for engineering, financing and building the road has been placed with the American Engineering Company. The officers of the company are Benjamin Raupfer, Columbia City, president; J. P. Dolan, Syracuse, vice-president; W. H. Magley, Columbia City, secretary; W. F. McLallen, treasurer; Melvin Blain, auditor; A. F. Weist, Jr., Columbia City, general manager; John A. Shafer, Indianapolis, chief engineer.

FEATURES OF THE PROPOSALS AND SPECIFICATIONS FOR BUILDING THE NEW YORK & WESTCHESTER IN THE BRONX

The revised route of the New York, Westchester & Boston Railroad as approved by the Board of Estimate of New York on June 14, between West Farms Road and the northern line of the city, is a material improvement over the original route, in that it gives an almost direct line from Bronx Park to the city line at Mt. Vernon. This will facilitate the operation of the road, and make it possible to maintain very high speeds. As already announced, contracts will be let shortly for the construction of the entire Westchester line in the Bronx, including the section running up to Mt. Vernon. William A. Pratt, chief engineer of the company, has supplied blank proposals and articles of agreement, the specifications including grading, clearing and grubbing, ditching and drainage, masonry and brick work, tunneling, concrete, timber, iron, etc. It is made a part of the specifications that all work under the contracts to be let by the end of this month shall be commenced within ten days. Another paragraph in the specifications of interest is that which states that "the contractors will be required to construct all viaducts over streets and tunnels under streets, and all bridges necessary to carry the streets over the railway in such a manner as not to interfere with the ordinary use of the street or road as a public highway; and shall protect and keep in service all sewers, conduits, gas, water and other pipe line, and all street railway tracks and appurtenances."

STREET RAILWAY PATENTS

[This department is conducted by Rosenbaum & Stockbridge, patent attorneys, 140 Nassau Street, New York.]

UNITED STATES PATENTS ISSUED JULY 18, 1905

794,719. Railway Rail; Emil F. Krell, Detroit, Mich. App. filed Aug. 15, 1904. The rail has projecting flanges to rest upon a suitable foundation and a depending web projecting downward from beneath the flanges to be embedded in the foundation and anchor bolts embedded in the foundation and engaging the flanges of the rails.

794,740. Wheel; Henry H. Porter, Jr., Chicago, Ill. App. filed March 17, 1902. A shiftable flange for a car wheel directly attached thereto, and so mounted upon the wheel that it may be thrown into and out of operative position as an active flange, and a non-rotating bearing for the flange having means to shift and fix it in place.

794,869. Means for Operating Tramway Points; Jacob Levy, Johannesburg, Transvaal. App. filed Nov. 28, 1904. Engaging means on the roof of the car whereby a lever in the path thereof is actuated to throw the switch point in advance of the car.

794,871. Device for Increasing the Adhesion Between Wheels and Rails; Robert C. Lowry, Seattle, Wash. App. filed Oct. 19, 1904. The wheels are magnetized by electro-magnets arranged adjacent thereto.

794,964. Attachment for Trolley Poles; Paul H. White, Indianapolis, Ind. App. filed Aug. 24, 1903. A diamond-shaped clip attached at one end of the trolley pole, and at the other end of the retrieving cord prevents the trolley from catching over the wire when being retrieved.

795,016. Trolley Ear; Montraville M. Wood, Schenectady, N. Y. App. filed Jan. 15, 1903. A rigid frame has a pair of longitudinal slightly inclined grooves therein, and a pair of jaws for gripping the trolley wire having correspondingly inclined or cam surfaces so that the wire is gripped when the jaws are moved longitudinally by a suitable rack and pinion engagement.

795,035. Street Car Brake; Joseph Hastreiter, Morgantown, W. Va. App. filed May 26, 1905. The operating shaft has a bevel-gear connection with a shaft under the car to which the brake chain or cable is attached, the last named shaft being provided at the end opposite its bevel-gear connection with a peripheral flange provided with pawls adapted to engage grooves in a stationary stud thereby to lock the brake in any position.

795,157. Railway Switch Mechanism; Henry B. Nichols, Philadelphia, Pa. App. filed Jan. 16, 1905. Comprises a movable switch tongue, a rod rigidly attached thereto, a lever pivoted at one end and connected to a spring-pressed plunger at the other, the lever engaging the rod intermediate its ends and a pivoted cylinder in which the plunger is slidably mounted, the pivots of the clyinder and lever being in the same plane, whereby the spring-pressed plunger tends to hold the lever and rod in either of their extreme positions.

795,158. Railway Switch Mechanism; Henry B. Nichols, Phila-

delphia, Pa. App. filed Jan. 16, 1905. A movable switch-tongue, a pivoted lever having a connection at one end with the tongue, and at the other end with a tilting weight adapted to act through the lever upon the tongue to maintain the same in position, and means for retarding the movements of the weight.

795,159. Railway Switch Mechanism; Henry B. Nichols, Philadelphia, Pa. App. filed Jan. 16, 1905. A switch mechanism comprising a moving part for switching, a lever moving with the same to move or be moved by it, and a flask or vessel containing liquid and so connected to the lever that movements thereof are accompanied by shifting bodily the liquid in the flask.

795,170. Electric Brake; William G. Price, Pittsburg, Pa. App. filed Aug. 17, 1904. Comprises an actuating spring for operating the brakes, and an electric motor having a rotating armature for compressing the spring and releasing the brakes, the motor being reversed by the action of the spring when the brakes are to be applied.

795,201. Electrically-Heated Handhold; Fred S. Davis, Robertsville, S. C. App. filed Dec. 29, 1904. An incandescent lamp mounted within the hollow handle of a brake or other operating lever.

795,232. Slot Switch; John H. Pflieger, Johnstown, Pa. App. filed March 10, 1904. A slot switch having a tongue-supporting point, a surface-flush movable tongue or point having its base portion extended beyond its point proper and received beneath the flanges of the slot rails.

795,243. Railway Brake Apparatus; Granville T. Woods and Lyates Woods, New York, N. Y. App. filed April 10, 1903. Under certain conditions in a motor-control system the current is directed through the coils of a magnetic brake.

795,247. Current Collecting Shoe; William M. Brown, Johnstown, Pa. App. filed Jan. 26, 1903. The collecting shoe is made very long in order to bridge over spaced contact plates, and comprises a plurality of separately-movable electrically-independent contact sections or units, a conductor adjacent to, but normally separated from, the sections, and elastic members interposed between the sections and the conductor.

PERSONAL MENTION

MR. L. A. POOLE has been appointed assistant manager and purchasing agent of the Philadelphia, Bristol & Trenton Street Railway Company, of Bristol, Pa.

MR. FRED J. ACH has been elected to succeed the late Dr. J. E. Lowes as president of the Dayton & Muncie Traction Company, and Mr. Harry Kiefaher has been elected president of the Dayton & Northern Traction Company as the successor to Dr. Lowes.

MR. WALTER A. PEARSON, electrical engineer of the New York City Railway Company, was presented with a silver punch-bowl by the employees of the company at the Hotel Belleclaire Thursday evening, July 25. Mr. Pearson will, on Aug. 1, become engineer of the Canadian Electric Company at Niagara Falls.

MR. WARREN GREGG, heretofore trainmaster of the Cleveland division of the Lake Shore Electric, has become superintendent of the Lorain Street Railway Company. This is the Lorain and El ria branch of the Lake Shore Electric. Mr. Gregg succeeds Mr. Edward O'Hara, who has held the position for the past eighteen months.

MR. HENRY E. HUNTINGTON, after staying in Los Angeles about two weeks, returned to New York on July 16, planning to be back in Los Angeles within four or five weeks. He says new plans and extensions for Southern California electric railway enterprises make it necessary for him to return to Los Angeles as soon as possible.

MR. SMITH HOOD has been made assistant to Mr. A. L. Linn, general manager of the Fairmont & Clarksburg Traction Company, of Fairmont, Va. The appointment was made in order to give Mr. Linn more time to look after the construction work of a new line being built to Clarksburg. Mr. Hood has been with the company for a long time.

MR. WILLIAM S. REED, of Townsend, Reed & Company, has announced that the members of the firm, Mr. Geo. Townsend and Mr. Reed, have dissolved partnership, and that he is now located in the First National Bank Building, Chicago, to engage in the building, financing and general engineering of electric interurban and street railways. Mr. Reed has had more than 16 years experience in building, owning and operating roads, and is prepared to handle all kinds of railway projects.

MR. F. E. FROTHINGHAM, for three years manager of the Whatcom County Railway & Light Company, owning the street railway and gas plant in Bellingham, Wash., has resigned to resume on August 1 his former employment as expert in investigating properties considered for purchase by Stone & Webster, who own the Whatcom County property. Mr. L. H. Bean, superintendent of the underground and overhead department of the Seattle Electric Company, will succeed Mr. Frothingham at Bellingham.

MR. H. V. SCHREIBER has resigned as chief engineer and electrician of the Augusta-Aiken Railway & Electric Company, of Augusta, Ga., controlling the Augusta Railway & Electric Company, North Augusta Electric & Improvement Company, Augusta & Aiken Railway Company, North Augusta Hotel Company and North Augusta Land Company, to tour the country to acquaint himself with the latest engineering practice in his line.

MR. LORENZO BENTLEY, of New London, Conn., has been appointed to the position of superintendent of the New London & East Lyme Street Railway, now building between New London and East Lyme. Mr. Bentley was formerly superintendent of the New London Street Railway Company. He entered the service of that company more than 14 years ago, and remained in its employ until February, 1905, when the New London, Norwich and Montville Street Railways, all controlled by the Consolidated Railway, acting for the New York, New Haven & Hartford Railroad, were placed under one management. Construction work on the New London & East Lyme Railway is rapidly nearing completion, and it is expected that the road will be placed in operation within a few weeks.

MR. MANUAL M. REID has resigned as master mechanic of the Appleyard properties in Ohio. Mr. Reid has a thorough knowledge of steam railroad practice, and some five years experience in high-speed interurban railroading. In addition to this he has had considerable general railroad experience. He recently was acting superintendent of the Dayton, Springfield & Urbana Electric Railway, operating 65 miles of line. Mr. Reid was born in June, 1848, at Manila, and was educated at Everton Academy, Liverpool, Eng. He entered railway service in March, 1864, and was until 1869 apprentice machinist at Waterford & Limerick Railway shops, Limerick, Eng. From June, 1869, to 1871, he was machinist of the Grand Trunk Railway shops at Montreal, Can. Then he entered the service of the Central Pacific Railroad at Sacramento, Cal., and subsequently was connected with car building and railroad operations in Great Britain and the United States. From 1899 to 1901 he was master mechanic of the Southern Railway (Norfolk division) with headquarters at Lawrenceville, Va. From 1901 to 1905 Mr. Reid has been with the Appleyard lines in Ohio. He has been in charge of all rolling stock at Medway and Glen Echo, and has superintended overhead construction of Columbus power station. He has made weekly trips of inspection and reported to general managers as to the condition of power stations, overhead construction, rolling stock and roadbed. He has also been acting superintendent of the Dayton, Springfield & Urbana Railway, Springfield & Western Railway, and Urbana & Bellefontaine Railway, and has done coniderable construction work. Mr. Reid has not decided upon his plans for the future.

MR. WALTER E. HARRINGTON has just resigned his position as vice-president and general manager of the New York-Philadelphia Company, and of its affiliated companies, the Camden & Trenton Railway Company, Trenton & New Brunswick Railway Company, New Jersey Short Line Railway Company. Mr. Harrington, who is a member of the executive committee of the American Street Railway Association, was for eight years general manager of the Camden & Suburban Railway Company, which greatly prospered under his direction. Upon the lease of this company to the Public Service Corporation of New Jersey last year, Mr. Harrington resigned his position as manager and took charge on March 14, 1905, of the New York-Philadelphia Railway and its allied properties, in which Stern & Silverman, of Philadelphia, are largely interested. These lines extend from New Brunswick to Camden, and through a traffic agreement with the Public Service Corporation at the north and south terminals furnish a through service from Jersey City to Philadelphia. During his connection with this line, Mr. Harrington has introduced a large number of improvements, particularly on the Camden & Trenton division, among the most important being the installation of a block signal system, relaying a considerable portion of the track, reconstruction of the trestle work and rolling stock, addition of shop equipment, feeders, bonding and one unit at the power station, and a revision of the schedules. Mr. Harrington's plans for the future are not announced, but it is stated that he retains his stock interest and remains a director in the company. His resignation was the occasion of most complimentary articles last week in the Trenton and Camden papers which testified to the value of the improvements introduced by him during his incumbency of the office of manager of the company.

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office by 10 a. m. Monday preceding the date of publication, except the first issue of the month, for which changes of copy should be received two weeks prior to publication date. New advertisements for any issue will be accepted up to noon of Tuesday for the paper dated the following Saturday.

Of this issue of the Street Railway Journal 8200 copies are printed. Total circulation for 1905, to date, 253,550 copies, an average of 8179 copies per week.

The Table of Street Railway Statistics

Following our usual custom, we have tabulated the statistics given in the Red Book, showing the mileage, cars and capitalization of the street and elevated railways in the United States and Canada, and are publishing the table in this issue. As explained in the article accompanying this table, some slight modifications have been made in the method of compiling these statistics followed in former years, and the cable, steam and horse railways have been grouped in one column instead of in two as last year, or in three as in previous years. The maintenance of this column is due almost entirely to the retention of horses on a few of the downtown lines in New York, of the cable in a few other cities like Chicago, Kansas City and San Francisco, and to a few steam dummy lines which are still in operation in the Southern and far Western States. Certain of these cable lines may never be changed to electricity, owing to steep grades to be negotiated in Kansas City, San Francisco and a few other cities on the Pacific Coast, but these roads should be considered more in the nature of inclined planes than of normal street railways. The horse is, of course, an anachronism at present, and no one realizes this better than the companies which have them in use, but as yet circumstances in New York, where they are most in evidence, have prevented a change to a better power.

The Era of Interurban Consolidation

We appear to be now on the eve of an era of extensive consolidation of interurban roads. That such consolidation must come inevitably as a development of the business has been evident for some time. While consolidations in a small way have been taking place continuously since interurban building began, the present developments along the New York Central in New York State and the efforts of the Widener-Elkins syndicate in Southwestern Ohio and Eastern Indiana are probably forerunners of large movements of this kind wherever interurban networks exist. It is as natural that such consolidation should take place on electric interurban lines as on steam railroad, and the same reasons exist which make consolidations desirable. So far there seems to be no effort on the part of steam railroads in the Middle West to follow the example set by the New York Central in getting control of parallel electric lines and using them to take care of and develop a local traffic.

Observation Cars for Sightseers

For several years in a number of our cities which are popular objective points for tourists, the street railway companies have maintained a regular service for the benefit of sightseers and tourists. One of the first of these was the service given by the "Seeing Denver" cars in Denver. That city is yearly visited by many thousands of tourists, who are glad to be able to obtain a car which will take them all over the city without the trouble of transferring and with a guide to point out the places of interest. These "Seeing Denver" cars make several trips a day, leaving the downtown hotels at stated times. Similar service has been given in some other cities, among which Washington, Detroit, Montreal, Cleveland and San Francisco are probably the most prominent examples. In Montreal, as described elsewhere in this issue, a special car has been built for this purpose, and as it is along the lines of a tally-ho, it fulfils admirably the purposes for which it has been designed. While a service of this kind cannot be a very great source of revenue, it is a good thing for the city and indirectly a benefit to the company, as it raises the company in the esti-

mation of the public, both at home and abroad, to have a first-class service of this kind maintained. There are many cities so situated that a service of this kind would hardly pay, but it would seem that a more extensive trial of this scheme would be worth while.

The Automobile in Street Railway Work

To many operating officials the thought of using the automobile in street railway work comes as something of a surprise. In large city systems, however, there is no doubt that a great deal of time can be saved by the employment of the runabout or even the touring car in certain departments. Officials like the superintendent of transportation, chief engineer of power stations, supervisor of rolling stock and others whose duties call them almost daily to all the car houses and mechanical headquarters in the system are seldom able to use surface cars with anything like economy of time. Realizing this, some companies have furnished certain officers with a horse and carriage in times past with excellent results. The automobile is now coming into service in this way, and the ease and flexibility with which such machines can be navigated through streets crowded with heavy traffic, or directed through short cuts not traversed by the company's regular cars, contribute largely to their economy of official time. It is really surprising to find how much inspection can be done in this manner in a day, the point being that the amount of unproductive time lost in traveling from place to place is greatly reduced.

Manifestly it is impracticable for a company to provide all of its higher officials with automobiles, but even one machine can be made to do pretty substantial duty as a starter. Equipped with a suitable tonneau, light supplies can be transferred readily from place to place, and when one official is not using the machine there is little likelihood of its standing idle. Supposing that a company buys a machine costing $2,000 and that it is run 50 miles a day, operating expenses and all fixed charges ought not to exceed $600 per annum—a sum readily saved in the time of the class of officials by which it is used. The matter is well worth thinking about, at all events.

The Testing of Supplies

The purchase of the supplies which are used in the operation and maintenance of equipment upon electric railways is one of the most important essentials in economic operation. In no other line of work are the requirements made upon the materials and supplies used more severe and exacting than here, and variations in quality of materials for certain specific uses may mark the difference between success and failure. It stands to reason that careful study and an intelligent understanding of the situation are necessary in the proper management of the purchasing department, and that this is being recognized is evident from the greater amount of engineering skill that is being employed in the purchasing departments of most of the larger roads, particularly in reference to supplies subject to variations in quality.

It is also obvious that increasing care in the purchase of all classes of supplies is necessary to obtain the best results, on account of the more strenuous operating conditions of modern railway practice. In many lines this has come to signify the laboratory testing of certain classes of supplies. The important part that laboratory testing plays in civil and mechanical engineering lines is well known. In all work of any magnitude, testing is resorted to, and, in many cases, even the manufacturers have elaborate facilities for testing their product. In electrical apparatus the only method to predetermine probable qualities is by test. Not only must quality tests be made, but tests to develop faults in design and construction, to check up theoretical calculations, and finally to predetermine the practical limitations. Elaborate testing facilities are as essentially responsible for the high standard of excellence of electrical materials and machinery put on the market by the larger manufacturer as is the design.

If it is a source of economy for manufacturers, both large and small, to subject their products to thorough tests, it would seem that the purchaser may make use of testing to equal advantage. Large quantities of materials and supplies are purchased by the majority of electric railways without any knowledge of the actual qualities in individual cases. That almost all materials vary in quality is well known; accordingly it is inevitable that some purchasers will receive better grades of materials than others. Furthermore, it is unfortunate but true that in some lines of supplies there are salesmen who are willing to foist inferior grades of goods upon unsuspecting purchasers; this regrettable fact will be only too readily admitted by all purchasing agents.

All this can be remedied by inserting in the specifications or order, when purchasing, clauses referring to strict compliance with specifications, which shall cover all points where inferiority may enter. Public laboratories are now available to purchasers wherein all necessary tests of materials and of any desired accuracy may be made, and the records and reports may be kept confined as strictly in the possession of the purchaser as desired. This relieves the purchasing agent of responsibility in the technical side of the question, with which he may not be familiar, and enables him to secure for his company supplies and materials of the best grades obtainable.

As an instance of the effect of a very slight variation in quality, may be cited the case of copper wire, which, when bought from reliable makers, may be expected to be of uniformly good quality and show but slight variation in quality. On the other hand, it is well known that a variation of 2 per cent in conductivity of the copper wire is equivalent, electrically, to a variation of 2 per cent in the amount of wire that must be obtained for a certain definite carrying capacity, or, in effect, a variation of 2 per cent in the price paid. In one instance recently, a purchaser of copper wire in large quantities had four samples submitted for test, all of which looked very much alike, and variations in quality or conductivity would not have been suspected from the outside appearance; yet under test the conductivity of these four samples were found to be: (1) 57.7 per cent; (2) 65.6 per cent; (3) 80.2 per cent; (4) 99.1 per cent. The moral is evident. Three of the samples were so influenced as to electrical conductivity by very slight variations of chemical composition that their actual value for electrical purposes was seriously impaired. If it is desirable to go to no end of trouble in the power plant, or in a car equipment, to minimize the wastes in operation, it would seem to be fully as important to arrange for tests upon the conductivity of samples of wire before purchasing.

In other lines of supplies exact values cannot be assigned to variations in quality, but nevertheless such variations may be of great importance. The insulators used in construction work upon high-tension distribution lines may vary considerably in strength and resistance, and in view of the serious consequences which may attend the break-down of a single insulator, it is very important to get only the best. The only method of determining the variations in quality in such a case

is by inspection and test. While it is the general practice of all larger companies to buy high-tension insulators subject to inspection and test, still a great many use insufficient care in this direction and are obviously liable to get poor insulators. The cost of testing in this case is, as in many others, well repaid by the greater reliability in subsequent operation which results from it.

Results from the Valtellina Railway

We are glad to present to our readers a full account of the latest methods employed on this important line, together with a complete description of the new locomotive equipment there in use. It must be remembered that, considering the length of track and the character of the service, this is one of the most considerable electric roads in the world; in fact, one of the very few lines whereon electricity is used as a full substitute for steam in ordinary railway working. As the principal example of three-phase traction, its performance has been watched with great interest, and it has now been in operation long enough (three and one-half years) to allow something like a sound judgment concerning its practical performance. About a year ago three electric locomotives of new design and greatly increased power were added to its equipment, and the details of these form an important part of the present article. They possess many interesting features, but by all means the most novel are those relating to the design and support of the motors. As in the earlier passenger equipments, four motors are used, two of them fitted for use in cascade with the others, thus giving a powerful torque at half speed, while at full speed the main primary motors are adequate for all demands. The two normal speeds thus available are 40 m.p.h. and 20 m.p.h., while the rheostats supply the necessary gradations. In these new locomotives, twin motors, each consisting of a primary motor and motor for cascade connection, are united in a single structure, two such units being employed on each locomotive.

On its face, this seems a heavy and somewhat intricate arrangement, but it is more effective than would appear at first sight, since, after all, the total weight of the locomotive is not excessive, being but 62 tons, and the combination is, upon the whole, highly efficient. When connected for high speed, the motor efficiency is stated to be 95 per cent, while in cascade connection it falls to 88 per cent. These figures compare favorably under operative conditions with those obtained from d. c. equipments or a. c. series motors of similar size. The power factor on single connection is a little above 95 per cent, giving thus an apparent efficiency of fully 90 per cent, which should dispose of any fears about the carrying capacity of the line. On cascade connection the power factor falls to 79 per cent, giving an apparent efficiency of only a scant 70 per cent. This is the weak point of the cascade connection, which, however, is only intended for incidental use in the ordinary course of running, so that its total effect upon the efficiency of the system is not serious.

Even more unusual than the structure of the motors is their connection to the axles. There are three pairs of driving wheels on the locomotive, with the two motors spring supported in the spaces between the pairs, and each driving all three axles by means of cranks and connecting rods. The explanation given of this extraordinary design is not altogether illuminating. It is stated that for large units gearing is undesirable, in which we concur, and that the ideal drive for main line traction is by direct-coupled motors. But inasmuch as the flexible connection used on the earlier Valtellina equipment for the direct-coupled motors is stated to have worked satisfactorily in every respect, it is not quite clear why it was abandoned in favor of cranks and connecting rods. Of course, the new arrangement allows much easier access to the motors in case of necessary repairs, but since it is stated that it has not yet been necessary to change the bearings or to renew the bushings, although most of the motor cars have run over 100,000 miles, and that there has been no occasion to repair the motor windings for a year and a half past, the reasoning does not seem particularly cogent. It strikes us that the main function of the new drive is to compel the motors to pull together under all circumstances. However, this much may be said, that the drive does not seem to give any trouble and does not materially affect the efficiency, so that while certainly cumbersome it may be unobjectionable.

More important to engineers than the report on the new locomotives is the general information as to some of the operative features of the system. The current collector in use seems to have satisfactorily solved the problem of dealing with two trolley wires. It is a single flexibly supported bow carrying two long rollers borne by ball bearings on the same shaft. Current is taken from these by carbon brushes. The rollers are found to give fully 12,000 miles without repairs, and the copper exterior shell can then be easily renewed. Current up to 200 amps. can be taken off by this simple contrivance without the slightest difficulty, and the wear upon the trolley wires seems to be practically nothing. The experience of three and one-half years of operation appears also to have shown that the difficulty of operating with two trolley wires, especially at switches and in yards, has been greatly overestimated.

Meter tests on the system, to which we have recently referred, show a very moderate consumption of power, amounting on a year's average, including all the current generated for every purpose on the system, to but 71.6 watt-hours per ton-mile. The peak of the load, it should be added, is about three times the average load for the day. One interesting matter taken up is the effect of the normally constant speed of the motors upon train operation. It is generally understood that making up time on a three-phase road is decidedly troublesome. The necessary leeway is gained on the Valtellina system as follows: First the schedule is left, as it generally is, with a moderate reserve of time. Then in making up time the motorman does any or all of the following: Holds up speed in nearing stations instead of allowing himself a long coast; coasts down grade at increased speed; runs up grades at full speed instead of putting the motors in cascade. These devices have proved effective under the working conditions of the line, and the normally constant speed makes the trains somewhat less liable to lose time that must be made up. With a line having sufficient grades this scheme would seem to work out well enough, but on a nearly level line only the first mentioned recourse would be available, and some further means of getting back to schedule would have to be devised.

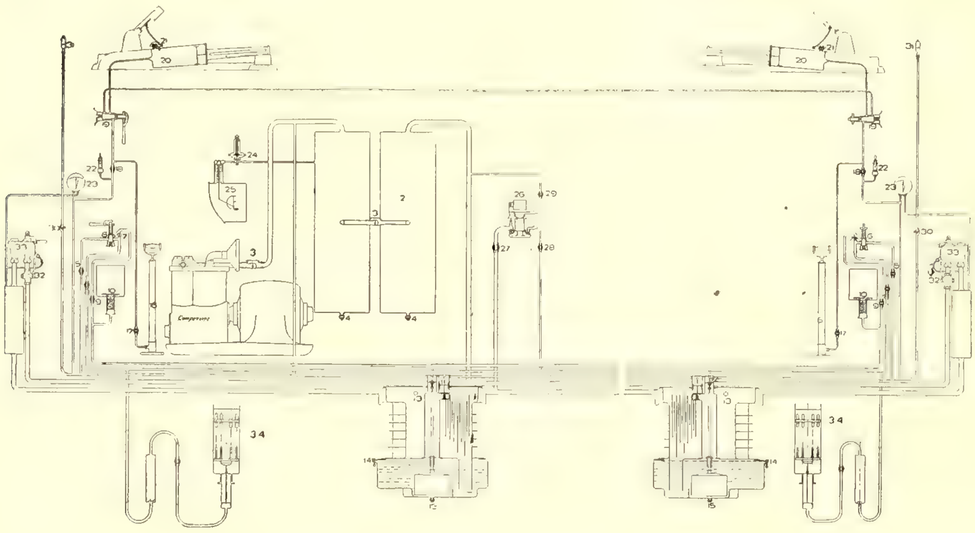
Altogether, Mr. Valatin's paper is most instructive, and we commend it to the earnest attention of our readers, particularly those who have been in the habit of thinking three-phase traction impracticable. Many of the details are worth careful study, for they seem to have been very thoroughly worked out. It must certainly be admitted that the Valtellina system has earned the right to an impartial hearing and need make no apologies, even though it has violated the most sacred canons of American electric railroading. It must, in view of its record, be judged strictly upon its merits.

NEW ELECTRIC LOCOMOTIVES FOR THE VALTELLINA RAILWAY

BY BELA VALATIN

An extended description of the Valtellina Railway in Northern Italy, was published in the issue for May 30, 1903, of the STREET RAILWAY JOURNAL. Since that date the electrical equipment of the line has undergone several changes which will be the subject of discussion, but before considering them it will, perhaps, interest the readers of this paper if the general features of this important line are briefly described.

The Valtellina Railway is a part of the general railway system of the Società Italiana per le Strade Ferrate Meridionali, generally called the "Rete Adriatica" (the Adriatic Railway), which company owns more than 3600 miles of track. The Valtellina line proper is only 106 km, or about 66 miles, in length, the total length of track, including sidings, being about 85 miles.



1—Air reservoir for the electric apparatus
2—Main air reservoir for Westinghouse brake
3—Return valve
4—Discharge cock
5-8-9—Shut-off cocks for the starting cock
6—Starting cock
7—Throttling valve
10—Short circuits
11—Large valve of water rheostat
12—Small valve of water rheostat
13—Feed-pipe for the water rheostat
14—Trying cock of rheostat
15—Discharge cock of rheostat
16—Hand air pump
17—Shut-off cock for the hand pump
18—Shut-off cock for the trolley air pipes
19—Trolley valve
20—Air cylinder of trolley base
21—Trolley safety valve
22—Safety valve and whistle
23—Pressure gage
24—Switch governor for the air pump
25—Automatic switch for the air pump
26—Automatic brake
27—Shut-off cock between automatic brake and brake pipes
28—Shut-off cock between automatic brake and large valve
29—Shut-off cock between automatic brake and main tank
30—Whistle valve
31—Air whistle
32—Shut-off cock from the brake pipes
33—Westinghouse brake valve
34—Primary switch

FIG. 1.—AIR-PIPE DIAGRAM OF THE MOTOR CAR

Three-phase alternating current is generated at the power station at 20,000 volts and 15 periods direct, without step-up transformers, and is distributed by primary conductors along the line and transformed to 3000 volts by means of static transformers, which feed the overhead line at this pressure. There are in all nine transformer stations, each having a normal capacity of 300-kilovolt amperes, except that there is one of double that capacity, but all the substations can be overloaded five to six times their normal load for short periods without damage.

The first electrical equipment of the road included ten electric motor cars and two locomotives, the former for passenger trains, the latter for the freight trains. Each motor car has four motors which are designed for two normal speeds, viz.: 40 and 20 miles an hour. At 40 miles only two single motors are in operation; at 20 miles all four motors are used in cascade connection. Originally, the motor cars were designed for hauling trains of 85 (metric) tons, including their dead weight, the normal capacity of the motors having been guaranteed to be 150 b.hp each. As a matter of fact, they haul at present trains of 180 tons total weight, consisting of the motor car and ten to twelve ordinary railway cars as a maximum, at a speed of 40 miles an hour. Therefore the motors develop about double their normal capacity in ordinary working. In the motor cars compressed air is used not only for the brake signals, but also for controlling the current-collecting devices and for most of the rest of the apparatus. Fig. 1 gives the scheme of the air connections of the motor cars. The weight of the motor cars is 54 tons each.

The two electric locomotives used for freight traffic have four axles, each of them being directly driven by one motor. The weight of these locomotives is 46 tons. They have only one normal speed, i.e., 20 miles an hour; therefore all motors are high tension, although provisions are made to enable the use of only one part of the motors if the load is less. Each motor is designed for a normal capacity of 130 bhp and 128 r. p. m., the maximum tractive force of the locomotives being 8 tons at the above speed, measured on the periphery of the wheels.

Two peculiarities of the equipment should receive especial mention: the current-taking device and the water rheostat. Both were severely criticized when first proposed, but both have proved very satisfactory in actual practice.

THE CURRENT COLLECTORS

The current collectors consist of two long rollers mounted on the same wooden shaft and rotating in ball bearings. The current is taken from them by carbon brushes. They give a broad contact surface of 24¾ ins. for each phase, the distance of the two wires apart being 34¼ ins. It has been proved by three years' experience in actual service that the advantages claimed for this device really exist, viz.:

(1) They combine the advantages of the trolley wheel, the rolling friction, with that of the broad contact of a Siemens bow.

(2) They are perfectly safe and practically sparkless, even at currents of 200 amps. and speeds of 40 m.p.h. Trials were made with a speed of 60 m.p.h. and 100 amps, and the result was quite satisfactory, both for the current collectors and for the present overhead construction. These trials did not leave any doubt that with this device the problem of electric traction with considerably higher speeds and large capacities is easily to be solved.

(3) The maintenance and repairs are small, especially if one considers that for high-tension lines the ordinary trolley wheel cannot be used, owing to the difficulty in handling the same when jumping off the wire. Several electric railways running at high speed have tried to use the bow contact, but in all cases the result has been an extraordinarily quick wear and a high figure of maintenance. On the other hand, the cylinder contacts on the Valtellina line will run 12,000-locomotive or car-miles without repair. The latest form is a steel tube contact cylinder covered by a sheet of electrolytic copper. After running about 12,000 miles up to 25,000 miles this copper covering is renewed and the contact cylinders can be used again.

Not only is the maintenance of the current collector low, but that of the trolley wires is also considerably reduced by the use of these rollers. The Valtellina line has now been running

for about 3½ years (including the 1¼ years of the trial run), and it is not even possible as yet to measure any diminution of the section of the trolley wire. There is a small surface, about 1-32 in. broad, on the bottom part of the wire which is polished by the rollers, but there is no other sign of wear. This fact furnishes enough evidence of the advantages offered by this system of current collection.

WATER RHEOSTATS

The Valtellina line was the first to use water rheostats as starting devices for traction purposes. Compressed air moves the water to and from the plates of the rheostat, producing a contact of a more or less broad surface and thereby varying the resistance. In the early periods of the service the cooling of the water was not quite sufficient, owing to the fact that the rheostats were originally calculated and constructed for a smaller capacity. But after the necessary alterations were made, the water rheostats proved more suitable for railway service than metallic ones. Their weight is less; moreover, repairs which, in the case of metallic rheostats, are sometimes very troublesome are practically avoided, as water rheostats do not burn when overloaded, nor does solder melt out. The worst that can happen is that the water evaporates. Accordingly, the overload capacity of the rheostats is large. Starting can also be effected very smoothly, as there are no steps in going from one speed to another.

OTHER FEATURES

Another important result of the Valtellina installation is the proof furnished that the small air gap in three-phase traction motors does not interfere with the safety of the railway traffic in any way, supposing the bearings are properly designed. Most of the motor cars have run over 100,000 miles, and it has not yet been necessary to change the bearings or to renew the bushings. Only two or three break-downs have occurred which were due to the burning out of the bearings, and all these cases were caused through the carelessness of the attendant in forgetting to oil the bearings. A great deal has been said, also, in technical periodicals about the difficulty of using two overhead wires in switches and station yards. They are said to be complicated and to involve a constant danger to railway working. Exact notes were made by the exploiting company concerning expenses, and on going over them for the last year we see that the cost of maintenance and repairs of the air-switches was only a very small percentage of the whole cost of maintenance of the overhead line, and quite unimportant.

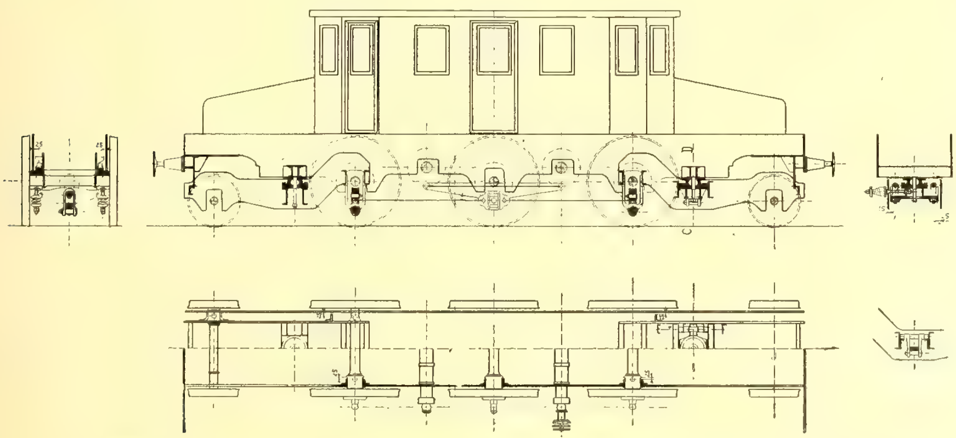


FIG. 3.—DIAGRAM SHOWING GENERAL ARRANGEMENT OF NEW LOCOMOTIVE

THE NEW LOCOMOTIVES

As has already been stated, the passenger trains on the Valtellina Railway are being operated by motor cars. In extending the service, however, the company decided, after a careful study of the question, to employ electric locomotives.

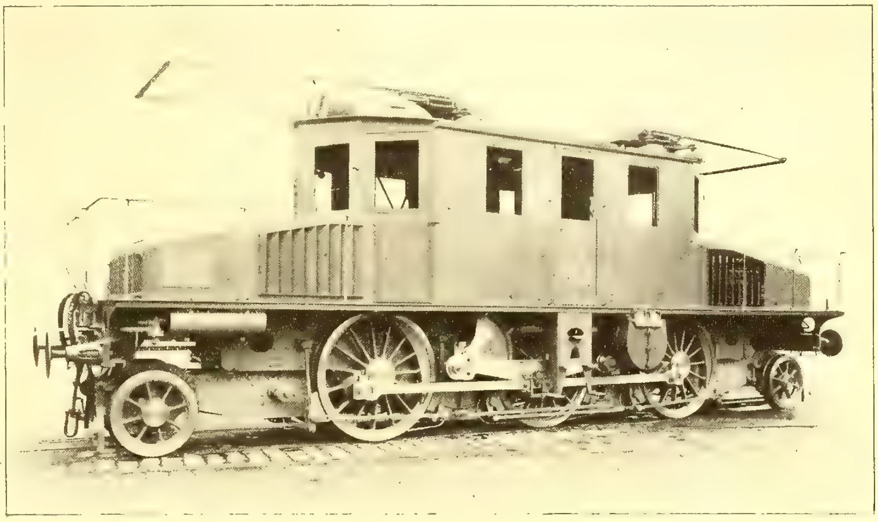


FIG. 2.—SIDE VIEW OF NEW LOCOMOTIVE

This decision was reached partly because the line connects with others, and the use of through cars was thought to be a convenience, and partly because it was thought that the cost of inspection and maintenance would be smaller.

Specifications for three locomotives were accordingly sent out by the railway company in October, 1902. The principal characteristics of the locomotives in question were to be the following: The locomotives should have two two-axle trucks, all axles being driven by gearless motors. The maximum pressure per axle should not be more than 16 tons. The motors should be fed by three-phase alternating current at 3000 volts and 15 periods, the locomotives to have two economical speeds, one about 40 m.p.h., the other about 20 m.p.h. The normal tractive force at constant working was to be 3.5 tons at the higher, and 6 tons at the lower speed, measured on the circumference of the driving wheels.

According to these specifications, Ganz & Company put in a tender on an eight-wheel locomotive, in which the four motors were direct coupled to the axles by the same type of flexible coupling used on the locomotives and motor cars of the original equipment.

The order of the railway company was placed with Ganz & Company in March, 1903, on the lines of their tender for these three locomotives, two locomotives being ordered exactly as tendered for; the third one was stipulated for as a special design.

At the same time, however, both Ganz & Company and the engineers of the railway company studied more carefully the question of driving the locomotive axles, and came to a solution which the railway company accepted finally for all three locomotives, i.e., using cranks and coupling rods, as shown in Fig. 2.

As already mentioned, in the specification of the railway company the solution with gearing was excluded. To use geared motors had for a long time been the general solution of electric driving. This is undoubtedly proper for small machines, but for outputs of several hundred horse-power, geared motors

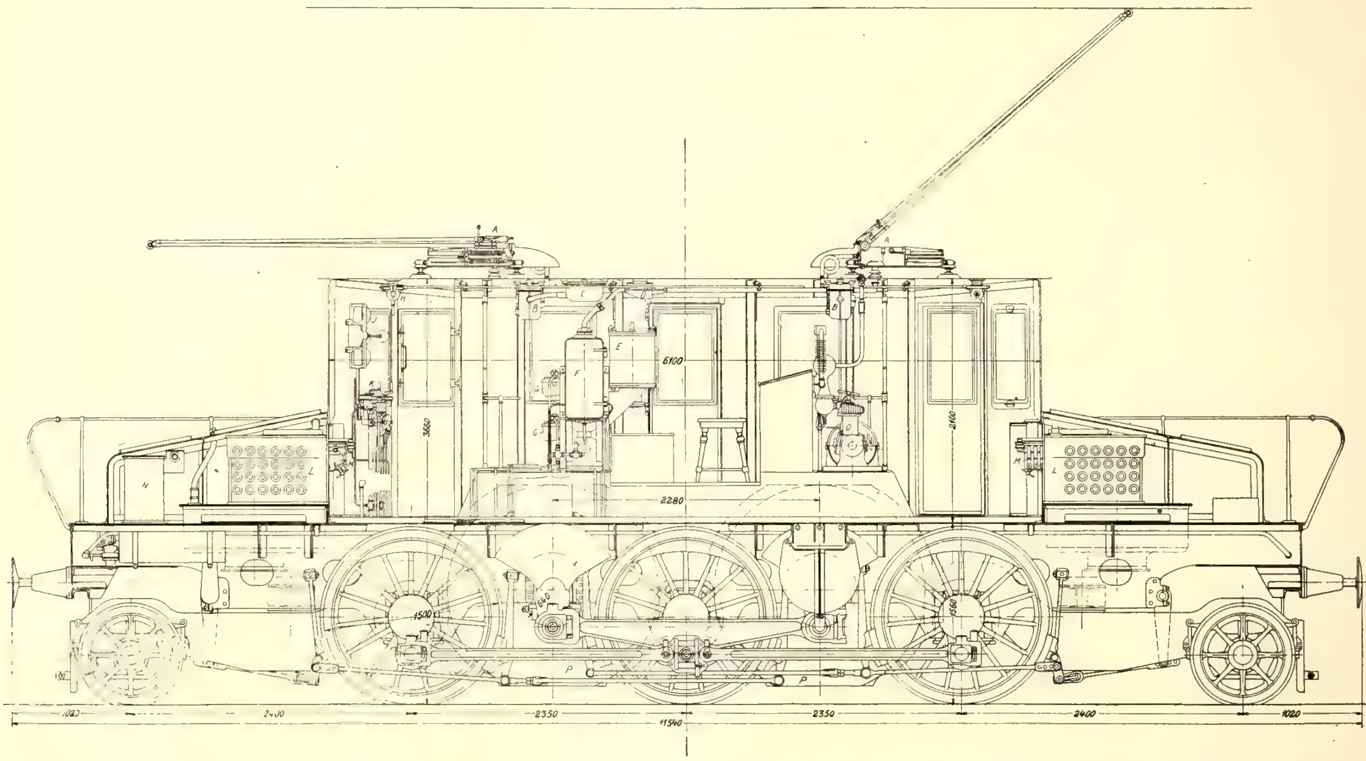
would cause much trouble, both in their designing and in their operation. The gears themselves occupy valuable space, which would otherwise be available for the motor. The cost of repairs is increased, and so is also the watt consumption, owing to the losses in the gearing.

The ideal solution for main-line traction is direct-coupled motors. They have been used in several instances, but have become discredited, in some cases, owing to being rigidly connected to the axle and to their weight being spring-borne. For the motor cars and in the first locomotives of the Valtellina also, direct-coupled motors were used with a flexible coupling between axle and motor. A description of this coupling was given at the time, and it need only be stated in this connection that during two years of service it has proved to be quite practical and to work satisfactorily in every respect.

Direct coupling has, nevertheless, great drawbacks in the eyes of the railway engineer, especially in the case of induction motors. As the casing of the latter is not made of two pieces, it cannot be opened, and in case of any repairs on the windings, the wheels have to be pressed off the axles. For the new Valtellina locomotives, therefore, the following solution was adopted: The motors run with the same number of revolutions as the driving axles, but are mounted between the two axles and drive the axles with cranks and coupling rods.

Fig. 3 shows the general design of these locomotives. They have ten wheels (five axles), six of them being driving wheels. The total weight of the locomotive in working order is 62 tons, 42 tons being divided as adhesional weight on the three middle axles, and 20 tons as dead weight on the first and fifth axle.

The main advantages to be claimed for this design are: The motors, being built in between two axles, may easily be taken out for repairs and can be replaced by other motors. The slip-rings and brushes of the motors are put outside of the locomotive frame, the use of such a design enabling ready access to those parts of the motors which require attendance and revision. As all driving axles are driven by all motors with the same mechanism, there is no danger that different loads are thrown upon the individual motors, or that one of the driving axles should slip. The mechanism has no dead point, the cranks on the two sides being keyed at a different angle of 90 degs. This mechanism has only rotating parts, which can be completely balanced by counter-weights, so that no disturbing oscillations can arise by unbalanced masses, as in the case of steam locomotives. The energy losses in the mechanism are small, whereas the piston rods and connecting rods cause the most friction in the mechanism of a steam locomotive. The weight of the motors has no hammering effects on the rails, as all parts are spring-supported.



A—Trolley
B—Main fuses
C—Choking coil
D—Distributing box
E—Speed controller
F—Primary switch
G—Automatic relays
H—Trolley controller
I—Measuring apparatus
K—Master controller
L—Water rheostat
M—Head of the water rheostat
N—Transformer
O—Compressor
P—Twin motor

FIG. 4.—LONGITUDINAL SECTION OF LOCOMOTIVE

THE MECHANICAL DESIGN

The locomotive is driven by two motors, one of which is placed between the second and third axles, and the other between the third and fourth axles. The locomotive has only one fixed axle, viz., the middle one. The other two driving axles have a range of movement sidewards of about 1 in. At both ends of the locomotive there is a pony axle (a leading and trailing axle, respectively), both having a radial movement, one of them also has a lateral movement. This portion of the design is not new, as it has been used with the best results with steam locomotives of the Adriatic Railway and was designed by the company's own engineers. The electric locomotive can be run equally well in both directions.

The fixed wheel base of the locomotive is the distance from the middle driving axle to the middle of the fixed truck. The design of this truck allows of a very smooth running in curves, and has over other designs the advantage of the weight being transmitted by the bolster and by the side frame of the truck to the axle boxes, and that the distribution of the weight is perfectly secured.

A general description of the driving mechanism has already been given. There is yet to be mentioned the special arrangement, which has been patented by Mr. de Kandó, by which, although the axles are not in the same horizontal line, there can be no vertical forces which will increase or decrease the

pressure on the rails. The cranks of the motors are connected by a coupling rod, which again is connected to the crank of the middle driving axle, but the bearing on this crank is permitted a free vertical movement in the rod. Both sides of that portion of the rod are linked in by bolts, the coupling rods being connected to the cranks of the next driving wheels of the locomotive.

Fig. 4 is the side view of the whole locomotive, showing the general arrangement of both the mechanical and electric parts. The total length between the buffer ends is 11,540 mm (37 ft. 10¼ ins.), the diameter of the driving wheels 1500 mm (59 ins.); that of the idle wheels 850 mm (33½ ins.). In the middle of the locomotive is the motorman's cab. The front of the cab is so shaped as to reduce the air resistance when running at high speed. At both ends it has a continuation of the casing with oblique surface, which covers the rheostats. The cab is provided with doors on both sides and also at both ends, enabling a communication with the next carriage along the outside of the locomotive.

The two main speeds of the locomotive correspond to the cascade and single connection of the motors. In cascade connection each pair of motors is combined in such a manner that the primary of the one (the high-tension motor) is connected to the line, whereas its secondary is connected to the primary of the other motor. The secondary of the second motor is either connected to the rheostat or short-circuited. In single connection each motor used is independently connected to the line.

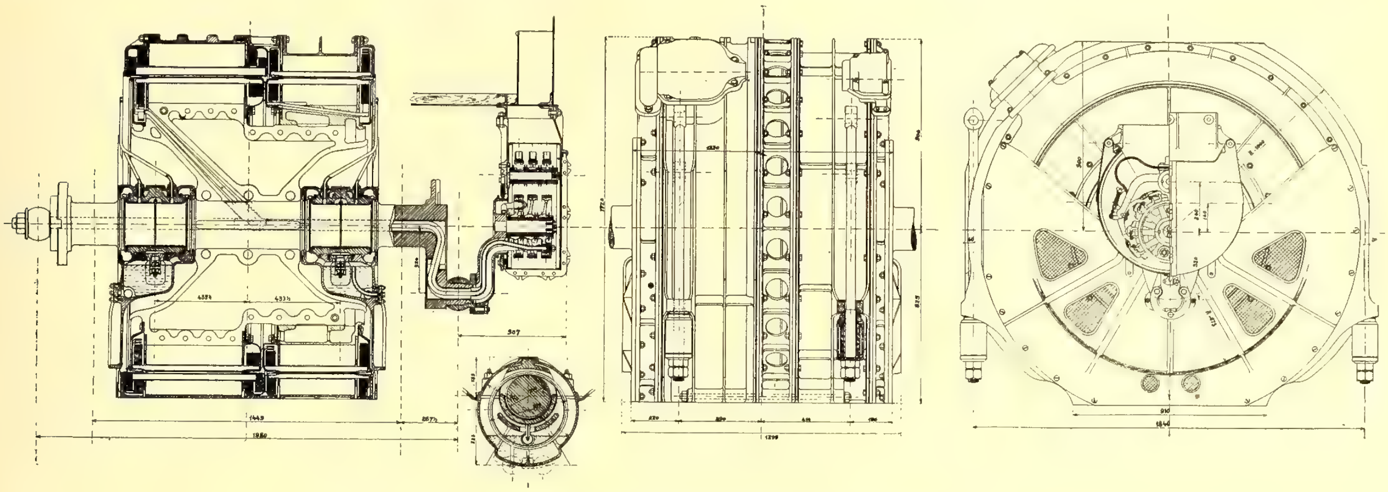


FIG. 5.—SECTION AND ELEVATIONS OF MOTOR

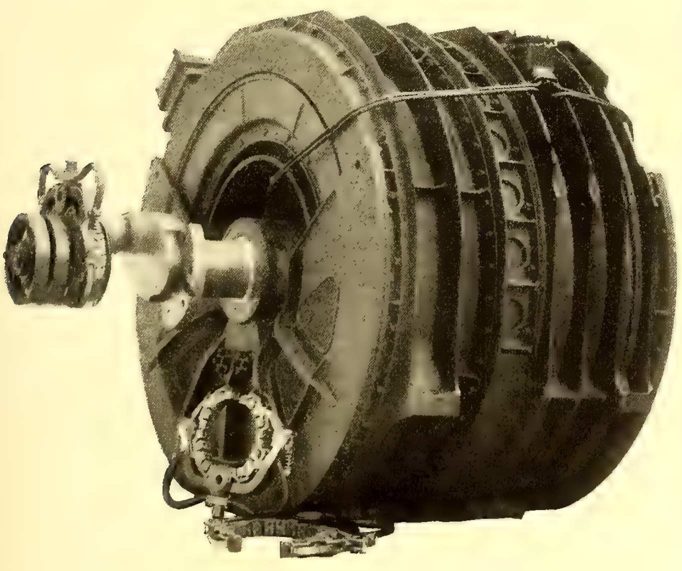


FIG. 6.—SIDE VIEW OF TWIN MOTOR

MOTORS

The locomotive is equipped with two motors of the same type. (See Figs. 5 and 6). Both are double motors uniting a high-tension and a low-tension motor on the same axle and in the same casing. Both halves of these twin motors have eight poles, and accordingly the number of revolutions is 225 per minute, or when working in cascade 112.5 per minute. During the official tests they have repeatedly developed double their normal tractive force, even when the voltage dropped about 25 to 30 per cent.

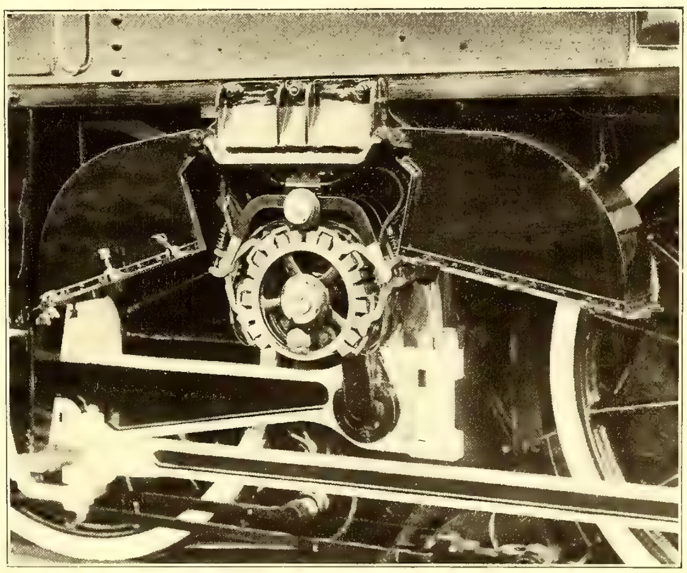
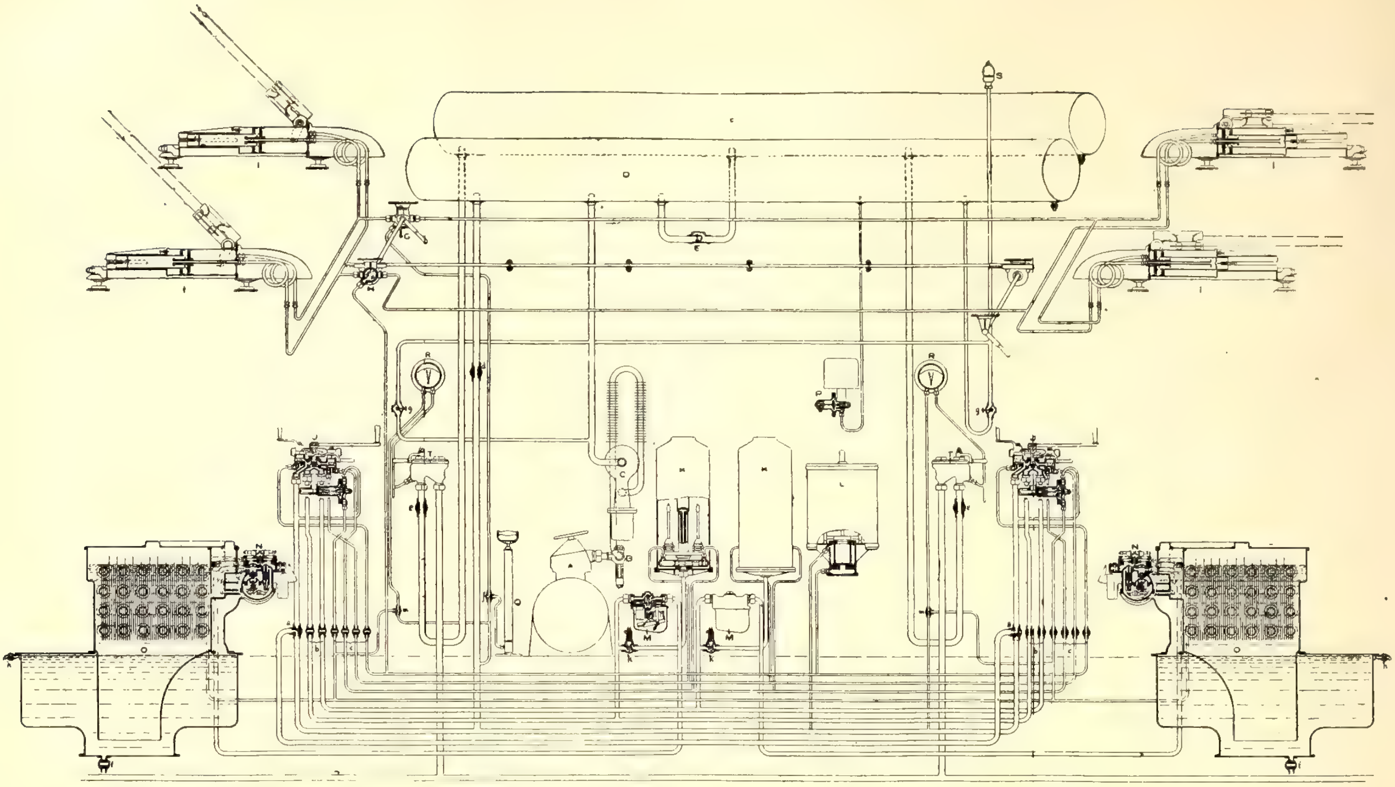


FIG. 7.—SLIP RINGS AND BRUSHES

The two halves of the twin motor have common slip-rings. When the group works in single, only the high-tension motor is switched in, and then its rotor is short-circuited through the slip-rings. When the two motor halves work in cascade, the slip-rings are not used at all, since the two rotors are connected together and the stator of the second motor is short-circuited.

Fig. 11 represents the electrical wiring scheme of the locomotive. Fig. 8 gives a scheme of the air-pipe connections. All apparatus for taking off the current and for actuating and regulating the motors are controlled from one place by means of compressed air, viz., the current-collecting device by means of the so-called trolley valve, the driving apparatus by the pneumatic master-controller.



A—Compressor
B—Return valve with dash pot
C—Oil separator
D—Air tank for the electric apparatus
E—Return valve
F—Air tank for the air brake
G—Trolley controller (direct acting)
H—Trolley controller (indirect acting)
I—Trolley base
J—Pneumatic master controller
K—Primary switch
L—Speed controller
M—Automatic relays
N—Automatic governor of the rheostat
O—Water rheostat
P—Switch governor of the rheostat
Q—Hand air pump
R—Manometer
S—Air whistle
T—Air-brake valve
a—Shut-off and safety cock
b—Shut-off cocks for the two motor groups
c—Shut-off cocks
d—Principal shut-off cock
e—Shut-off cock of the air brake
f—Shut-off and commutating cock
g—Whistle valve
h—Trying cock.
i—Escape.
k—Commutating valve for the primary switch.
m—Commutating cock for the air reducer.

FIG. 8.—AIR-PIPE DIAGRAM OF THE MOTOR CAR

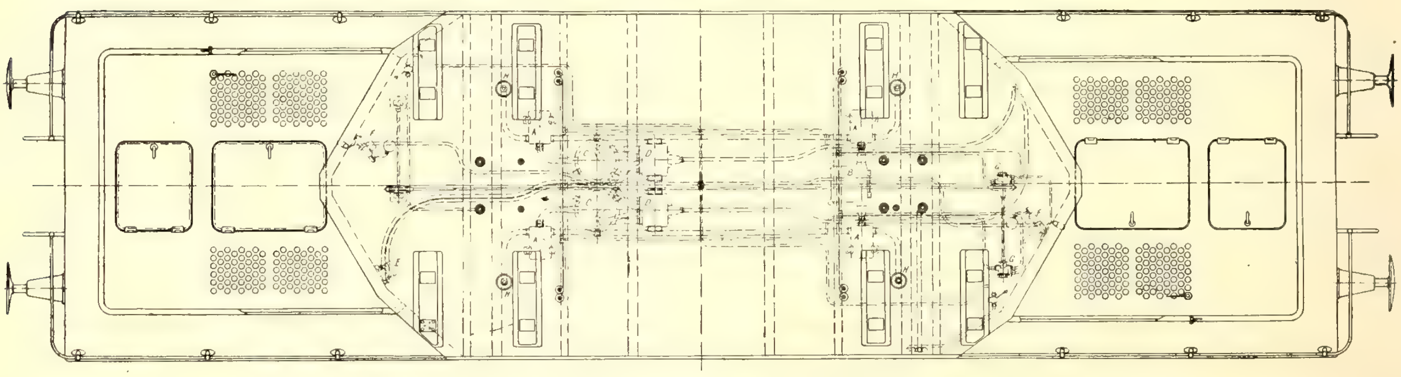
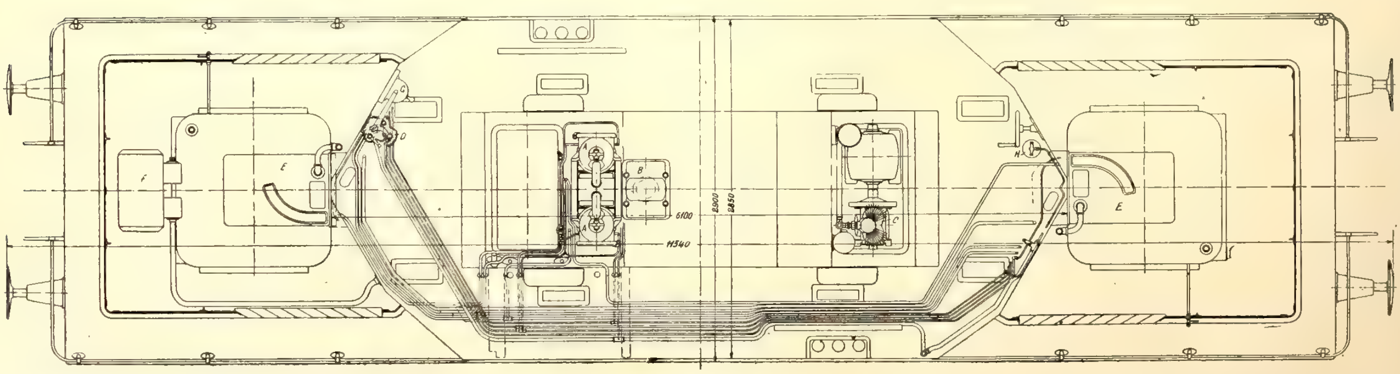


FIG. 9.—FLOOR PLAN OF LOCOMOTIVE, SHOWING ARRANGEMENT OF APPARATUS



A—Primary switch
B—Speed controller
C—Compressor
D—Master controller
E—Water rheostat
F—Transformer
G—Hand switch for compressor
H—Hand air pump

FIG. 10.—HORIZONTAL SECTION NEAR ROOF OF LOCOMOTIVE, SHOWING ARRANGEMENT OF APPARATUS

CURRENT COLLECTOR

The locomotive is provided with the same system of current collectors as has been used on the other vehicles of the Valtellina Railway. That is, two pairs of current-collecting rolls are used, working alternately, corresponding to the two directions of the run.

The under frame of the current collector differs in some features from the older construction, as will be seen in Fig. 15, which is from a photograph of the current collector or trolley base, and Fig. 12, which is a longitudinal section of the trolley base.

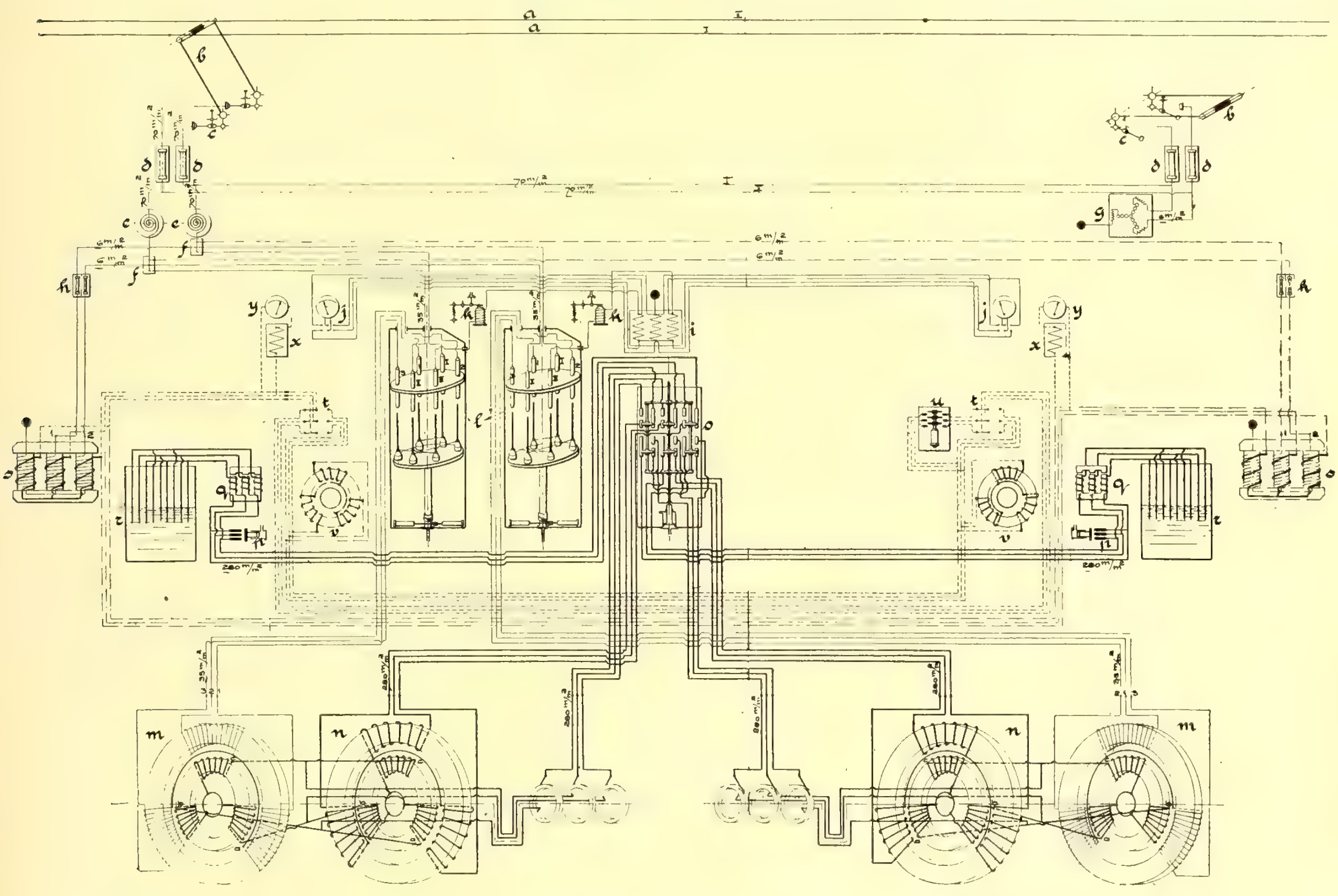
The current-collecting rollers are pressed against the overhead wires by compressed air, which is conducted into the cylinders of the under frame. In order to lessen the shocks in raising or lowering the current collector, a glycerine dash pot is used. Previous experience has shown that the current collectors give greatest satisfaction when pressed against the overhead wires with a pressure corresponding to the running speed. Accordingly, two degrees of pressure are provided, corresponding respectively to the two main speeds of 64 and 32 km per hour. When inserting the trolley valve, compressed air is admitted only to the surface of the main piston, corresponding to the lower speed. When regulating with the pneumatic master-controller up to the higher speed, compressed air passing through the bore of the piston rod is simultaneously admitted to the surface of the auxiliary piston, which further compresses the trolley spring and causes a greater pressure on the wires.

The pressure on the contact wires by the current collector at the lower speed is 6.6 kg (14.5 lbs.); at the higher speed, 8.5 kg (18.7 lbs.).

Another novelty of the current collectors of these locomotives consists in a switch, which is inserted in the current leads, and which is automatically opened (Fig. 11) when the current collectors are lowered. In this way all connection between the trolley wire and the inner part of the locomotive, as well as with the other current collector, is broken. Accordingly, the current collector, which is lower, is without current, while the other is raised. The switch is of the knife-blade type, and is arranged on the roof of the locomotive below the casing of the trolley base.

The trolley base (four for each locomotive), rests on four special high-tension insulators, which are cast-iron balls with wrought-iron fastening bolts. The bolt is separated from the ball by three layers of insulation, consisting of stabilit, porcelain and stabilit.

The regulating valve for the current collector is similar to that used on the other cars on the Valtellina Railway, and can be operated from either end of the car. The valve is so arranged that the trolley cannot be put on the wire unless the cases of all of the high-tension apparatus are closed.



a—Trolley wires
b—Trolley
c—Trolley cut-out
d—Main safety fuses
e—Choking coil
f—Distributing box
g—Lightning arrester
h—Safety fuses of transformer
i—Shunt for ammeter
j—Ammeter
k—Automatic relays
l—Primary switch
m—Primary motor
n—Secondary motor
o—Speed controller
p—Short circuiter
q—Water rheostat
s—Transformer
t—Commutator (by hand)
u—Switch governor of compressor
v—Compressor motor
x—Additional resistance of voltmeter
y—Voltmeter

FIG. 11.—WIRING DIAGRAM OF THE LOCOMOTIVE

ELECTRICAL EQUIPMENT BETWEEN THE TROLLEY AND PRIMARY SWITCH

The high-tension cut-outs, lightning arresters, choking coils and fuse box are fitted on the lower side of the roof of the motorman's cab. The current from the current collector passing through high-tension leads is first carried to the high-tension main fuse box, on the inner side of the motorman's cab.

There are two such single-pole main fuses on each side of the locomotives. The bóxes are enclosed, and the cut-outs are imbedded in porcelain.

After passing the cut-outs the conductors coming from the two current collectors are connected together, and connections are then branched off to the high-tension lightning arresters, Fig. 18. The latter consists of a series of zinc rollers arranged

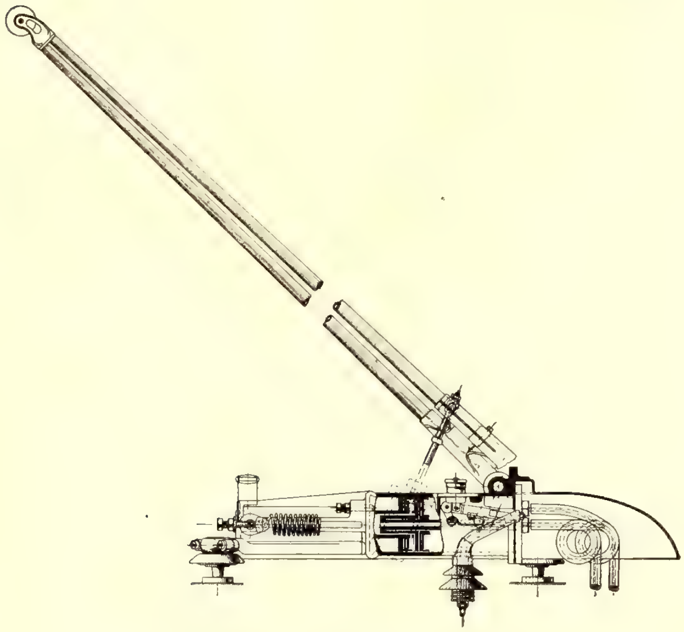


FIG. 12.—CURRENT COLLECTING DEVICE

in a locked box. The zinc rollers are connected in Y. The two end rollers are connected to the main conductors which join the current collectors. The third end roller is earthed by graphite resistance, and the whole apparatus is mounted in a piece of porcelain.

After passing the lightning arrester, the two main conductors are carried through one choking coil to the main distributing boxes, each of which has four branches, two for the primary switch and two leading to the lowering transformers, which supply the air compressor with current.

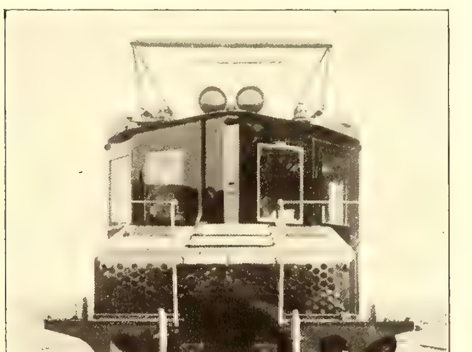


FIG. 13.—FRONT VIEW OF LOCOMOTIVE

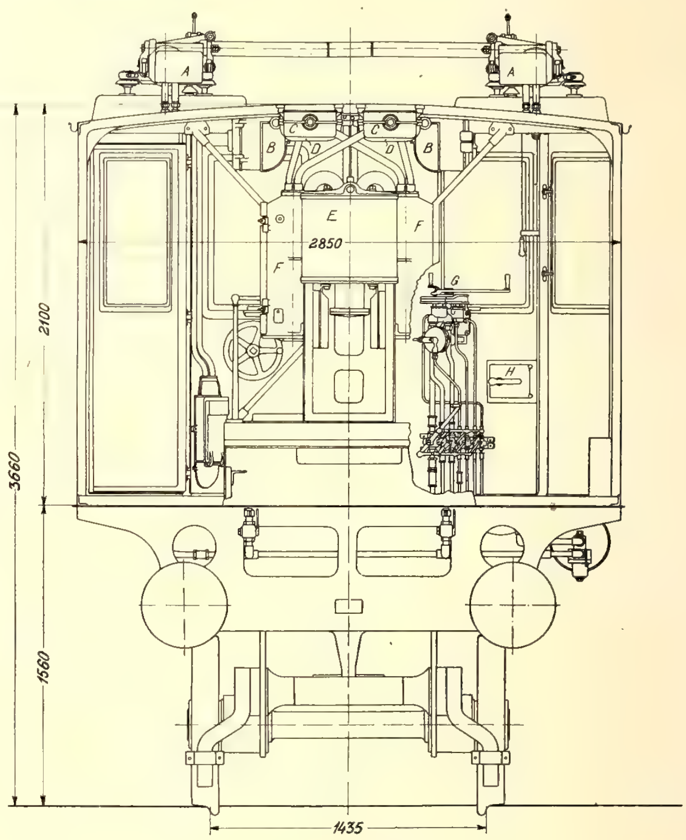
All high-tension conductors of this locomotive are placed in metal tubes, which are carefully grounded.

PNEUMATIC MASTER CONTROLLER

Through the two pneumatic master controllers fitted at both sides of the locomotive is operated the entire connecting and regulating apparatus of the motors, viz., the two primary switches, the speed controllers and the two water rheostats, including the short circuiter. In this respect only two of the locomotives are alike, because the third locomotive, for experimental purposes, was fitted with metallic instead of water resistances. A description of these resistances will be given later on.

The pneumatic master controller, Fig. 16, is a combination of valves. It has three levers performing various functions and being interlocked. The main lever, A, which is also a starting lever, serves for operating the starting and regulating valve. At standstill the starting lever stands vertically to the longitudinal axle of the locomotive. At starting, the locomotive driver pulls the starting lever towards himself, when it describes a certain angle and is brought into its first position at which it acts upon the starting lever, C, and thus admits compressed air to the primary switches and rheostat switchheads. By this means the primary switches are first thrown in, while the rheostat heads are brought into a position at which, while not yet in circuit, are ready to be acted upon by the regulating valve. When the lever is further turned, the regulating valve, D, begins to act and effects the insertion of the water rheostat.

The second, shorter lever, E, below the starting lever, is the



A—Trolley base
B—Main fuses
C—Distributing box
D—Choking coil
E—Speed controller
F—Primary switch
G—Master controller
H—Hand switch for compressor

FIG. 14.—ARRANGEMENT OF THE APPARATUS IN THE MOTORMAN'S CAB (TABLE)

reversing lever and acts upon the reversing valve. The outward position of this lever makes the locomotive run forward, whereas, if the lever is thrown towards the inside, the locomotive moves backward. The regulating valve has two openings, which are connected with the corresponding parts of the air pistons of the primary switch. According to the position of the regulating valve these openings are connected either with the air tank or with the open air. The third lever, F, at the left hand of the starting lever, is the speed lever, and connects the motors either in cascade or single.

The various levers are interlocked in such a manner as to allow of the reversing lever and speed-regulating lever being moved only when the starting lever is in its initial position, so that both the primary switch and the rheostat are disconnected. On the other hand, the starting lever can be moved only when the two other levers are in their end positions.

Since there are two pneumatic master controllers on the locomotive, care has been taken that these cannot be used simultaneously. As will be seen from Fig. 14, there are below the master controllers seven regulating cocks arranged in the

seven air pipes leading to the switch, which may be simultaneously operated with a single lever. Fig. 11 shows which pipe connections correspond to the two positions of this lever. Thus, the pneumatic master controller receives the compressed air from the air tank through the regulating cocks of the other driver's stand. If both groups of regulating cocks were placed in the position indicating "run," none of them could receive air from the reservoir. Thus the pneumatic master controller can be put to action only when the supply cocks of the other one are closed.

Two cocks are inserted in the air pipes which, leading from the starting valve to the primary switches and rheostats, are separately disconnectable, so as to allow of each pair of motors being perfectly cut out in case of breakdown.

PRIMARY SWITCH

Each group of motors has a separate primary switch, the two primary switches being placed on a common base in the middle of the motorman's cab, as shown in Figs. 4 and 9. They are constructed on the same principle as the primary switches of the other Valtellina vehicles, being of the dry-piston type. The switches are actuated throughout by compressed air for throwing in as well as for reversing. The switches are thrown in such a manner that a plate holding the contact plungers is lifted by the admission of compressed air through the starting valve of the master controllers whereby the contact plungers are pressed into the contact tubes. The contact is broken per phase at two points. The reversing can be done only with a primary cut-out switch. It is effected by the plate with the contact plunger being turned at an angle of 60 degs. For this purpose two pistons are provided connected with the reversing valve of the pneumatic master controller. According as the one piston or the other is connected with the reservoir or the open air, the plate assumes the corresponding position.

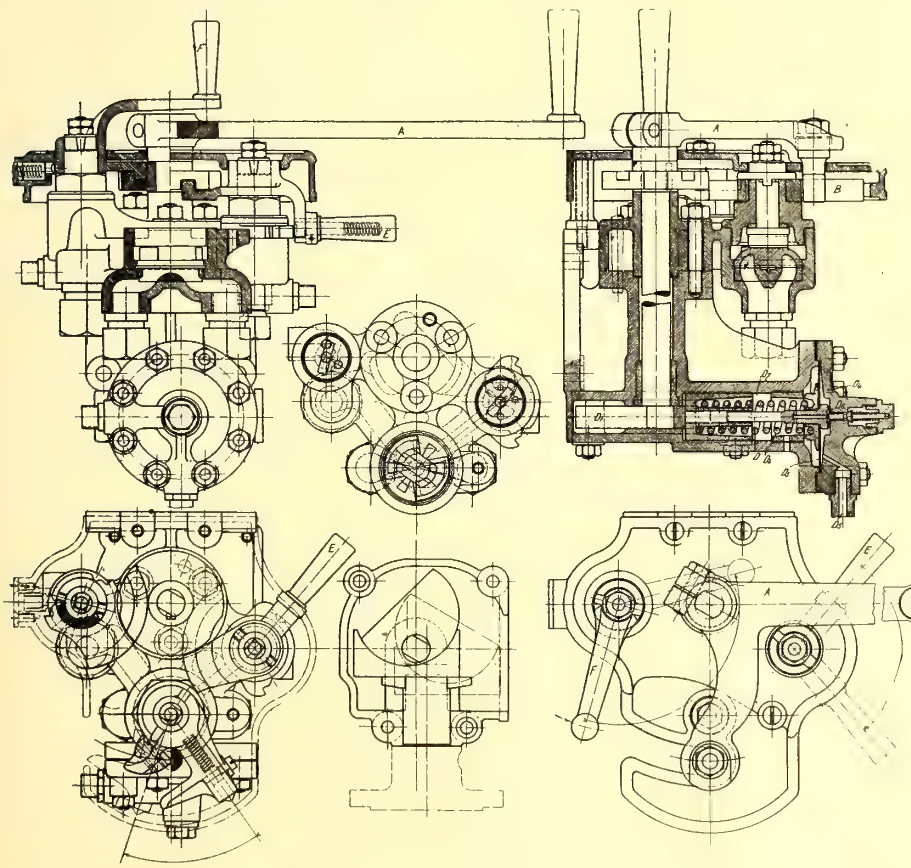


FIG. 16.—SECTIONS OF MASTER CONTROLLER

SPEED REGULATOR

The speed regulator serves for connecting the two twin motors in cascade or single. Figs. 5, 6 and 11 show the construction of this apparatus. On one axle are the contact brushes, which bring about the two different connections, and this axle can be shifted in a vertical direction. It terminates in the piston of an air cylinder whose smaller and upper surface is connected with the air reservoir, so that the air pressure ordinarily holds the apparatus in the lower position, which corresponds to the cascade connection. The larger surface on the bottom of

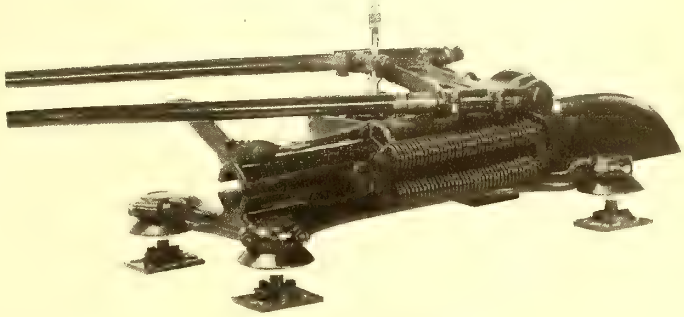


FIG. 15.—TROLLEY BASE

the piston is in connection with the atmosphere through the speed-regulating valve of the pneumatic master controller. Now, when the lever, F, of the master controller is in the position indicating high speed, compressed air flows through the speed-regulating valve into the lower part of the cylinder, and in consequence of the larger pressure surface the piston is pressed up and thus it effects the connection in single. Since the corresponding lever of the pneumatic master controller can be moved only when the starting lever is at zero, it is impossible to operate the speed regulator except when it is without current.

WATER RHEOSTAT

For every twin motor there is a water rheostat, which is built on a similar principle to that used for the other cars of the Valtellina Railway. Essentially, the rheostat consists of a vessel made of two parts. In one part three groups of sheet-iron plates are suspended. When not in circuit the water does not touch the sheet-iron plates. When the rheostat is thrown into circuit compressed air is admitted into the other part, forcing the water upward around the plates. The more air is admitted to the rheostat, the greater will be the surface of the plates in contact with the water until the resistance becomes a minimum. The connections from the three secondary motor ends are then short-circuited by a shorter circuiter. Fig. 17 shows this water rheostat.

ELECTRICAL EQUIPMENT OF THE THIRD LOCOMOTIVE

Two of the locomotives supplied are of identical construction; the third one differs from the two inasmuch as instead of water rheostats metallic resistances have been used to gain experience with this type. Accordingly, also, the master controllers and the apparatus for operating the resistances are of another design. In other respects the equipment of this locomotive is perfectly identical to that of the other two locomotives,

The resistance switches represented in Fig. 22 consist of six rings of contacts insulated from one another, being on the one

hand connected to the terminals of the secondary motor, and on the other hand with the various steps of the resistances. On a vertical shaft operated from below by a chain pulley from the motorman's stand, contact knives are arranged, which, by

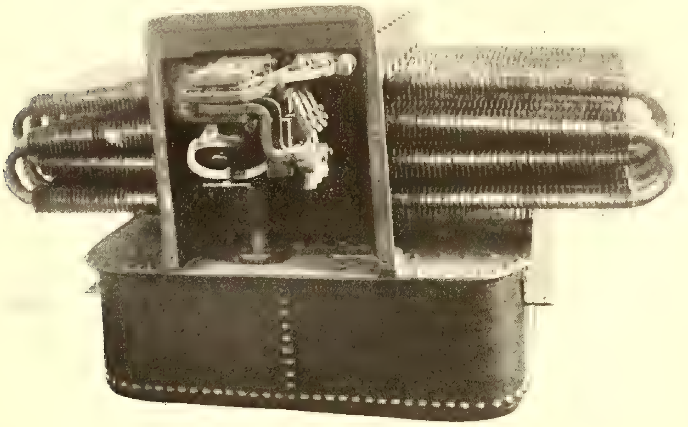


FIG. 17.—WATER RHEOSTAT

turning the shaft further, disconnect, step by step, the resistances until in the last position the secondary terminals of the motor are short-circuited.

TESTS ON THE NEW LOCOMOTIVES

Of the new locomotives the first was delivered in May, 1904, and put in regular operation in June. The two others were delivered somewhat later, but all three new locomotives have been in regular service since September. Before commencing regular operation they were tested thoroughly by the Government authorities, as well as by the railway company, to determine whether they fulfilled all the guarantees. It is characteristic of these locomotives that when the first one was put in operation it came up to the requirements of the service at once, and continued to do so until, after a month's time, it was taken out of the service for a day for inspection. The locomotives haul passenger trains up to 250 tons in weight and freight trains up to 400 tons. Fig. 23 shows a freight train at Colico station.

During the tests with these locomotives a dynamometer car was put between the locomotive and the other part of the train, which permitted a measure of the draw-bar pull and speed of the locomotive as a function of the time and of the distance. One test made with these locomotives covered thirty successive startings with a train of 400 tons to a speed of 30 km at time intervals of 120 seconds. During these tests a tractive force was observed several times with the dynamometer car, which, reduced to the circumference of the wheels, was about 12 tons, thus being about double the normal in cascade connection. It should also be mentioned that on such occasions a very great drop of the voltage was observed; the tension generally amounted to not more than 2200 volts to 2300 volts. This fact proves the great overload capacity of properly designed three-phase traction motors, even if the drop should be about 25 per cent.

The efficiency of the motors is about 95 per cent in single connection, and 88 per cent when connected in cascade. The power factor is 95.6 per cent in single and 79 per cent in cascade connection.

Another series of tests made with these locomotives was to measure their own resistance. The locomotive was accelerated to its highest speed, and then, with its current cut off, the locomotive coasted on a line with known grades. By measuring the distance and time it was possible to fix the resistance of the locomotive itself. At a speed of about 60 km this resistance amounted to 5.5 kg (12 lbs.) per ton, whereas, at a speed of 30 km the resistance was only 2.8 kgs (6 lbs.) per ton. This shows that the coupling rods do not increase the resistance of the locomotive considerably, and that the resistance of the locomotive is not much more than that of an ordinary car.

Fig. 24 shows two interesting run-diagrams with the new locomotives. The first of the two shows the run with a train of 286 tons from Cosio to Ardenno, the second run with a train of 280 tons from Ardenno to Cosio. The diagrams also show the grades of the line. The portions of the run made in cascade connection are distinctly marked.

From this diagram it will be clearly seen that the motors recuperate energy on down grades. The diagram is also very interesting from the point of view of showing that the train runs at a speed of 60 km (36 miles) per hour on a grade of 1.7 per cent.

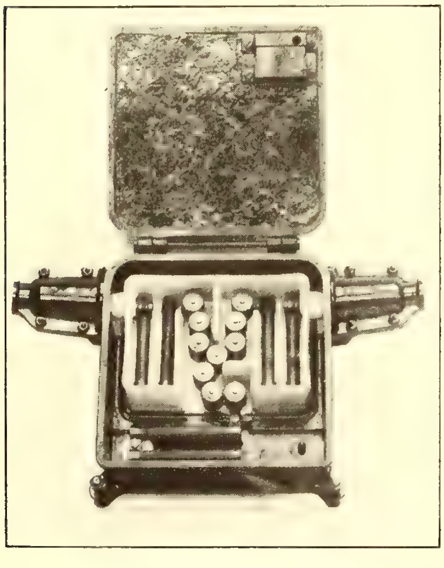


FIG. 18.—LIGHTNING ARRESTER

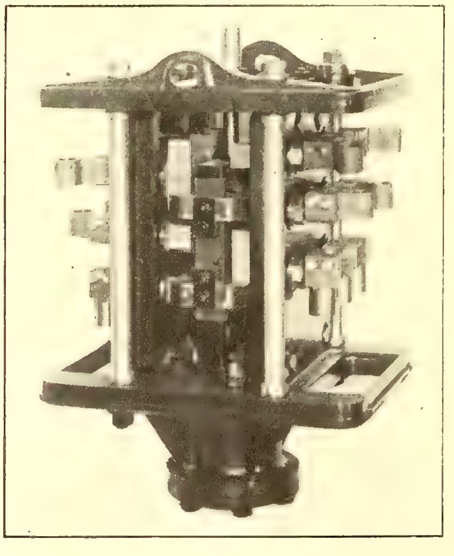


FIG. 19.—CONTROLLER

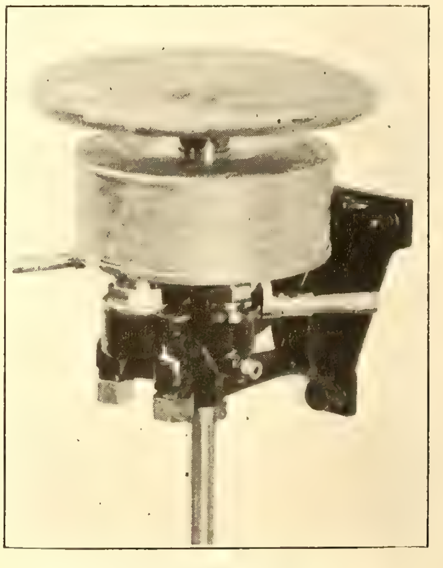


FIG. 20.—MASTER CONTROLLER OF THIRD LOCOMOTIVE

WATT-CONSUMPTION OF THE VALTELLINA LINE

The watt-consumption was measured by meters in the Morbegno station ever since the beginning of the electrical service. It must be borne in mind that these meters not only measure the watt-consumption of the trains, but all the current supplied by the central station, *i. e.*, the losses in the primary and secondary conductors, the losses in the transformers, the consumption of the lighting installation in stations, also that of the motor-dynamos for charging the accumulators used for the lighting of the motor cars and that of several motors driving the repair shops.

The total watt-consumption during a year (from July 1, 1903, to June 30, 1904,) was 3,402,502 kw-hours; the total number of ton-kilometers made during that time by electric trains was 75,845,265 (including the ton-kilometers of motor cars and locomotives), or 47,759,642 ton-miles, thus the average watt-consumption during this period has been 44.51 watt-hours per ton-kilometer, or 71.62 watt-hours per ton-mile, in which figures the above-mentioned losses are all included, as is also the watt-consumption when shunting the trains in stations.

To have a uniform basis of comparison for lines with different grades it is often customary to employ the virtual instead of the real ton-kilometers. The virtual ton-kilometers are obtained by multiplying the weight of the train in tons with the virtual length of the line—i. e., the length which a horizontal imaginary line would have, the energy consumption of which is the same as that of the actual line with existing grades. The number of virtual ton-kilometers on the Valtellina line during the above period was 92,541,511 ton-kilometers, or 57,514,923 virtual ton-miles, and therefore the average watt consumption was 36.77 watt-hours per virtual ton-kilometer, or 59.16 watt-hours per virtual ton-mile.

Several series of tests were made on the Valtellina line in order to ascertain the watt consumption of trains measured on the trolley wires—i. e., without the above-mentioned losses. One of the most complete tests was made April 20, 1904, with a train of 116 tons total weight, with a motor car at the head, on the Lecco-Colico line. This test was made during the night when there were no other trains on the line, all transformer

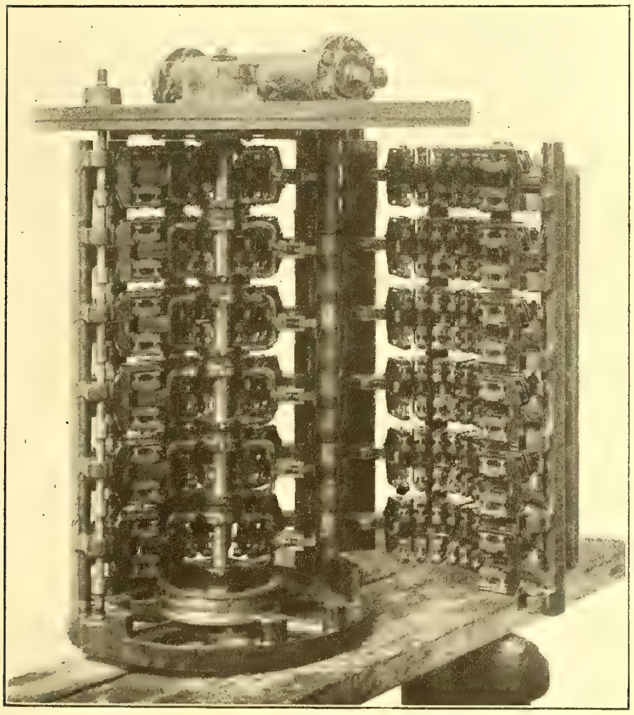


FIG. 22.—CONTROLLER FOR METAL RHEOSTAT

stations excepting one having been disconnected, so that the wattmeters in the central station were able to indicate the watt consumption of the train, with the deduction of easily calculable losses in the one transformer and in the line.

A total run was made from Lecco to Bellano, and vice versa. The average watt consumption of the train measured on the trolley line was 30.2 watt-hours per ton-kilometer.

The number of trains simultaneously on the line is very limited, and normally there are not more than five to six during the busiest hour of the service. In the morning and in the evening there are even less. It is not to be wondered therefore that the maximum load peak in the central station is about three times as much as the average load for the whole day.

THE ELECTRIC SERVICE ON THE VALTELLINA LINE

During the last periods of steam traction the daily number of train-kilometers on the whole system were 1104, or 686 train-miles; with electric traction they amount to 1998 train-kilometers, or 1242 train-miles. For the fiscal year ending June 30, 1904, the entire mileage made by the twelve electric vehicles (ten motor cars and two freight locomotives) was 678,109 km, or 421,447 miles. Therefore one electric vehicle performed

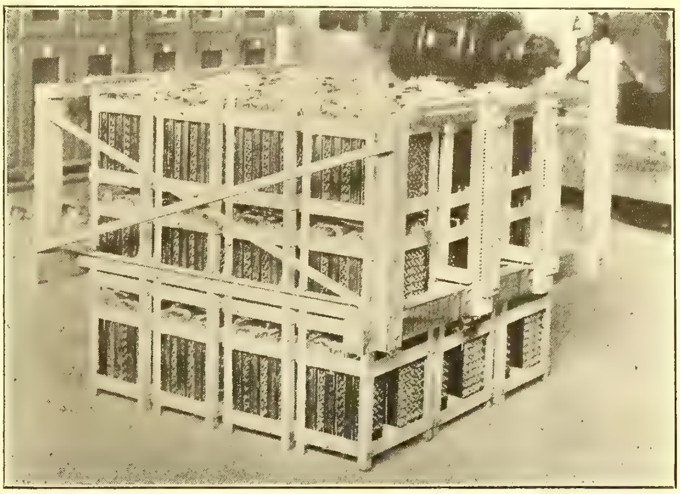


FIG. 21. METAL RHEOSTAT

on the average 56,509 km, or 35,120 miles. That is a very large amount compared with the normal performances of steam locomotives, especially if one takes into consideration that during this period the motor cars were taken out of the service for changing the car bearings, two of them having been withdrawn from the service for repairs for several months on account of a collision. The ordinary performance of a steam locomotive on the lines of the Adriatic Railway is not more than 27,720 km, or 17,213 miles, per annum.

The first years of the electric service proved that also with three-phase traction it is possible to make up time in cases of retardation. For that purpose several means are available:

(1) The time-table is not worked out for the quickest possible run, a small reserve of time being left between two stations which can be utilized.

(2) The motorman does not brake from the highest speed, but the train coasts when approaching the station. By shortening the coast it is possible to make up time.

(3) On down grades the motorman can coast out the train to a higher speed.

(4) Some parts of the line, especially those with higher grades, are run with motors in cascade—i. e., at lower speed—to avoid great load peaks in the generating station. When making up time, cascade working is extended to a higher grade, thus allowing a larger maximum watt consumption per train and giving a longer run at a higher speed.

We have therefore practically the same means at disposal to make up time with three-phase motors as with a motor of the series-motor characteristics. The great advantage of three-phase motors, however, is that in ordinary operation the speed is quite independent of the grades and of the weight of trains. In the operation of tramways or suburban railways this peculiarity is insignificant, owing to the short distances between stations. In that case, although the maximum speed is lower, the same schedule speed can be made through quicker acceleration and shorter coasting. On a main line, however, where the greater part of the line is to be run at the normal speed, it is very difficult, with heavy trains, to make up speed. But even if this were possible, it is an advantage to the motorman that he need not think about the weight of his train when running, since the speed with three-phase motors is the same in any

case. There are, therefore, no objections to the constant speed of three-phase motors in railway work; it is rather an advantage for this class of service.

SAFETY

The experience on the Valtellina line shows that safety, in connection with high-tension current for electric traction, is only a question of good engineering, as Prof. Sylvanus P. Thompson said some years ago. During the entire period of three and a half years of the trial runs and normal service no man was killed by the high voltage used on the railway. The only accident that occurred was the death of the constructor of the exploiting company, in Colico sub-station, but this had nothing to do with the adoption of the high tension for the operation of the railway, and would have happened for the same reasons in any high-tension transformer station.

But the service on the Valtellina line has shown that in railway operation any security desired can be attained with the high-tension three-phase equipment, supposing that it is designed properly. After the first period of difficulties the present service is quite satisfactory. In the first year of the regular service considerable trouble was caused by the oil getting to the windings of the motor, but after repairing the damaged insulation and providing for a hermetical closing, no further repairs were necessary; in fact, there has been no occasion during the subsequent period of the last one year and a half to repair the motor windings. This is the best proof for the reliability of three-phase traction motors.

EFFECT ON THE TELEPHONE AND TELEGRAPH

Some years ago a great deal was said in periodicals about troubles which alternating current with earth return may cause in telegraph and telephone circuits. At the opening of the Valtellina line, although the periodicity was not more than fifteen, the railway company was obliged to erect separate insulated return wires for all telegraph and telephone lines running parallel with or near the railway line. Later on different methods were adopted to permit the operation without return wires, and as a matter of fact the telegraph lines along the Valtellina Railway are now working on earth return with entire satisfaction.

FIG. 23.—LOCOMOTIVE WITH FREIGHT TRAIN

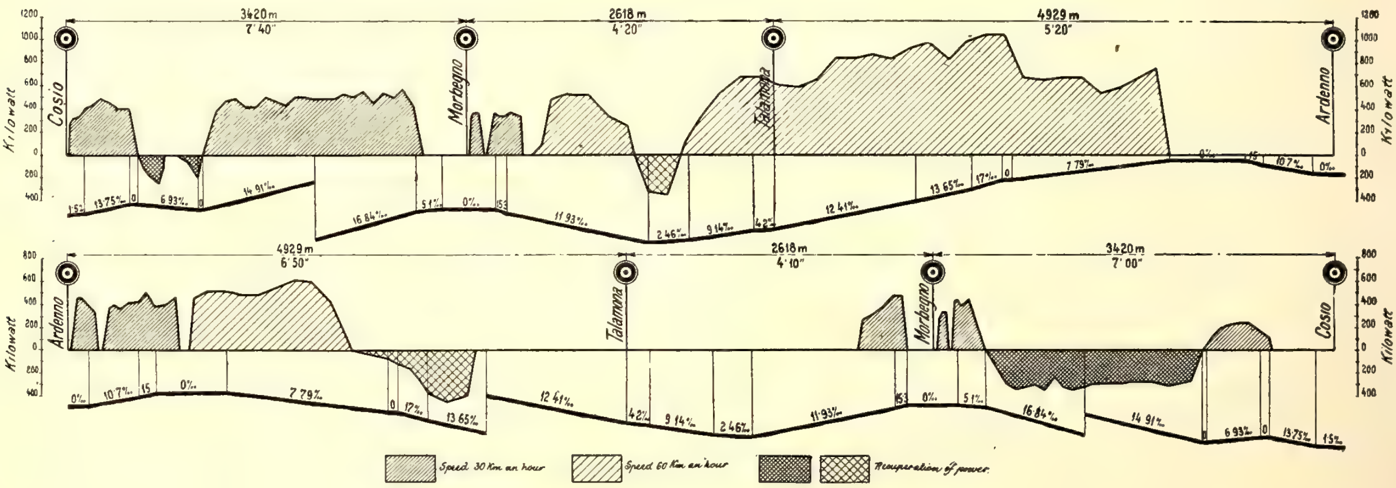


FIG. 24.—RUN SHEET BETWEEN ARDENNO AND COSIO

OPERATING COSTS

As regards the operating costs of the Valtellina line, only those are of interest which show a difference from steam service. Such an item is the cost of power. To this belong all the costs in connection with the electric equipment in the central station, sub-stations and overhead wires, as well as with the rolling stock, including the wages of the motormen.

These costs for the year from July 1, 1903, to June 30, 1904, were the following:

1. Power station: Labor and material for the operation and maintenance	$4,138.36
2. Primary and secondary line and transformers: Labor and material for the operation and maintenance	6,700.42
3. Electrical equipment of the rolling stock: Labor and material for operation and maintenance	6,382.28
4. Maintenance of the mechanical equipment of motor cars and locomotives	1,152.00
5. Wages for the staff on the motor cars and locomotives	5.040.00
Total	$23,413.06

During the same period the performance of the electric trains was 61,934,569, or 38,492,585 ton-miles, excluding the mileage of the motor cars and locomotives, and therefore the above costs per 1000 ton-kilometers are 37.8 cents, or 60.6 cents per 1000 ton-miles. The electric train-kilometers during the same period were 678, or 421,447 train-miles, and accordingly the cost per train-kilometer was 3.86 cents, or 5.56 cents per train-mile.

It must be borne in mind that the Valtellina line works under somewhat unfavorable conditions, inasmuch as the traffic is not very dense, the total number of ton-miles being 584,288 per mile of length, and that with the same central station and sub-stations a considerably larger traffic could be dealt with.

OBSERVATION CAR IN MONTREAL

The increasing demand from observation parties for a car which would be as satisfactory as a coach or tally-ho has lead to the construction by the Montreal Street Railway Company of a car for this especial purpose. The objection to the ordinary car for this service is that the roof of the car obscures observation to any height above the shop windows. The Montreal car avoids this by dispensing entirely with the roof. As shown, the seats are arranged in seven tiers, with the entrance from the back of the car. Two arches, made up of ornamental scroll work, carry fifteen lamps each for illumination at night. In the rear of the car are lockers, in which any supplies may be carried if the car is chartered by a private party.

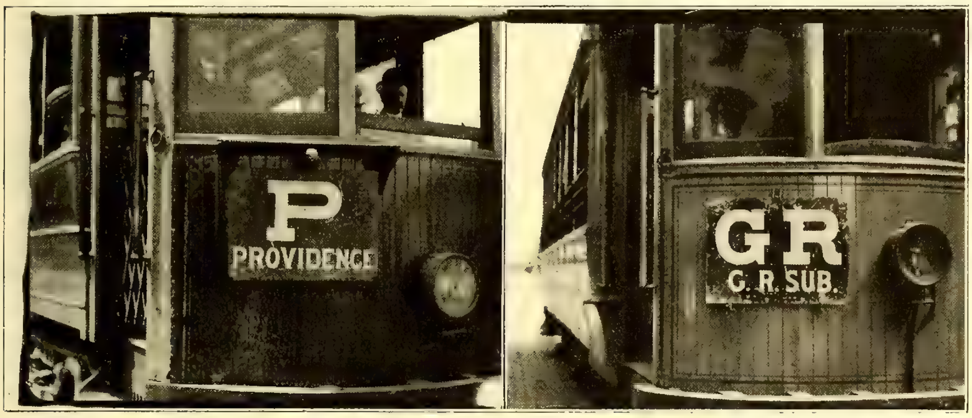
THE NEW ROOFLESS OBSERVATION CAR USED IN MONTREAL

The design of the car has been registered and a patent for it has been applied for.

The Singapore Electric Tramways, Limited, with $2,000,000 capital, will electrically equip the Singapore Tramways, and a side company, the East India Construction Syndicate, is formed to take over and re-equip all the other tramways in Singapore and in other ports of the Straits Settlements.

A NEW FORM OF DESTINATION SIGN

The difficulty of obtaining a destination sign for use upon street cars which shall be easily read from a distance, both by day and night, has been a serious problem. Many styles of signs which are in use are effective in daytime, but the trouble with most of the illuminated signs has been the difficulty of even and thorough illumination at night, so that they are easily deciphered when a car is approaching rapidly.



SCRANTON CAR SIGNS, ILLUSTRATING THE USE OF LARGE INITIAL LETTERS

A new form of sign has recently been applied to all cars of the Scranton Railway Company, Scranton, Pa., which is an innovation in this respect. Each line throughout the city is designated by an initial or group of initials, and these initials are lettered in extremely large size on dash signs, so as to be readable at a distance of several blocks. Representative signs of this kind are illustrated in the accompanying views. As may be noted, the letters are about a foot high and are painted in white upon a dark background so as to stand out very strong in all classes of weather and at night, if properly illuminated. A difficulty that might otherwise be encountered in understanding the symbols is obviated by the introduction of the name of the line in small leters (4 ins. high) below the main initials.

The company is at present experimenting as to methods of properly illuminating the sign for night use. While the sign is sufficiently large to be easily readable at night if the street is fairly well lighted, yet in outlying portions of the city and in suburban districts some difficulty is experienced by passengers not being able to see the signs at a distance. Various arrangements of lamps have been made for illuminating the sign, one of which is shown in the first of the accompanying illustrations.

A more successful arrangement, however, is that in which the lamp, while fully illuminating the sign, shall not be visible to the passenger waiting for the car, so as to partially blind his view of the sign. Such a method of sign illumination is in use upon some of the cars and has proven very satisfactory—so much so that its use will probably be extended to the entire system.

THE INSTALLATION OF ELECTRIC TRAMWAYS IN CHRISTCHURCH, NEW ZEALAND

BY JAMES DRUMMOND

On June 5 the city of Christchurch, New Zealand, celebrated the installation of a municipal electric railway system, built under the auspices of the municipality.

In a way, Christchurch, which is the center of Canterbury,

ONE OF THE OLD-TIME STEAM DUMMY TRAINS

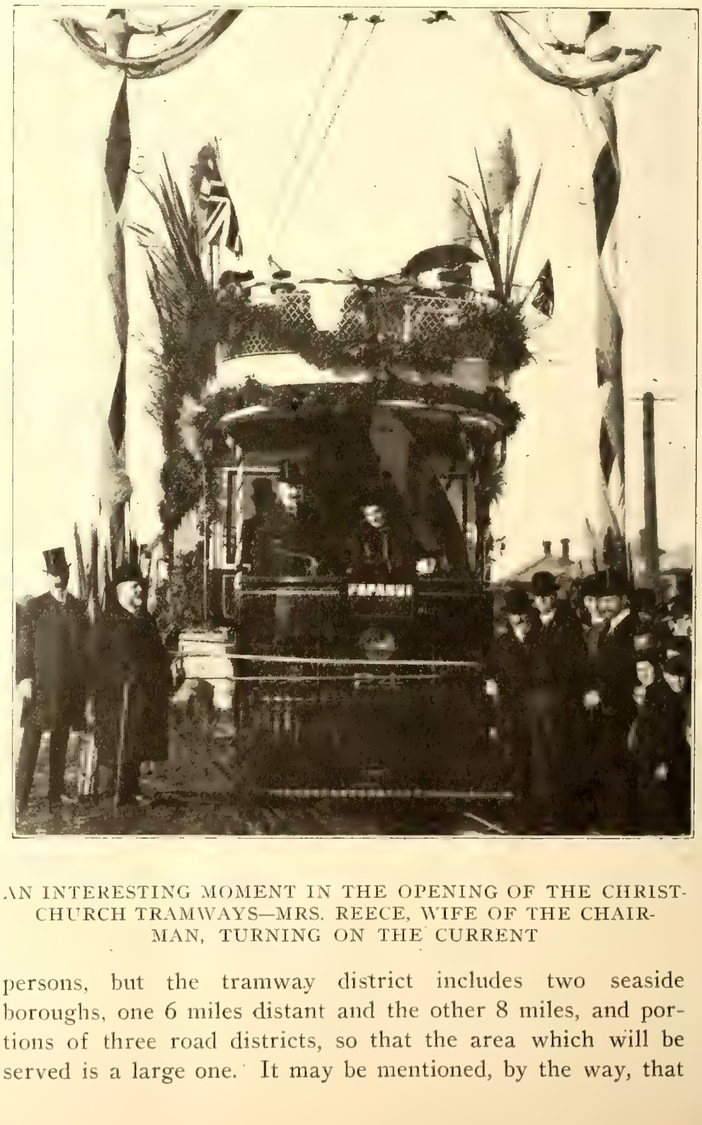
the wealthiest province of the colony, is admirably situated for electrical traction. It is as flat as a pancake, the main streets are 66 ft. wide, and many of the populated districts lie near the center. The absence of heavy grades has helped largely to solve the problem of the distribution of current, and

ON THE ROAD TO SUMNER, CHRISTCHURCH'S SEASIDE RESORT

it will be a factor in operating the system economically. On the other hand, a very large portion of the city is sparsely settled, and this feature will be carefully considered when extensions are made. The bicycle traffic in Christchurch is probably larger than in any other city of the same size in the world, but it is thought that a frequent and

LAYING PERMANENT WAY AT CATHEDRAL SQUARE, CHRISTCHURCH

up-to-date tram service will have a material effect on the use of bicycles. The city itself has a population of about 60,000

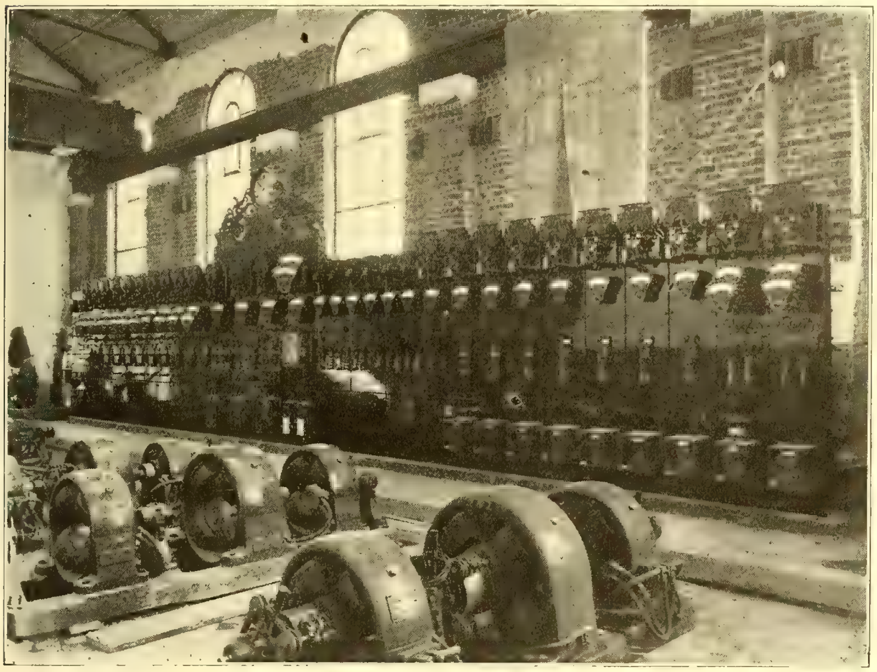


AN INTERESTING MOMENT IN THE OPENING OF THE CHRISTCHURCH TRAMWAYS—MRS. REECE, WIFE OF THE CHAIRMAN, TURNING ON THE CURRENT

persons, but the tramway district includes two seaside boroughs, one 6 miles distant and the other 8 miles, and portions of three road districts, so that the area which will be served is a large one. It may be mentioned, by the way, that

Christchurch is not much more than 50 years old, and it is an excellent illustration of the manner in which towns and cities spring up in the colonies and rapidly attain a position of importance and affluence.

In fixing upon a site for the power house, due consideration was given to securing the most economical power distribution without sacrificing good coal and water facilities. The section of land taken was chosen because it is almost halfway between the extreme ends of the system. It is an ideal site from the point of view of distribution, and as it adjoins the railway line, it affords the cheapest means of obtaining coal.



SWITCHBOARD IN POWER STATION OF THE CHRISTCHURCH TRAMWAYS

The tramways have been constructed by a Tramway Board, which is constituted by an act of Parliament, and is elected by popular vote in the district interested in the use of tramways. The citizens, seeing that they had entered upon a large and important scheme, selected their best men to carry on the operations and control the system. The board was elected in January, 1903, and it lost no time in getting to work. It was fortunate in securing the services of an exceptionally able and experienced electrical engineer, F. Hubert Chamberlain, who was in Australia at the time and was just about to leave for America, his native country.

The act that constitutes the board empowers it to borrow £250,000 in the first instance, and also an additional £100,000 after the first sum has been expended. It easily obtained the sanction of the voters to raise the first loan, and with that sum it has carried on the work, which has been pushed on so expeditiously that the first section of the line was opened on June 5, as stated before. The board has taken over the old horse and steam-motor system from private companies which ran the trams for many years, and it has converted the old system into an electrified one. To the principal company it paid £23,910 for the plant and concessions.

THE POWER HOUSE

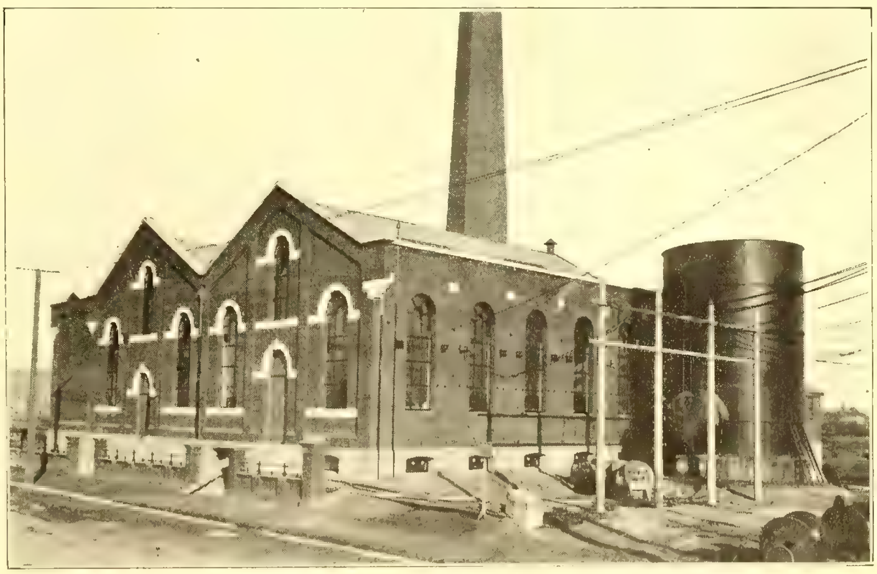
The power house is thoroughly up to date in every respect, and its equipment reflects great credit on the authorities, the consulting engineer and contractor, the latter being the General Electric Company, which supplied the Curtis turbines used, as well as all of the electrical apparatus for the system. The presence of a steam turbine in the power house places Christchurch in the proud position of having the only complete turbine-driven tramway power system in the Southern Hemisphere. Lately the Government of Victoria has installed two small steam turbines for lighting purposes, and the Railway Commissioners of New South Wales have installed a turbine in their power station in Sydney, but those installations do not affect the premier position occupied by Christchurch.

The board called for tenders for both reciprocating engines and steam turbines. By accepting tenders for the latter, it has reduced the cost of the building of the power house by over £2,000, due to the smaller space required by the turbines; and it is expected that there will also be a large reduction in the operating expenses and the charges for attendance and in other directions.

Only one of the board's turbines has been erected, but its power is sufficient to generate current for the whole system. Even when the two ordered are available, one will be held as a reserve unit.

The switchboard is the largest in New Zealand, and measures 47 ft. in length, with a height of 6 ft. It is made of black marble panels, with a subbase of similar material. Just below a handsome clock are the names of the present Christchurch Tramway Board.

The boiler room contains three Babcock & Wilcox boilers, each capable of evaporating 6000 lbs. of water an hour and of working at a pressure of 150 lbs. to the square inch. Combined with them are superheaters. The waste gases from the boilers are passed through a Green's economizer, which heats the feed water before it enters the boilers. Mechanical stokers of the chain-grate type are placed under each boiler.



FRONT VIEW OF THE POWER HOUSE, SHOWING COOLING TOWER AT RIGHT

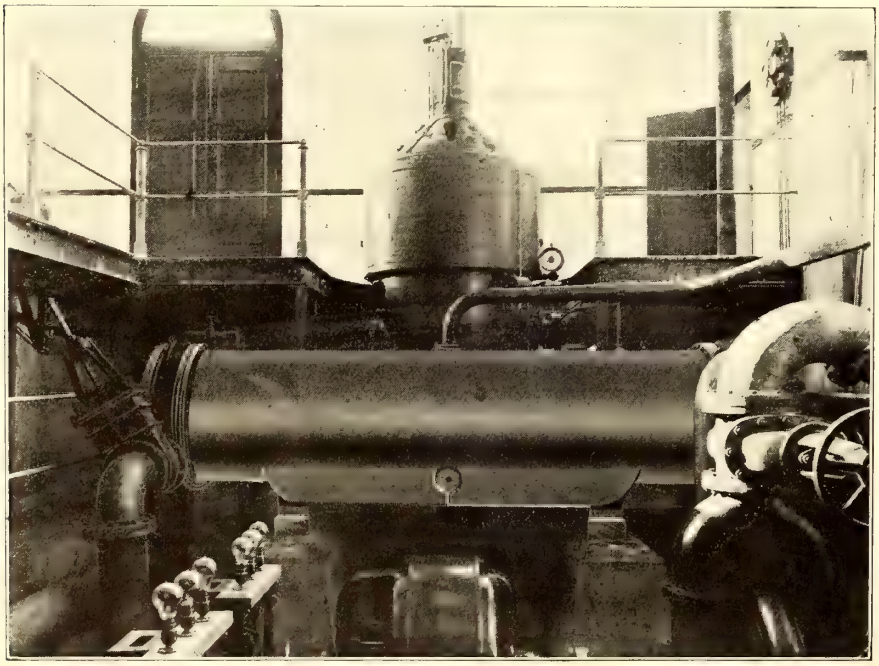
The coal bunkers have a capacity of 400 tons, and are filled direct from the railway trucks, which are hauled up an inclined way by an electric winch. This allows a minimum of handling of the coal; and when the bunkers have to be filled

it is necessary merely to haul up the trucks, open the truck doors and shoot the coal into the bunkers. Sidings have been provided at the railway side for conveniently handling the full and empty trucks. A 35-hp compound engine, directly connected to a dynamo, has been installed for supplying light to the power house, car shed and offices. Condensation is obtained by a cooling tower 35 ft. high and about 25 ft. in diameter, which is operated by two electrically-driven fans, each 8 ft. in diameter. Water is obtained from a 4-in. artesian well, which has been sunk to a depth of 425 ft. From the well the water passes into a concrete tank, which will hold 4000 gals. A connection has been made to this tank for the convenience of the fire brigade in case of an outbreak of fire in the vicinity of the power house.

The chimney is 149 ft. high, and rests on a concrete foundation 32 ft. square and 14 ft. deep. It has a clear internal diameter, inside the fire-brick lining, of 8 ft., and is built of brick, the base being of panel design.

THE OVERHEAD CONSTRUCTION

Both iron and wooden poles are used to support the overhead structure. The iron poles are painted a whitish gray, picked out with black bases and bands, wrought-iron arms and ornamental caps, rings and collars, and present a neat appearance. They are designed to stand a lateral strain of 1000 lbs. applied at the top of the pole, with a lateral deflection of not more than 6 ins., and a similar strain of 1500 lbs. with a permanent deflection of not more than ½ in. The wooden poles are Australian ironbark. Wooden side-bracket poles are to be used in the New Brighton, Sumner and Riccarton portions of the suburban lines.



ONE OF THE STEAM TURBINES AND ITS CONNECTIONS INSTALLED IN THE CHRISTCHURCH POWER STATION

No sooner had the decision been announced to use the single overhead trolley system than the Royal Society of Great Britain sent a long letter to the government, drawing attention to the important work which was then being done at the Magnetic Observatory in Christchurch, and the undesirability of any interference in that direction. The board virtually decided that it would be easier and more convenient to remove the observatory than the tramway system, and that the observatory ought not to have been erected near the city.

The overhead line is divided into ½-mile sections, in accordance with the Board of Trade regulations, with section insulators and switches, so that any ½-mile can be isolated without interfering with any other part of the line. No joints have been allowed in the trolley wire, except in splicing ears, and there is not more than one joint between each pair of section insulators. In the original specifications, guard wires were provided for the trolley or feeder wires where telegraph or telephone wires pass over them. After the contract had been let, however, the board agreed with the Public Works Department to have the guard wires obviated, and instead special arrangements were made for insulating all telephone and telegraph wires where they pass over either the trolley wire or the feeder cable. There is double insulation throughout the system for all steel poles, and single insulation for the wooden-pole construction.

MAKING EXCAVATIONS FOR THE TRACKWORK IN CATHEDRAL SQUARE, CHRISTCHURCH

THE TRACK CONSTRUCTION

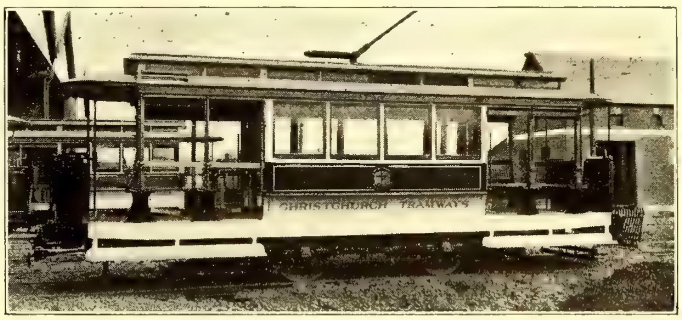
Up to the present time about 12¼ miles of standard gage track have been laid, and when the whole system has been completed there will be nearly 29½ miles of single track and 2½ miles of double track, the latter being used within the city limits. Ninety-two-lb. grooved rails will be used on the straight tracks over the whole system, with the exception of about 4 miles on the Sumner line, which runs down to one of the seaside resorts, where 72-lb. T-rails are employed. All rails are double-bonded with General Electric ribbon bonds.

The flexibility of the sub-soil in the district required that special consideration be given to the sub-construction. The soil was first removed for 4 ft. on each side of the center line of the track to a depth of 17 ins., where the 92-lb. or 95-lb. rail were laid, and to a depth of 15 ins. for the T-rails. After the excavation was made and thoroughly rolled, it was filled to within 11 ins. of the finished surface with 2½-in. broken stone. The surface was then rolled with a roller weighing

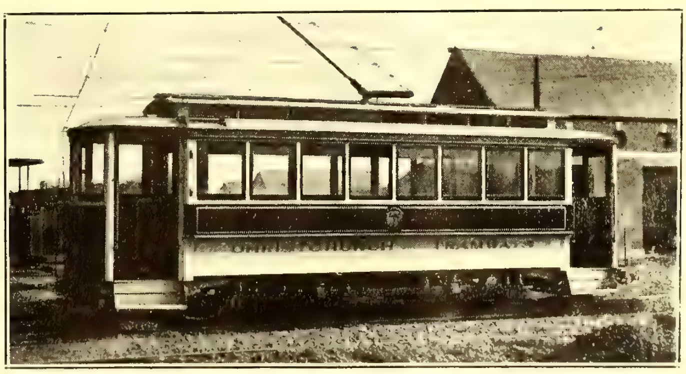
more than 5 tons, and the rails were placed on the ties. The ties are of Australian hardwood, hewn from large trees.

It was deemed advisable to cut off one of the bays of the estuary on the Sumner line. This deviation has caused a great deal of filling to be done, and also the construction of a special embankment, 15 ft. wide and 4290 ft. long. It has three bridges, each 20 ft. long, so as to allow for the flow of the tidal water.

CAR SHEDS OF THE CHRISTCHURCH TRAMWAYS, WITH OFFICES OF THE TRAMWAY BOARD ON THE LEFT



TWO TYPES OF COMBINATION CARS USED BY THE CHRISTCHURCH TRAMWAYS



TYPES OF THE DOUBLE-DECK CAR AND DOUBLE-VESTIBULE CLOSED CAR USED ON THE CHRISTCHURCH TRAMWAYS

THE CAR SHED

The car shed covers an area of 170 ft. x 170 ft. Of this, 170 ft. x 130 ft. is devoted to the use of the cars exclusively. The floor of the shed has been excavated for pits. The shed can receive fifty cars, which is a much larger number than the board will be called upon to deal with in the shed at present. In view of the future development of Christchurch, however, provision has been made for extending the shed so that it may double its present capacity at a comparatively small expense. The roof is wood, covered with glass and iron. Ample provision has been made for dealing with possible outbreaks of fire. Hydrants with hose and nozzles have been provided in different places around the building. A tank, which stands at an elevation of 30 ft., has a reserve store of 2000 gals. It is connected with the fire mains, and is kept filled automatically by an electrically-driven pump. The water supply is obtained

from a 3-in. artesian well, which flows into a large supply sump under the tank.

The repair shop is part of the same building. The plant is up to date; it includes a hydraulic wheel press, 12-in., 8-in. and 4-in. lathes, a radial drill, a large vertical drill and a small drill, a shaping machine and blacksmiths' forges. The armature room and woodworking shop contain a Lipe winding lathe, a band saw, a wood lathe and a drying oven for field coils, armatures and other parts of the electrical equipment that require to be dried by heat. The machines are driven by an electric motor, and a complete overhead traveling crane has been installed, which communicates with the repair shop pits at both ends, so that heavy parts of cars may be handled with perfect ease. A complete telephone system has been installed throughout the buildings, and also an intercommunication system between the offices, the machine and repair shops and the stables.

THE ROLLING STOCK

The cars, which were specially designed by the board's staff, are the only ones in Australasia provided with front fenders or life guards in addition to the wheel guards. The board has taken the precaution of fitting the cars in this respect on account of the extraordinary number of bicycles in Christchurch. Both the wheel guards and fenders were made by the Consolidated Fender Company, of the United States.

Each car is equipped with a motor-driven air compressor, Hale & Kilburn seats and electric heaters.

The rolling stock comprises seven steam locomotives, twenty-seven electric cars and forty-two trailers. The latter are the old cars taken over from the Christchurch Tramway Company. Most of the electric cars are made by the John Stephenson Company, of New York. Ten are of the single-truck combination type, ten of the double-truck combination type, three of the single-truck closed-vestibule type, three of the double-truck double-deck type, one of the closed-vestibule type, 30 ft. long, with a baggage compartment, and one single-truck electrically-driven water sprinkler.

All of the cars have been mounted on Peckham trucks. The wheels were made by John Baker & Company, of England, and are steel-tired.

THE MANAGEMENT

Wm. Reece, the chairman of the board, was born in Christchurch, and has always taken a prominent part in the city's public affairs, having been Mayor and a member of special committees appointed to deal with such events as the sending forth of contingents to the South African War.

F. H. Chamberlain, the engineer, served his apprenticeship with the old Daft Electric Company, and later was connected with the Metropolitan Railway Company in Washington. Before being appointed engineer to the Christchurch Board, he was engaged by the Railway Commissioners of New South Wales to superintend the construction of a three-phase power house and sub-station system in Sydney.

The whole system has been constructed by the New Zealand Electrical Construction Company, of Christchurch. The company was organized locally by T. E. Taylor, member of the House of Representatives, who is treasurer and secretary, while another Christchurch gentleman, J. L. Scott, is superintendent.

The First National Bank of Ypsilanti, Mich., has done the unusual thing of shipping $35,000 in specie, mostly silver dollars, by an electric car to the First National Bank of Detroit. The money filled thirty-one bags, and was loaded into the early morning limited car of the Detroit, Ypsilanti, Ann Arbor & Jackson Railway, and was in charge of four officials. The regular express charge on this shipment would have been $1 per thousand. By sending it by electric car the bank paid four fares to Detroit and return.

STREET AND ELEVATED RAILWAY MILEAGE, CARS AND CAPITALIZANION OF THE UNITED STATES OF AMERICA

The accompanying table shows the mileage, number of cars and capitalization of the street and elevated railway companies in the United States and its insular possessions (Porto Rico, Hawaii and the Philippines), Canada (including Newfoundland) and Cuba, for 1903-1904, and has been compiled from the last two editions of "American Street Railway Investments." In compiling these figures, a slightly different method was followed than in previous years, in regard to the leased roads. It is very difficult, in view of the number of leased lines reporting in the Red Book, to determine absolutely to what extent the property of an operating company reporting covers that of its leased companies. This is particularly true in the case of recent consolidations. In preparing this table, especial effort was made to collect and compile this information, not only for 1904, but also for the previous year, and revised figures for 1903 are given with those of 1904, in the accompanying table. Another change has been made in the division of motor powers. Last year three separate columns were published for motive powers, viz., electric, cable and steam, and horse. This year, owing to the rapid disappearance of cable, steam and horse railways, their statistics have been combined. As will be noticed, about 80 per cent of the cars in these columns are in New York, Illinois, Missouri and California. This is owing principally to the retention of the cable or horse systems in New York City, Chicago, St. Louis and San Francisco.

The dates of the reports for the several railways as indicated by the reports in "American Street Railway Investments" vary, but practically all of them are within the limits of June 30, 1904, and May 1, 1905. The average we believe to be not far from Dec. 30, 1904, so that for this reason the 1904 figures may be considered as fairly representing the condition of the industry at the close of that year. In a few cases, where reliable reports could not be obtained of the capital stock and the funded debt of the companies, estimates have been made upon the known physical property of the separate companies. As the roads so not reporting were very small, however, both in number and importance, the estimates do not vitally affect the accuracy of the table. More important estimates had to be made of the outstanding capital stock and funded debt in cases where holding or leased companies owned a portion of the outstanding obligations or capital of sub-operating companies. These estimates were required, as many of the holding companies do not report the proportion of the capitalization of sub-companies controlled by them.

A number of slight inconsistencies in the reports of individual companies for the two succeeding years were discovered, particularly in the division of rolling stock between motor cars, trail cars and service cars. This is owing in most cases undoubtedly to the personal equation introduced through the preparation of the original report by a different officer each year. Under the belief, however, that such discrepancies as furnished by individual companies were slight, that they would naturally tend to balance each other, and that consequently they would not vitally affect the total result, the returns were compiled in the form they were presented.

As will be noticed, the total capital liabilities of the street railway companies in the United States show an increase of $134,839,324, or 44 per cent. Those of the insular possessions of the United States, $1,497,500, or 41 per cent, and those of Canada, $10,055,554, or 17 per cent.

Chicago has granted the Aurora, Elgin & Chicago Railway the right to carry freight and express in the cars it operates over the Metropolitan downtown loop for ten years.

STREET AND ELEV UNITED STATES AND CANADA.

," EDITION OF 1905.

STATES.	NO. OF ROADS.	TRACK MILEAGE.		MOT	EL NDED DEBT.		CAPITAL LIABILITIES.			STATES.
					AL.	INCREASE FOR YEAR.	TOTAL.		INCREASE FOR YEAR.	
	1904	1903	1904	1903	1904		1903	1904		
New England States.										**New England States.**
Maine	18	353	378	409	$6,772,732	$811,732	$11,042,813	$12,705,745	$1,662,932	Maine
New Hampshire	14	272	292	324	11,363,000	12,500	18,255,400	18,267,900	12,500	New Hampshire
Vermont	9	112	112	116	1,533,000	60,400	3,534,100	3,724,100	190,000	Vermont
Massachusetts	73	2,621	2,734	7,203	44,061,000	317,000	132,452,718	134,400,065	1,947,347	Massachusetts
Rhode Island	9	384	403	872	19,221,031	860,831	34,085,200	35,778,731	1,693,531	Rhode Island
Connecticut	26	668	687	1,264	20,999,642	777,642	48,109,890	49,846,882	1,736,992	Connecticut
TOTAL	149	4,410	4,606	10,188	103,950,405	2,840,105	247,480,121	254,723,423	7,243,302	TOTAL
Eastern States.										**Eastern States.**
New York	106	3,175	3,192	11,788	299,637,590	1,411,530	62[illegible],722,177	635,669,985	12,947,808	New York
New Jersey	35	1,025	1,108	1,939	78,477,600	3,641,510	160.925,250	166,305,890	5,380,640	New Jersey
Pennsylvania	124	3,142	3,319	7,298	163,117,714	9,940,155	377,696,385	394,473,209	16,776,824	Pennsylvania
Delaware	6	136	137	238	7,074,000	100,000	11,874,000	11,974,000	100,000	Delaware
District of Columbia	8	294	308	828	20,460,000	192,550	49,872,450	51,065,000	1,192,550	District of Columbia
Maryland	9	452	454	1,658	52,401,000	49,305	69,260,001	70,180,006	920,005	Maryland
Virginia	19	402	414	571	29,146,500	616,686	54,999,314	56,171,600	1,172,286	Virginia
West Virginia	11	214	224	313	7,461,000	1,031,900	12,959,600	15,504,000	2,544,400	West Virginia
TOTAL	318	8,840	9,156	24,633	657,775,404	16,983,636	1,360,309,177	1,401,343,690	41,034,513	TOTAL
Central States.										**Central States.**
Michigan	30	1,199	1 203	1,796	44,139,500	1,665,500	82,394,000	84,126,500	1,732,500	Michigan
Ohio	98	3,181	3,437	4,499	106,434,500	11,252,400	270,092,650	285,393,500	15,300,850	Ohio
Indiana	45	1,197	1,360	1,246	50,182,500	7,993,500	90,794,900	104,715,000	13,920,100	Indiana
Kentucky	12	276	292	564	10,491,000	724,700	19,548,200	21,381,900	1,833,700	Kentucky
Wisconsin	18	525	540	783	18,823,850	1,791,594	34,823,756	39,442,350	4,618,594	Wisconsin
Illinois	55	1,986	2,080	4,378	112,639,500	4,915,500	276,531,910	286,699,150	10,167,240	Illinois
Minnesota	7	352	360	813	17,794,000	1,899,000	41,486,495	43,385,495	1,899,000	Minnesota
Iowa	27	478	554	729	10,159,000	845,500	25,849,500	27,019,000	1,169,500	Iowa
Missouri	21	866	902	2,407	86,710,000	331,000	155,504,100	160,826,500	5,322,400	Missouri
TOTAL	313	10,060	10,728	17,215	457,373,850	31,418,694	997,025,511	1,052,989,395	55,963,884	TOTAL
Southern States.										**Southern States**
North Carolina	10	61	73	113	2,736,000	3,500	5,080,600	5,201,600	121,000	North Carolina
South Carolina	7	80	89	128	3,916,000	466,000	6,168,000	6,700,000	532 000	South Carolina
Georgia	13	338	356	459	16,988,000	195,000	36,234,000	36,576,000	342,000	Georgia
Florida	9	81	85	67	1,919,000	50,000	4,135,000	4,235,000	100,000	Florida
Alabama	12	234	246	267	10,850,000	1,741,000	19,184,900	21,090,900	1,906,000	Alabama
Mississippi	8	41	48	73	1,661,000	253,000	3,333,000	3,624,200	291,200	Mississippi
Tennessee	10	285	292	456	10,460,500	751,875	19,383,125	20,239,000	855,875	Tennessee
Louisiana	6	213	214	678	30,880,000	....	67,572,800	67,647,800	75,000	Louisiana
Arkansas	8	75	92	141	2,355,000	285,000	5,040,000	6,744,500	1,704,500	Arkansas
TOTAL	83	1,408	1,495	2,382	81,765,500	3,745,375	166,131,425	172,059,000	5,927,575	TOTAL
Western States.										**Western States.**
North Dakota	2	12	12	11	260,000	50,000	470,000	560,000	90,000	North Dakota
South Dakota	1	....	4	...	....	....	....	....	....	South Dakota
Nebraska	7	166	198	347	7,875,000	....	18,462,500	18,462,500	....	Nebraska
Nevada	1	....	5	....	75 000	75,000	....	175,000	175,000	Nevada
Kansas	12	116	120	116	2,266,000	381,000	4,550,000	5,256,000	706,000	Kansas
Indian Territory	2	9	27	9	266,000	75,000	403,500	578,500	175,000	Indian Territory
Oklahoma	2	11	22	10	550,000	330,000	440,000	1,750,000	1,310,000	Oklahoma
Texas	19	349	400	562	14,693,000	2,714,000	27,786,500	30,577,500	2,791,000	Texas
Colorado	11	320	334	377	17,759,000	1,957,000	33,452,000	36,659,000	3,207,000	Colorado
Montana	5	62	64	77	1,240,000	40,000	2,895,613	2,935,613	40,000	Montana
New Mexico	2	....	15	....	300,000	75,000	475,000	650,000	175,000	New Mexico
Idaho	2	18	23	9	440,000	140,000	704,000	978,400	274,400	Idaho
Utah	3	96	96	143	5,458,000	2,588,000	9,020,000	11,608,000	2,588,000	Utah
Washington	12	347	355	360	13,877,000	1,187,000	32,781,100	36,426,100	3,645,000	Washington
Oregon	8	198	208	263	9,978,000	....	14,866,000	16,643,000	1,777,000	Oregon
California	38	1,321	1,668	1,429	79,498.000	1,456,000	164,602,400	172,259,750	7,657,350	California
Arizona	3	11	12	10	120,000	....	397,800	457,100	59,300	Arizona
TOTAL	130	3,036	3,563	3,723	154.655,000	11,068,000	311,306,413	335,976,463	24,670,050	TOTAL
United States	993	27,754	29,548	58,141	1,455,520,159	66,055,810	3,082,252,647	3,217,091,971	134,839,324	**United States**
Insular Possessions of U. S.—Hawaii, Porto Rico and Philippines	6	50	78	66	1,930,000	820,000	3,614,000	5,111,500	1,497,500	Insular Possessions of U. S.—Hawaii, Porto Rico and Philippines
Canada, including Newfoundland	42	860	861	2,305	28,571,050	3,423,492	59,348,638	69,404,192	10,055,554	Canada, including Newfoundland
Cuba	2	52	55	160	8,550,000	....	22,050,000	22,050,000	....	Cuba

STREET AND ELEVATED RAILWAY MILEAGE, CARS AND CAPITALIZATION IN UNITED STATES AND CANADA.

COMPILED FROM THE STATISTICS OF THE VARIOUS PROPERTIES CONTAINED IN "AMERICAN STREET RAILWAY INVESTMENTS," EDITION OF 1905.

STATES.	No. of Roads.	ELECTRIC RAILWAYS. Track Mileage.		Motor Cars		Trail Cars.		Service Cars.		CABLE, STEAM AND HORSE RAILWAYS. Track Mileage.		Grip Cars or Locomotives.		Trail Cars or Horse Cars.		TOTAL RAILWAYS. Track Mileage.		Cars.	
	1904	1903	1904	1903	1904	1903	1904	1903	1904	1903	1904	1903	1904	1903	1904	1903	1904	1903	1904
New England States.																			
Maine	18	353	378	409	432	57	71	132	166	3	3		....	6	6	356	381	604	675
New Hampshire	14	272	292	324	338	6	1	40	57							272	292	370	396
Vermont	9	112	112	116	121	2	2	2	2							112	112	120	125
Massachusetts	73	2,621	2,734	7,203	7,305	146	59	1,094	1,151					25	25	2,621	2,734	8,468	8,540
Rhode Island	9	384	403	872	894	6	6	32	32							384	403	910	932
Connecticut	26	668	687	1,264	1,405	20	24	178	191							668	687	1,462	1,620
TOTAL	149	4,410	4,606	10,188	10,495	237	163	1,478	1 599	3	3			31	31	4,413	4,609	11,954	12,288
Eastern States.																			
New York	106	3,175	3,192	11,788	12 013	2,114	2,276	987	1,100	159	137	122	31	1,473	519	3,334	3,329	16,484	15,942
New Jersey	35	1,025	1,108	1 939	2,012	112	103	11	12	8	8	28	2	8	29	1,033	1,116	2,098	2,158
Pennsylvania	124	3,142	3,319	7,298	7,024	232	407	656	711							3,142	3,319	8,186	8,142
Delaware	6	136	137	238	253	3	2		3							136	137	241	258
District of Columbia	8	294	308	828	978	243	292	13	17							294	308	1,084	1,287
Maryland	9	452	454	1,658	1,669	10	10	45	45							452	454	1,713	1,724
Virginia	19	402	414	571	578	14	38	84	51	2				2		404	414	671	667
West Virginia	11	214	224	313	324			3	3							214	224	316	327
TOTAL	318	8,840	9,156	24,633	24,851	2,728	3,128	1,799	1,942	169	145	150	36	1,483	548	9,009	9,301	30,793	30,605
Central States.																			
Michigan	30	1,199	1 203	1,796	1,832	71	98	145	160							1,199	1.203	2,012	2,090
Ohio	98	3,181	3 437	4,499	4,544	261	267	135	313	6	2	4			6	3,187	3,439	4 899	5,130
Indiana	45	1,197	1,360	1,246	1,389	112	161	21	62	7	7			15	13	1,204	1.367	1,394	1,625
Kentucky	12	276	292	564	577	242	241	5	42							276	292	811	860
Wisconsin	18	525	540	783	813	70	57		3					2		525	540	855	873
Illinois	55	1,986	2,080	4,378	4,571	863	1 352	222	809	117	97	467	470	2,439	1,156	2,103	2,177	8,369	8,358
Minnesota	7	352	360	813	813	306	303									352	360	1,119	1,116
Iowa	27	478	554	729	738	85	91		2	2	2			2	2	480	556	816	833
Missouri	21	866	902	2,407	2,388	174	64	16	12	36	36	187	187	203	202	902	938	2,987	2,853
TOTAL	313	10,060	10,728	17,215	17,665	2,184	2 634	544	1.403	168	144	658	657	2,661	1,379	10,228	10,872	23,262	23,738
Southern States.																			
North Carolina	10	61	73	113	138	2	2	8		2	2			3	3	63	75	126	143
South Carolina	7	80	89	128	120	16	16			3	5			3	10	83	94	147	146
Georgia	13	338	356	459	468	22	37	1	26	6	7			6	11	344	363	488	542
Florida	9	81	85	67	109	8	11	18	9	15	13	3	3	4	14	96	98	100	146
Alabama	12	234	246	267	287	90	97	19	29	10	9	2	3	10	10	244	255	388	426
Mississippi	8	41	48	73	82		2	1		8						49	48	74	84
Tennessee	10	285	292	456	498	103	119	1	1	7	7	13	14	4		292	299	577	632
Louisiana	6	213	214	678	679	5	4			5	5			14	11	218	219	697	694
Arkansas	8	75	92	141	175	28	28									75	92	169	203
TOTAL	83	1,408	1,495	2,382	2,556	274	316	48	65	56	48	18	20	44	59	1,464	1,543	2,766	3,016
Western States.																			
North Dakota	2	12	12	11	15											12	12	11	15
South Dakota	1		4		3		2										4		5
Nebraska	7	166	198	347	347	86	86			19	13			23	17	185	211	456	450
Nevada	1		5		5												5		5
Kansas	12	116	120	116	118	35	47	5	15	17	17			26	26	133	137	182	206
Indian Territory	2	9	27	9	18											9	27	9	18
Oklahoma	2	11	22	10	27	2	2									11	22	12	29
Texas	19	349	400	562	656	41	58		6	9	11			10	12	358	411	613	732
Colorado	11	320	334	377	375	57	148	29	30	21	19	15	15	64	62	341	353	542	630
Montana	5	62	64	77	81	16	25	12								62	64	105	106
New Mexico	2		15		12												15		12
Idaho	2	18	23	9	13	7	7			19	21	2	2			37	44	18	22
Utah	3	96	96	143	143	7	7			8	8		3			104	104	150	153
Washington	12	317	355	360	383	71	67	102	201	34	33	94	94			381	388	627	745
Oregon	8	198	208	263	307	47	56	127	132	18	16	11	3	4	4	216	224	452	502
California	38	1,321	1,668	1,429	1,545	69	147	70	82	150	151	595	527	175	299	1,435	1,928	2,338	2,600
Arizona	3	11	12	10	10	7	7			11	10	4		7	10	22	22	28	27
TOTAL	130	3,036	3,563	3,723	4 058	445	659	345	466	306	299	721	644	309	430	3,342	3,862	5,543	6,257
United States	993	27,754	29,548	58,141	59,625	5,868	6,900	4,214	5,475	702	639	1,547	1,357	4,528	2,447	28,456	30,187	74,298	75,904
Insular Possessions of U. S.—Hawaii, Porto Rico and Philippines	6	50	78	66	166	10	8			4	3			12	14	51	81	88	188
Canada, including Newfoundland	42	860	861	2,305	2,424	71	42	40	111	60	39	12	12	76	50	920	900	2,504	2,639
Cuba	2	52	55	160	160											52	55	160	160

STATES.	CAPITAL STOCK. Total.		Increase for Year.	FUNDED DEBT. Total.		Increase for Year.	CAPITAL LIABILITIES. Total.		Increase for Year.
	1903	1904		1903	1904		1903	1904	
New England States.									
Maine	$5,081,813	$5,933,013	$851,200	$5,961,000	$6,772,732	$811,732	$11,042,813	$12,705,745	$1,662,932
New Hampshire	6,904,900	6,904,900	....	11,350,500	11,363,000	12,500	18 255,400	18,267,900	12,500
Vermont	2,061,500	2,191,100	129,600	1,472.600	1,533,000	60,400	3,534,100	3,724,100	190,000
Massachusetts	88,708,718	90,339,065	1,630,347	43,744,000	44,061,000	317,000	132,452,718	134,400,065	1,947,347
Rhode Island	15,725,000	16,557,700	832,700	18,360,200	19,221,031	860,831	34,085,200	35,778,731	1,693 531
Connecticut	27,887,890	28,847,240	959,350	20,222,000	20,999,642	777,642	48,109,890	49,846,882	1,736,992
TOTAL	146,369,821	150,773,018	4,403,197	101,110,300	103,950,405	2,840,105	247,480,121	254,723,423	7,243,302
Eastern States.									
New York	324,496,117	336,032,395	11,536,278	298,226,060	299,637,590	1,411,530	622,722,177	635,669,985	12,947,808
New Jersey	86,089,160	87,828,290	1,739,130	74,836,090	78,477,600	3,641,510	160,925,250	166,305,890	5,380,640
Pennsylvania	224,518,826	231,355,495	6,836,669	153,177,559	163,117,714	9,940,155	377,696,385	394,473,209	16,776,824
Delaware	4,900,000	4,900,000	....	6,974,000	7,074,000	100,000	11,874,000	11,974,000	100,000
District of Columbia	29,605,000	30,605,000	1,000,000	20,267,450	20,460,000	192,550	49,872,450	51,065,000	1,192,550
Maryland	16,908,306	17,779,006	870,700	52,351,695	52,401,000	49,305	69,260,001	70,180,006	920,005
Virginia	26,469,500	27,025,100	555,600	28,529,814	29,146,500	616,686	54,999,314	56,171,600	1,172,286
West Virginia	6,530,500	8,043,000	1,512,500	6,429,100	7,461,000	1,031,900	12,959,600	15,504,000	2,544,400
TOTAL	719,517,409	743,568,286	24,050,877	640,791 768	657,775,404	16,983,636	1,360,309,177	1,401,343,690	41,034,513
Central States.									
Michigan	39,920,000	39,987,000	67,000	42,474,000	44,139,500	1,665,500	82,394,000	84,126,500	1,732,500
Ohio	174,910,550	178,959,000	4,048,450	95,182,100	106,434,500	11,252,400	270,092,650	285,393,500	15,300,850
Indiana	48,605,900	54,532,500	5,926,600	42,189,000	50,182,500	7,993,500	90,794,900	104,715,000	13,920,100
Kentucky	9,781,900	10,890,900	1,109,000	9,766,300	10,491,000	724,700	19,548,200	21,381,900	1,833,700
Wisconsin	17,791,500	20,618,500	2,827,000	17,032,256	18,823,850	1,791,594	34,823,756	39,442,350	4,618,594
Illinois	168,807,910	174,059,650	5,251,740	107,724,000	112,639,500	4,915,500	276,531,910	286,699,150	10,167,240
Minnesota	25,591,495	25,591,495	... ...	15,895,000	17,794,000	1,899,000	41,486,495	43,385,495	1,899,000
Iowa	16,536,000	16,860,000	324,000	9,313,500	10,159,000	845,500	25,849,500	27,019,000	1,169,500
Missouri	69,125,100	74,116,500	4,991,400	86,379,000	86,710,000	331,000	155,504,100	160,826,500	5,322,400
TOTAL	571,070,355	595,615,545	24,545,190	425,955,156	457,373,850	31,418,694	997,025,511	1,052,989,395	55,963,884
Southern States									
North Carolina	2,348,100	2,465,600	117,500	2,732,500	2,736,000	3,500	5,080.600	5,201,600	121,000
South Carolina	2,718.000	2,784,000	66,000	3,450,000	3,916,000	466,000	6,168,000	6,700,000	532 000
Georgia	19,441,000	19,588,000	147,000	16,793,000	16,988,000	195,000	36,234,000	36,576,000	342,000
Florida	2,266,000	2,316,000	50,000	1,869,000	1,919,000	50,000	4,135,000	4,235,000	100,000
Alabama	10,075,900	10,240,900	165,000	9,109,000	10,850,000	1,741.000	19,184,900	21,090,900	1,906.000
Mississippi	1,925,000	1,963,200	38,200	1,408,000	1,661,000	253,000	3,333,000	3,624,200	291,200
Tennessee	9,674,500	9,778,500	104,000	9,708,625	10,460,500	751,875	19,383,125	20,239,000	855,875
Louisiana	36,692,800	36,767,800	75,000	30,880,000	30,880,000	...	67,572,800	67,647,800	75,000
Arkansas	2,970,000	4,389,500	1,419,500	2,070,000	2,355,000	285 000	5,040,000	6,744,500	1,704,500
TOTAL	88,111,300	90,293,500	2,182,200	78,020,125	81,765,500	3,745,375	166,131,425	172,059,000	5,927,575
Western States.									
North Dakota	260,000	300,000	40,000	210,000	260,000	50,000	470,000	560,000	90,000
South Dakota									
Nebraska	10,587,500	10,587,500		7,875,000	7,875,000		18,462,500	18,462,500	
Nevada		100,000	100,000		75 000	75,000		175,000	175,000
Kansas	2,665,000	2,990,000	325,000	1,885,000	2,266,000	381,000	4,550,000	5,256,000	706,000
Indian Territory	212,500	312,500	100,000	191,000	266,000	75,000	403,500	578,500	175,000
Oklahoma	220,000	1,200,000	980,000	220,000	550,000	330,000	440,000	1,750,000	1,310,000
Texas	15,807,500	15,884,500	77,000	11,979,000	14,693,000	2,714,000	27,786,500	30,577,500	2,791,000
Colorado	17,650,000	18,900,000	1,250,000	15,802,000	17,759,000	1,957,000	33,452,000	36,659,000	3,207,000
Montana	1,695,613	1,695,613		1,200,000	1,240,000	40,000	2,895,613	2,935,613	40,000
New Mexico	250,000	350,000	100,000	225,000	300,000	75,000	475,000	650,000	175,000
Idaho	404,000	538,400	134,400	300,000	440,000	140,000	704.000	978,400	274,400
Utah	6,150,000	6 150,000		2,870,000	5,458,000	2,588,000	9,020,000	11,608,000	2,588,000
Washington	20,091,100	22,549,100	2 458,000	12,690,000	13,877,000	1,187,000	32,781,100	36,426,100	3,645,000
Oregon	4,888,000	6,665,000	1,777,000	9,978,000	9,978,000		14,866,000	16,643,000	1,777,000
California	86,560,400	92,761,750	6,201,350	78,042,000	79,498,000	1,456,000	164,602,400	172,259,750	7,657,350
Arizona	277,800	337,100	59,300	120,000	120,000		397,800	457,100	59,300
TOTAL	167,719,413	181,321,463	13,602,050	143,587,000	154,655,000	11,068,000	311,306,413	335,976,463	24,670,050
United States	1,692,788,298	1,761,571,812	68,181,514	1,389 464,349	1,455,520,159	66,055,810	3,082,252,647	3,217,091,971	134,839,324
Insular Possessions of U. S.—Hawaii, Porto Rico and Philippines	2,504,000	3,181,500	677,500	1,110,000	1,930,000	820,000	3,614,000	5,111,500	1,497,500
Canada, including Newfoundland	34 201,080	40,833,142	6,632,062	25,147,558	28,571,050	3,423,492	59,348,638	69,404,192	10,055,554
Cuba	13,500,000	13,500,000		8,550,000	8,550,000		22,050,000	22,050,000	

CORRESPONDENCE

TOOL STEEL

Chicago, Ill., July 14, 1905.

EDITORS STREET RAILWAY JOURNAL:

In your issue of July 8 you publish an article, signed by Mr. Osmer, master mechanic of the Northwestern Elevated Railway, relative to a new process for tempering high-speed steel. Will you kindly let me know, through the columns of your publication, the kind of steel that Mr. Osmer is getting these phenomenal results from through this process of tempering?

GEORGE L. NELSON.

[Mr. Osmer reports to us that the steel for high-speed cutting that he is using and tempering by the process described is the Allen steel. We judge from what Mr. Osmer says that the best results can only be secured with this steel when the tempering is done almost at the fusing point, and this is what the apparatus he describes makes possible.—Editors.]

RAPID TRANSIT IN CITIES

In an address on this subject delivered last month by William Barclay Parsons at Purdue University, the speaker presented some interesting figures on the cost of the New York Subway. He stated that certain portions of the subway with four tracks, but exclusive of the equipment, cost at the rate of $5,000,000 per mile. The average cost, according to Mr. Parsons, including the elevated portion, which was, of course, much less expensive than the underground portions, was $2,000,000 per mile. The equipment cost about $750,000 per mile in addition. These figures are based upon a total length for the system of 24.7 miles, of which 5.7 miles are elevated, 1.4 miles are in iron-lined tubes, 3.4 miles are in deep tunnels, 1.2 miles are in arched construction and 13.0 miles are of the typical shallow subway construction, with concrete walls and flat steel roof. These variations in construction were adopted for topographical reasons. The average cost of the London tubular railways for two tracks, including stations and equipment, was given as $4,000,000 per mile.

In discussing general traffic conditions, Mr. Parsons said:

"In studying the problem for the building of a new line or the reconstruction or extension of an old one, the engineer should be sure he understands all phases of the question. While it is his business to supply the public with the facilities that the public desire, and not what he thinks they should desire, nevertheless he must be sure that there is sound and permanent logic in public demand. The traffic routes should be analyzed to determine the trend of travel and reasons for it. Frequently arguments are advanced that railroads should not be built along congested streets, because they tend to increase congestion, but instead they should be built along other and less frequented streets so as to draw travel away from the congested routes. Travel is usually concentrated along certain routes for well-established reasons, and frequently in spite of lack of transportation facilities. In this case it is idle to talk of drawing travel away. People that have become set in certain ways are hard to change, and a line built off a line of travel is of little public benefit and is doomed to failure or to a long wait for business to originate before attaining success.

"People also wish to be carried quickly. As our cities grow and distances increase, this question of speed becomes more and more important, as people measure the distance by minutes occupied in travel. Railroads for rapid transit should therefore, so far as possible, be on straight lines, and if one straight line cannot reach all the desired points, then other railroads must be built as soon as business warrants. The mistake should not be made of sacrificing the best individual results in the attempt to partially satisfy many. These were the errors in the location of the first underground railroads in London, where the attempt was made to avoid congested routes and give a circuitous location.

"In laying out rapid transit lines, it is found that people will not walk far to reach even a superior means of transportation, but are inclined to take the first at hand. For this reason one such road will not serve a very wide belt of territory, and the danger of disadvantageous parallel competition does not exist in anything like the same degree as with ordinary railroads operating in the same territory. New facilities of this character create their own traffic. The chief question arising is whether any particular route possesses in itself sufficient possibilities to justify the expensive construction. As parallel competition is not to be much feared, so new lines, even of an opposition corporation, should always be so constructed as to be capable of physical connection to permit through running. The whole tendency of American experience is toward consolidation of a city's transit lines. Our friends, the newspaper editors, and some of our other friends engaged in political strife, at times write and talk bitterly of local transportation monopoly. As a matter of fact, the public are better served when all lines are thus gathered together as a monopoly, and thus give the people the benefit of through running or of transfer.

"In judging of the value of traffic routes, two chief considerations must be kept in mind. First, mere density of population does not of itself signify great traffic returns. A certain portion of the population of great cities, and usually that which is densest, is not migratory, but being clustered around its work has little cause to go to other parts of the city. On the other hand, there are neighborhoods where the population is much more sparse, but where the residents leave their homes for business, shopping, visiting, school and entertainment. One must differentiate therefore between traveling and stationary population. This is well illustrated in New York, where one of the elevated lines traverses the celebrated tenement house district, where more people live per acre than in any other city of the world. The traffic returns are very low. Other portions of the line traversing districts where the population is not one-tenth of the former show receipts several-fold greater. Second, special points of occasional crowding are not so productive of traffic as they would seem to be. Recreation grounds and parks used occasionally or on certain days or seasons are illustrations, and even terminal stations of great railroads. To again quote from New York experience, when it is remembered that the Manhattan Elevated and Subway systems alone, on but a little over 50 miles of road, carry two-thirds as many passengers as do the steam railroads of the United States on over 200,000 miles, it needs no demonstration to show that the number of passengers interchanged with the Grand Central Station, the terminus not only of the New York Central system, but of the New England railroads as well, does not constitute a large percentage. Even in London, where the facilities are inferior to an American city, the Board of Engineers in their report advising the Royal Commission on London Traffic, show that one trolley terminus where the lines, through opposition, are compelled to stop short of ultimate destination, discharges and receives more passengers than are similarly handled at six large railroad passenger stations combined. A street passing through a commercial or shopping district, with places of entertainment in the neighborhood, is a much more desirable district to reach from the point of financial return, and more necessary from the point of view of public convenience, than the greatest railroad terminus or most popular ball ground."

ADVERTISING THE CONNECTICUT VALLEY ELECTRIC TRANSIT ROUTE

Several colored folders, published by the Public Service Corporation of New Jersey, the Detroit United Railway Company, the International Traction Company, of Buffalo, and others, have been illustrated in these pages, but it is comparatively rarely that several roads combine to issue a circular of this description. This course has been followed, however, in the case of the Connecticut Valley roads.

The plan was originated by Thomas C. Perkins, of the Hartford & Springfield Street Railway Company. Upon looking up the matter of an individual folder, it was found that the cost of getting out a map and lithographing, printing, etc., would entail an expense of $1,000 or more, no matter how small an edition was to be published. The plan was then suggested that the managers of all the street railways of the Connecticut Valley combine to issue a universal folder, showing all the trolley connections throughout the valley, both east and west, and by dividing the expense among all the roads make the proportion very small indeed for each road.

COVER DESIGN OF CONNECTICUT VALLEY TROLLEY GUIDE

This matter was then taken up with the various companies, every one of whom was found anxious to have the plan put through. The original colored map cost about $250, as it required considerable labor to get it out and have the lettering and the locations of the towns made properly. About 220,000 of these folders were issued, divided among the various street railway companies, as per the accompanying table, substantially in proportion to the mileage of the different roads, although one of the roads took a little less than its proportion.

CONNECTICUT VALLEY ELECTRIC TRANSIT ROUTE

	Number of Folders Taken	Cost
Hartford Street Railway Company	55,000	$550.00
Farmington Street Railway Company	5,000	50.00
Hartford, Manchester & Rockville Tramway Company	10,000	100.00
Hartford & Springfield Street Railway Company	20,000	200.00
Springfield Street Railway Company	55,000	550.00
Woronoco & Western Street Railway Company	20,000	200.00
Springfield & Eastern Street Railway Company	16,500	165.00
Holyoke Street Railway Company	20,000	200.00
Northampton Street Railway Company	7,500	75.00
Connecticut Valley Street Railway Company	20,000	200.00
	229,000	

The cost of getting out this issue, including the cost of the map and expenses of various sorts, together with 500 black japanned tin holders, which were furnished to the various street railway companies, was 1 cent each per folder. This

MAP USED IN CONNECTION WITH THE DESCRIPTION OF THE CONNECTICUT VALLEY ELECTRIC TRANSIT ROUTE, HARTFORD, CONN., TO GREENFIELD, MASS.

allowed enough for the originator of the folder to pay his expenses of traveling around and looking after the matter. In getting prices on the lithographing and printing, it was found that the minimum price per 1000 could be secured only by publishing at least 100,000 folders. How this plan worked out may be noted from the preceding table.

It is plain that the scheme is a very good one where connecting roads will join in such an undertaking, for the cost to the Hartford & Springfield Street Railway Company alone was only $200, for which it was furnished 20,000 folders. Besides this it reaped the advantage of having over 200,000 of these folders distributed for nothing by the other street railway companies, all of which could not help but stimulate travel. This same advantage, of course, was gained individually by every road joining in this distribution.

To construct a map that would be satisfactory to the managers of all the different roads, the Government topographical maps were used as a basis, each manager marking in on the map his various lines. By putting all the numbers together it became possible directly to represent the complete system.

As to distribution, each street railway is supposed to appoint one man in the car house whose business it is to see that the tin boxes in each car are kept filled with folders, and also that a supply of folders is kept on hand in all the hotels, cigar stores, drug stores and other public places in the various towns represented by the company's particular system.

When the matter of bringing out the folders was first taken up, there was some difference of opinion among the managers of the various roads as to whether the folders would not be thrown away, and to prevent this the plan was adopted to have the cover of the folder contain a very attractive design which would catch the eye and be so novel that every one who got hold of a folder would take it home. Of course, nothing would fill the bill better than a pretty girl, hence the design on the cover. The idea of the design of the trolley car under the lady's arm is not original, being taken from a poster prepared for the Brockton & Plymouth Street Railway Company, one of Stone & Webster's roads. The actual design of the cover for the folder was made by Mrs. Anna Westermann, of the L. A. Westermann Company, of New York City, at a cost of $50. There has been a great demand for these folders in Hartford and on all the other roads, and few, if any, have thrown them away or have not been interested in the excellent descriptions of the attractive features of the Connecticut Valley.

There are many cases throughout the country where connecting railways could get together and issue a folder of this kind which would result in increasing business on all the lines. One very common fault of street railway managers is that, being so familiar themselves with their own lines and the connections, they think everybody else in the community knows as much about them as they do, so do not make an effort to educate the public along these lines. In the city of Hartford, for instance, up to the present time there probably was not one person in a hundred who knew anything about the connections up the Connecticut Valley beyond Springfield or Holyoke, and on the other hand, the people in Holyoke and Northampton and in Springfield knew almost nothing about the connections to Hartford and to the south and west—consequently carrying out such a plan as issuing a general folder will be of considerable value in the way of stimulating traffic. A street railway company has goods to sell just as well as a department store, and if the management will keep its road before the public and use as much judgment in jollying along the newspaper people and doing a little advertising, as an up-to-date storekeeper does, it will reap the benefit of much increased riding.

Another scheme which Mr. Perkins originated in Hartford to stimulate traffic was the running of special limited cars from Hartford to Mount Tom on Sundays, charging a little more than the regular fare, and having the seats put on sale a week beforehand at a corner drug store, in the center of the city of Hartford. This service has proved very profitable and has been a good advertisement for the railway.

WHY ACCIDENTS HAPPEN

BY DR. H. B. ROCKWELL

In considering the subject of accidents in their relation to electric railways, perhaps the first question that presents itself is, "Why are accidents so named?" Why should the unfortunate casualties that occur every day on street railways be called accidents? An accident may be defined as an unforeseen and injurious occurrence not attributable to mistake, neglect or misconduct, and how frequently we hear the expression, "It was nobody's fault, it was purely an accident."

Now, as a matter of fact and experience, accidents thus defined rarely, if ever, happen on street railways. But because some one has blundered, some one has disobeyed an order or undertaken to reverse a law of nature, an accident with its long train of consequences is the result.

By whatever name we may choose to call these dire events, on this point we are all agreed: that their prevention is to be most earnestly desired and a means to that end most eagerly sought. So long as there are railroads and because men are fallible, accidents are bound to happen, and their entire prevention is impossible; but something can be done, that is not done, to that end. As President Roosevelt said in addressing the graduating class of Williams College last month, and while talking upon Government control and the adjustment of railway rates: "We do not believe that it will produce the millennium or anything approaching it, but it will work a measurable betterment." In discussing the subject, "Why accidents happen," we must necessarily consider the correlative proposition, "Why accidents should not happen."

It is somewhat difficult to formulate a classification of accidents, for each one is in a class by itself. There are almost as many classes as there are accidents; each one presents some different phase, and this fact becomes most strikingly apparent when an attempt is made to adjust it, and as the physician in treating his patients must take into consideration the idiosyncrasies of each and not undertake to prescribe for them all by an inflexible rule of practice, so the adjuster must study the peculiarities of his case if he would secure the best result. We can, however, classify the causes of accidents, and such a classification will be of service to the adjuster by enabling him to systemize his work.

CLASSIFICATION OF THE CAUSES OF ACCIDENTS

1. Accidents that arise through the negligence of the corporation or its servants.

2. Accidents that occur as the result of contributory negligence on the part of the injured.

The latter class is by far the larger, but the former is in some respects the more important, because it involves and includes the principle of "a priori" liability.

While, as regards the amount of damages, it makes little difference whether an accident occurs through the negligence of the corporation itself or its servants, in order to discover the cause and find the remedy, it will facilitate the subject to consider them separately.

First, then, let us take up accidents resulting from the company's negligence and how they can be prevented. In searching for the causes of accidents that result from a company's negligence, it is necessary to begin at the beginning of a railroad, the construction. For various reasons, but principally

from a mistaken idea of economy, things are done or left undone in building a railroad that contribute later on to the occurrence of accidents.

I do not presume to dictate all the measures that should be adopted in construction for safety, for the scope of this article would not permit it. Neither do I make any claim to omniscience, but I should like to call attention to some defects in construction that I have learned from experience have been the cause of accidents, and some very bad accidents.

CURVES

When engineers learn that not only the shortest but the safest distance between two points is a straight line they will have accomplished much toward the prevention of accidents. I know that it takes money to buy the right of way through a man's farm, and that frequently a considerable initial expense is saved by going around it, but in order to go around it requires curves, and curves are a most fruitful cause of accidents, and in two ways: cars are more frequently derailed at curves and the view is obstructed and collisions result.

It is true that the right of eminent domain is not granted to electric roads as it is to steam railroads, and it is therefore impossible for engineers always to have their way on this point, but money will accomplish almost anything, and it is better to pay a man several times what his land is worth than to depart from practically straight lines in building a road. But granted that curves are in some instances unavoidable, it is possible to make them comparatively safe by removing obstructions to the view. I have in mind an accident that cost in the neighborhood of $100,000 that could have been wholly prevented by the removal of a few trees and some underbrush that grew on the inside of the curve. The steam roads are spending millions of money in straightening their roadbeds, and it is not done altogether to save time either. Why should not electric roads follow their example?

GRADE CROSSINGS

Is there any reason why street railways should delay the abolishment of grade crossings until compelled by legislative action to do so? Why is it they cannot see that by so doing they save not only enormous expense from accidents but valuable time as well. I am free to admit that accidents do not often occur at grade crossings because of the extra precautions that are taken, and I know, too, that it has come to be almost a truism that accidents do not as a rule occur at danger points; but they do sometimes happen, and when they do they are fraught with awful results that stamp a lasting impression upon the minds of the public.

OPEN CARS AND RUNNING BOARDS

It is becoming to be freely expressed in railway circles that this "abomination of transportation" must go. It is entirely within the confines of conservatism to state that 50 per cent of all accidents result from persons alighting from or boarding open cars.

It cannot be denied that this type of car offers a strong incentive to travel, especially upon those roads that depend for their business largely on pleasure riding, and they will undoubtedly continue to be used, but they should be built with aisles and the exit and entrance should be by the rear platform while en route and from both platforms at terminals, and roads will act wisely if they will go one step further and adopt the system so successfully in vogue on some roads, of placing gates on the rear platform, operated by the motorman.

There is no question at all that the use of the running board for the purposes of transportation is a most iniquitous practice. It was never designed for this purpose, and it is an unfortunate device from an economic standpoint, to say nothing of its dangerous character. The number of fares missed on account of a crowded running board will probably overbalance the extra number of passengers carried upon it. Accidents to passengers riding on running boards are a daily occurrence, and although the rules of the company may prohibit the practice and a notice to that effect may be posted in a car, the courts are holding the companies rigidly to account, arguing that the very presence of the running board is a tacit invitation to ride thereon. In the name, then, of economy, humanity and decency, banish the running board and the summer car so equipped!

CAR INSPECTION

Every car before making its daily trip should be run over the wheel pit and thoroughly inspected by a competent man, and after it has run not over 3000 car-miles it should be taken off its run and subjected to a minute inspection as to its concealed parts that cannot practically be examined at the daily inspection. Car inspection on many roads is performed in a perfunctory and inadequate manner, and from the accident point of view too much stress cannot be laid on this important duty.

CULTIVATION OF FRIENDLY RELATIONS WITH EMPLOYEES

The cultivation of at least a speaking acquaintance with the employees on the part of the high officials of the road is very important. There exists in the bosoms of men, even the lowliest of men, a spirit of pride in their occupation. They like to speak of our road and our company, and this spirit should be fostered. Let men believe that they are not mere machines, that they are sentient beings, capable of feeling, and that the success of the road depends largely upon their personal effort, as it does. Instead of constantly disciplining men for breach of rules, occasionally reward them for service well performed, and if the presidents of roads would occasionally unbend their dignity and at stated intervals meet their employees in friendly concourse, be present now and then at their social gatherings, and give them a speech to show that, although they may stand on a higher rung of the social ladder, they are made of the same clay, it will redound to the advancement and betterment of the road, and the public will benefit proportionately.

ACCIDENTS DUE TO THE NEGLIGENCE OF EMPLOYEES

In seeking a motive (if one can call it a motive) that actuates a man in deliberately disobeying a rule, designed for the safety and welfare of not only those in his care, but himself as well, we meet with a problem in psychology difficult of solution.

Several years ago a car was making its customary run between two small cities in the central part of New York. It was in charge of a motorman who had been in the employ of the company continuously for seven years, and always on this particular run. Just midway between the two cities, the road crosses the tracks of a steam railway. It was the rule of the company and the invariable custom of the men to stop before crossing the track, and the conductor's duty was to go ahead and signal the crossing. On this occasion the conductor, as the car approached the crossing, walked to the rear of the car and stood upon the step, prepared to execute his usual duty. The possibility of the motorman failing to stop never for a moment entered his mind. He always stopped. He had been stopping for seven years, and had never failed to stop, but this time he didn't stop. He ran directly in front of a train running at a high rate of speed, the car was struck just back of the forward trucks and every passenger instantly killed. The motorman was picked up 50 ft. from the wreck, badly injured, and taken to a hospital, and when I saw him a few days after and asked him why he did not stop, his reply was, "I do not know; I cannot state," and I was unable to obtain any other explanation from him. Now, why was it? This man had not been drinking. His reputation in that respect was exceptional. He was not asleep. The conductor testified that he had stopped a few moments before to let off passengers. He was not a new employee and unacquainted with the road, and he was perfectly

familiar with the rules requiring him to stop at that particular point. He had stopped there thousands of times and had never failed before. It would almost seem as though the very habit of stopping would have unconsciously caused him to set his brakes, but his mind at that particular moment was a blank. There was an appreciable time when, to all intents and purposes, that man was dead, and his mind or spirit was as completely inoperative as though it had left the body for its eternal flight.

Occasionally a man undertakes to operate a car while more or less under the influence of liquor. His mind is clouded from drink and the machinery of his brain becomes clogged when it ought to be exceptionally active, for crises cannot be anticipated, and it behooves a man who holds in his hands the lives of the people to be ready for emergencies. Owing to the strict enforcement of the rule against drinking, whether on or off duty, accidents from this cause rarely, nowadays, occur, but they formerly were not uncommon, and furnished a theme for the exponents of total abstinence of which they were quick to take advantage.

Men do make mistakes at crucial moments, and for various reasons, some plausible, some ill-defined and some unaccountable. A man occasionally is overworked and is kept out all night on a snow plow. If then assigned to his regular run in the morning he may fall asleep at his post and make some mistake of memory or judgment which is due to sheer physical exhaustion. The negligence in such case is chargeable to the superintendent in permitting a man to work who is in any way or from any cause incompetent or incapable.

I think I am warranted in saying that 75 per cent of all accidents, for which a corporation is legally liable, arise from the employee's inattention to his duties, and the other 25 per cent to his disobedience of orders.

I have mentioned one or two instances where inattention to duties resulted in accident, and have tried to specialize, as it were, the different forms this inattention takes. The most common form of inattention, and the one most fruitful in the matter of accidents, is characterized by a frivolous "don't care" sort of a spirit, a lack of dignity and a lack of seriousness. Men indulge too much while on duty, in jocularity, not only between themselves, but occasionally with the passengers. They try to be funny and smart, and there is a considerable tendency to flirt with women both on and off the car, a practice to be condemned, both for reasons of morality and expediency. They should be reminded by the management frequently, every day if necessary, of the seriousness of their employment. "There is a time to dance and a time to refrain from dancing," and this is one of the times to refrain. Boys, or what is worse, men with boyish proclivities, are out of place as railroad employees. The steam roads are a long distance ahead of the trolley roads in this respect. It is quite the exception to meet a garrulous employee on a steam road.

During the early part of last fall, on a dark and rainy night, a summer car was running along at a moderate rate of speed between two towns in Rhode Island. The motorman was carrying on a conversation with a young woman who was seated directly behind him, when suddenly she called his attention to some object lying on the track a few feet ahead of the car. The motorman reversed and made a frantic effort to stop, but the front truck passed over a man and crushed out his life. The coroner's jury handed in a verdict of "drunk; lying on the track; contributory negligence; company exonerated." The verdict might have been different if the jury had the same opportunity that I had for obtaining the facts.

DISOBEDIENCE OF ORDERS

I presume there are some men so degenerate and morally perverted that for spite or revenge they will deliberately disobey orders, but these cases are so rare that they hardly come within the scope of this article. Yet, disobedience of orders is the common cause of accidents, and is usually due to carelessness or forgetfulness. In the great army of employees occasionally one is found who receives a verbal order very much as a ship takes on a miscellaneous cargo. Things are piled together without any relation, one to the other, and so in his mind, while it is a storehouse of information, the sequence of events and the correlation of ideas are sadly mixed and indistinguishable. Since the system of written orders has become a common practice on street railways, this excuse for accidents has in a measure been eliminated, and yet so long as men are employed with untrained and therefore unbalanced minds, accidents from carelessness are sure to occur.

ACCIDENTS DUE TO CONTRIBUTORY NEGLIGENCE ON THE PART OF THE INJURED

If corporations could obtain from the courts and jury the justice to which they are entitled, it would only be necessary to touch upon this particular phase of the subject. It is a melancholy fact, however, that this class of accidents furnishes the bulk of the work in the claim department of every street railway. It is the experience of nearly every road, some time during its history, to be called upon to defend cases where a deliberate effort is made to defraud the company. I do not propose at this time to enlarge upon this subject, not because it is unimportant, but because the occurrences are comparatively few and do not constitute a menace to the financial success of the road, and because they are, strictly speaking, not accidents.

The great majority of accidents due to the negligence of the public happen in one of three ways—through indecision, preoccupation, or the pernicious practice of "taking a chance."

If it were not so often attended by serious consequences it would be ludicrous to watch the exhibitions of indecision given by women. It is noticeable particularly in alighting from cars and in crossing tracks. There is probably no class of employees more abused and maligned than motorman and conductors, yet they are frequently entitled to sympathy and praise for their acts of heroism, both physical and moral. A woman signals a conductor to stop, or perhaps she doesn't signal and walks to the rear of the car. By her act she conveys the impression that she desires to alight and discontinue her journey. The conductor rings the bell, the car stops, she places her foot on the step and is about to alight, perhaps she actually does leave the car, when suddenly she changes her mind (woman's prerogative). It is the wrong corner, or she has left her pocketbook, or she has forgotten to bid her friend good-bye, or she didn't want to get off at all. Our courts are full of cases where accidents happen in just this way, and her friends are sure to swear that the car had come to a full stop; that she had one foot on the step and the other on the ground, when suddenly the car started off with a jerk and threw her. And it is astonishing how many friends a woman can command at this opportune moment. And so in crossing the track in front of the car. It hardly seems credible that the mind can act rapidly enough to keep up with the changes that a woman will make in her plans and purposes. It is utterly impossible for a motorman to anticipate what her intentions are. This same indecision is seen in the drivers of vehicles. They first stop and then whip up the horse, and then they stop again right on the track and the car hits them. The judge says it is a question of "due care and the jury must decide," and the jury does decide, and the company can usually forecast what that decision will be.

A great many people (and this statement is not confined to women) are so engrossed with their own thoughts that they become perfectly oblivious to the presence or existence of others, and while in this state of suspended animation undertake to perform the acts that call for conscious guidance. In so doing they are sometimes hit by a trolley car and the com-

pany has to pay. It becomes a question of veracity, and no one is willing to confess to being a somnambulist, so he simply lies about it.

There is a spirit born in each one of us and made manifest at the age of seven that prompts us in the early winter to "try the ice" on the mill pond. It bends and cracks beneath our weight, but we cross in safety, and then instead of congratulating ourselves on our preservation, we try it again just to see it bend, and continue the operation till we are "spilled in the drink." And probably because we are all "children still" when we arrive at mature years, we are constantly taking chances.

If it were not for the danger of running into vehicles, it would hardly be necessary to stop the cars on Broadway, for it is a rare exception that a man waits until the car stops before either boarding it or alighting. He calculates or miscalculates the speed and says to himself: "I'll just take a chance," and what a common occurence it is for a man to race after a car as though his life depended upon boarding that particular one, and the cars running on a half-minute schedule!

This head-long rush is not seen in other countries; people abroad are content to live out their allotted lives in some degree of quietness and leisure, but this rush and crush is characteristic of our Americanism, and I would be considered lacking in patriotism to advocate a change.

In concluding this subject I want to emphasize this thought: That accidents, most of them, are preventable. It may be necessary in many cases to discount and anticipate the folly and carelessness of people, but if claim departments would devote some of the energy and zeal which they exhibit in settling accidents to means and methods and appliances for their prevention they would accomplish not such brilliant results perhaps, but they would gain the approbation of street railway men in general and the gratitude of a much-abused and sometimes outraged public.

VIEWS IN THE LONDON TRAMWAY EXHIBITION

THE TRAMWAY EXHIBITION IN LONDON

The most important street railway event in London last month was the opening of the third International Tramway Exhibition, which was held at the Agricultural Hall, Islington, London, on July 3-14. The accompanying illustrations give a good idea of the appearance of the hall and the nature of the exhibition. It is three years since the last exhibition, but with a few exceptions the character of the exhibits is much the same as in previous years.

Perhaps the chief new feature which stands out boldest is the introduction of the motor car, or more correctly, the motor omnibus, to this exhibition, as represented by Wolseley, of Birmingham, and the Peebles steam car. Three years ago no motor omnibuses were in evidence. Secondly, there were this year three distinct surface-contact systems with elaborate exhibits, namely, the Kingsland, the Lorain and the Dolter, and while one or two of these were shown three years ago, they did not receive the same attention as at present.

Among the other exhibitors, the two most striking exhibits were undoubtedly those of the Brush Electrical Engineering Company, of London, and Bruce Peebles & Company, of Edin-

burgh, the former showing chiefly cars and equipments, while the latter exhibited a locomotive for high-tension three-phase work, and trucks equipped with motors for three-phase work on tramways and light railways. Among the other well-known manufacturers of electric traction apparatus were the following: The Stirling Boiler Company, Ltd., which showed models of boilers; Babcock & Wilcox, Ltd., gravity bucket conveyor, chain stokers and models of boilers; W. S. Laycock, Ltd., car fittings; Mountain & Gibson, Ltd., trucks, trolleys and fenders; Callender's Cable & Construction Company, Ltd., cables and appliances; Vacuum Oil Company, Ltd., oils and lubricators; ment, etc.; Miller & Company, Ltd., chilled-iron car wheels and a 150-ton wheel press; Aiton & Company, wrought-steel piping, grease separator and pump; Ed. Bennis & Company, Ltd., conveyors, stokers and furnaces; the Lorain Steel Company, special work and the surface-contact system used in Wolverhampton; Glasgow Numerical Ticket & Check Book Printing Company, specimen tickets; Lancashire Dynamo & Motor Company, Ltd., boosters; Electrical Power Storage Company, Ltd., storage batteries; G. D. Peters & Company, walk-over and turn-over seats, shades, millboard and other interior car fittings; Edgar Allen & Company, Ltd., special work;

VIEW FROM EAST GALLERY, LONDON TRAMWAY EXHIBITION

the Continuous Rail-Joint Company of Great Britain, Ltd., rail-joints; Kelvin & James White, Ltd., portable and recording instruments; Standard Varnish Works, insulating compounds, varnishes and motor coils; Nalder Brothers & Thompson, Ltd., electrical instruments; Electric Tramway Equipment Company, overhead material, gear wheels and pinions; Elliott Brothers, switchboard and portable instruments; E. Green & Son, Ltd., models of economizers; the Forest City Electric Company, rail-joints and commutator segments; Hadfield's Steel Foundry Company, Ltd., crossings, switches, car wheels, photographs of special work; British Johns-Manville Company, Ltd., fuses, overhead line material, insulation and pipe coverings; Robert W. Blackwell & Company, Ltd., motor-driven tower wagon, line material, tools, trolleys, gears and pinions, air-brake equipment; John Baker & Company, Ltd., steel-tired wheels and axles; Joseph Dixon Crucible Company, graphite; S. Dixon & Son, Ltd., automatic switches and overhead line material; Robert Young & Company, sacarbolate for cleaning cars; Glacier Anti-Friction Metal Company, Ltd., anti-friction metal for bearings; Thermit, Ltd., thermit welded rail-joints, including daily demonstration of the method of casting; Haste Pump Company, Ltd., pumps.

While some of the largest electrical manufacturing companies did not find it to their interests to exhibit this year, yet the exhibits of the smaller companies, especially those handling the auxiliary apparatus, were better than usual, and the exhibition, while it lasted, was well attended throughout and proved entirely successful.

THE WILLANS-PARSONS STEAM TURBINE

About two years ago Willans & Robinson, Ltd., of Rugby, England, manufacturers of the well-known high-speed engine, decided to take up the manufacture of steam turbines. After a careful survey of the work being done in the direction of building turbines of different types, they decided that the parallel-flow turbine, on the system proposed and developed by C. A. Parsons, had stood the test of time and was in a position for manufacture on a large scale. Negotiations were entered into with Mr. Parsons and a license to manufacture under his patents was taken. Consequently the Willans-Parsons turbine is identical in principle and in its main features with the Parsons standard type, and it is only in details of design and manufacture that there are any differences. As, however, these alterations have been introduced with a view to lending greater flexibility to the turbine when in use and facilitating manufacture on the interchangeable system, a few remarks on the subject may be of interest.

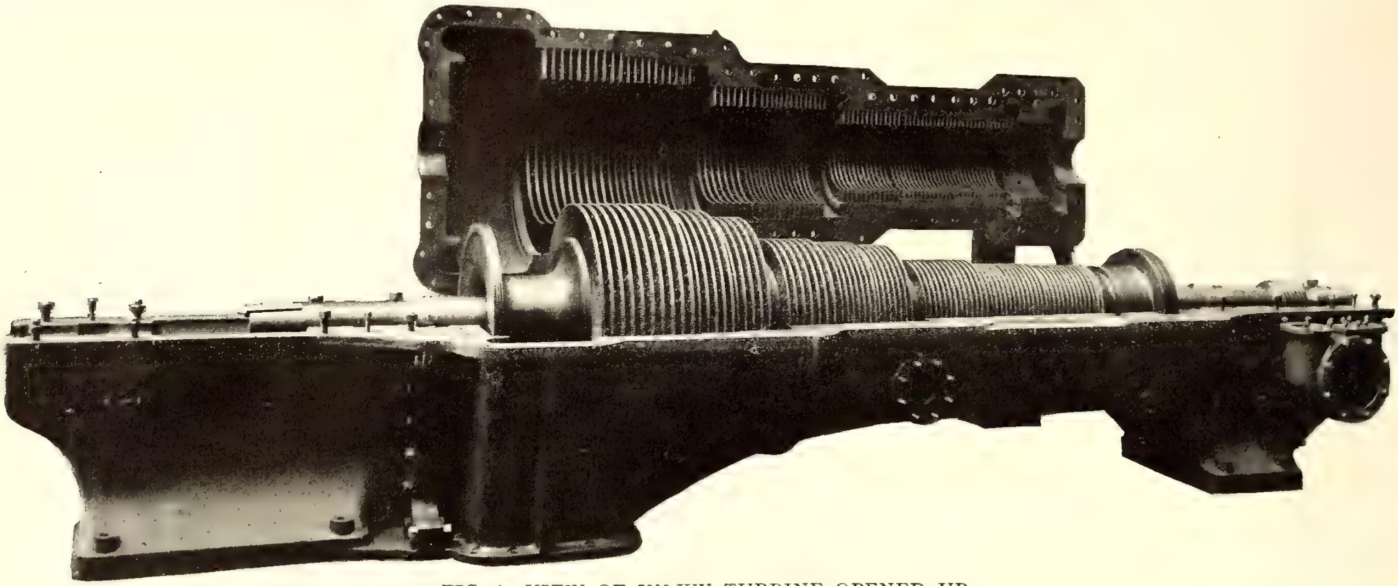


FIG. 1.—VIEW OF 5000-KW TURBINE OPENED UP

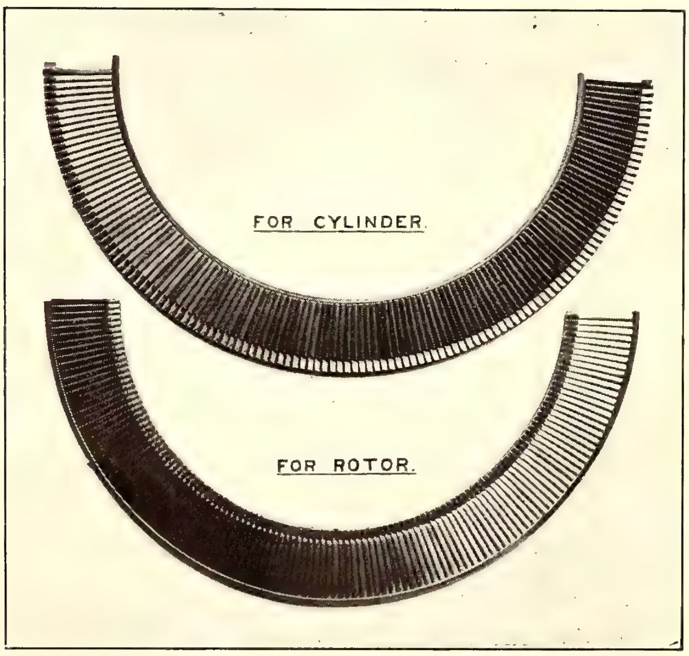


FIG. 2.—TWO HALF RINGS OF BLADES READY FOR ASSEMBLING

Special attention has been given to the arrangement of necessary details, such as governor gear, oil pump, steam and water piping, etc., as it has been found that ability to inspect the working portion of a turbine without dismantling any attendant gear is a convenience appreciated by those who have to take charge of the running and maintenance of machinery. To enable this to be attained, all the gearing and fittings named above are mounted on the bottom half of the bearing pedestals, and the top cover of the turbine, as well as the bearing caps of the three main bearings, are left free for instant removal.

To facilitate further the opening of the turbine, the top half of the casing has been arranged with two hinges, thus avoiding the use of guide studs and placing the turbine cover in a suitable position for examination. In the case of the 1000-kw Willans-Parsons turbine, it is possible for two men to remove the main bearing caps and to open up the turbine for inspection in less than an hour. A view of a turbine opened up in this manner will be found in Fig. 1.

By a rearrangement of the balancing passages it has been found possible to shorten somewhat the length of the ordinary parallel-flow turbine, and, further, due to Fullagar's system of balancing, it has been found possible to dispense with the large balance piston at the high-pressure end of the turbine and to substitute in its place one of considerably smaller dimensions at the low-pressure end. It has been found in practice that this method of arranging the balancing pistons has the advantage of enabling castings of a more symmetrical form to be adopted, and in this way many of the troubles brought about by unequal expansion of the different parts are avoided.

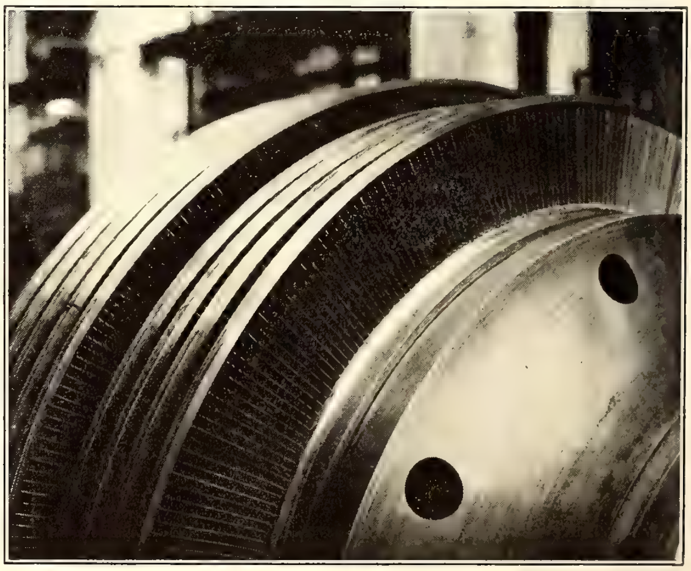


FIG. 3.—VIEW OF TURBINE BLADES, SHOWING SHROUDING

An improved method of attaching the blades to the rotor and casing has been adopted in this turbine. Extraordinary stiffness and rigidity is given to the blade rings when they have been fitted into their respective body or shaft grooves. In the ordinary turbine of this type, each blade is fixed separately into the rotor and casing by means of its own caulking piece. In the Willans-Parsons steam turbine, as will be seen from Fig. 2, the blades for one complete ring are built up on two half rings, which rings have had the necessary grooves for receiving the blades cut in them by means of automatic machinery. These complete half rings of blades are then caulked into the shaft or the casing. Attention might be drawn to the fact that the cutting and assembling of the blading by means of specially designed automatic machinery insures that the whole of the blade angles and openings on which the efficiency depends are mathematically correct. Fig. 2 shows two of these half rings complete for assembling on the shaft and in the casing.

Another feature of the Willans-Parsons turbine consists in the special channel shrouding encircling the blades which this manufacturer has the right to use under the patent of H. F. Fullagar. This shrouding is fixed on the half ring of blades before assembly on the shaft or in the casing, and has several points of merit. It adds materially to the mechanical strength of the blades themselves and removes any danger of the blades stripping should the rotor come into contact with the casing, or the blading on the casing come into contact with the revolving shaft. Further, the action of the channel shrouding when under working conditions minimizes the loss due to leakage over the revolving or fixed rows of blades, and by this means a considerable gain in the steam economy is effected. A view of the shrouding around the blades is shown on the right-hand side of Fig. 3.

Special attention has been paid to the question of governor gear with a view of making it as simple and as reliable as possible. By dispensing with some of the intermediate gears hitherto used on governors controlling steam turbines, it has been found possible to eliminate many of the undesirable features and to obtain results in the direction of close governing which it is believed surpass anything hitherto obtainable. All the turbines are fitted with by-pass valves, which automatically open when the maximum economical output of the turbine is exceeded, and by means of these by-pass valves any required overload can be obtained up to the full capacity of the generator, the steam economy of the turbine being, of course, reduced.

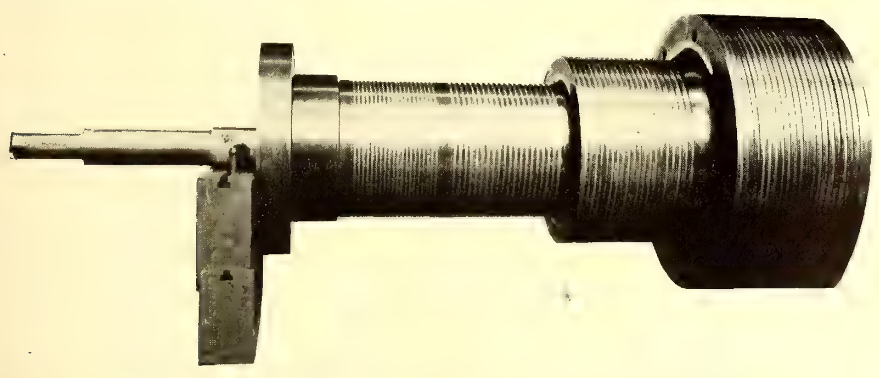
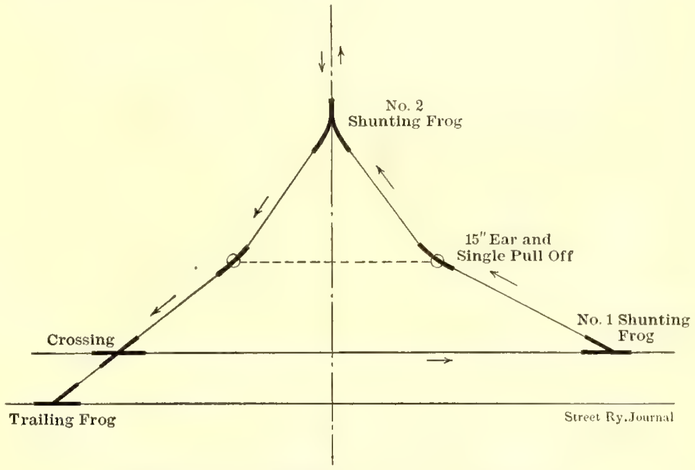


FIG. 4.—VIEW OF TURBINE SHAFT READY FOR BLADING

At the present time this company has 24,250 kw of this type of turbine at work or nearing completion, the smallest at the present time being of 750 kw normal capacity and the largest of 5000 kw normal capacity. Among others might be mentioned the following: Two 3000-kw and one 1500-kw for the Glasgow Corporation; two 1000-kw for the Bristol Corporation; one 3000-kw for the Metropolitan E. S. Company, London; two 1000-kw for Bruce Peebles & Company, Ltd., and one 1000-kw for Messrs. Watsons, of Linwood; also three 750-kw for the English McKenna Steel Process Company, Ltd., Birkenhead.

TROLLEY REVERSER USED IN BRISTOL, ENG.

The Bristol Tramways & Carriage Company, Ltd., has been using for some time Ward's trolley reverser. This is made in the form of a triangle, consisting of two switching points, one trailer and one crossing. This should be fixed in a suitable position at the terminus, so that the trolley head, when the car has stopped, has passed the switching or shunting point called No. 1 on the sketch. As the car starts on the return journey, the trolley, instead of taking the through wire, is lead off by the aforementioned shunting point on to one side of the triangle, at the apex of which is fixed another shunting point in such a position that the trolley head, when at a right angle to the car, has just run past it. The car proceeding brings the trolley head with it along the other side of the triangle and trails through on to the main line wire.



TROLLEY REVERSER USED IN BRISTOL

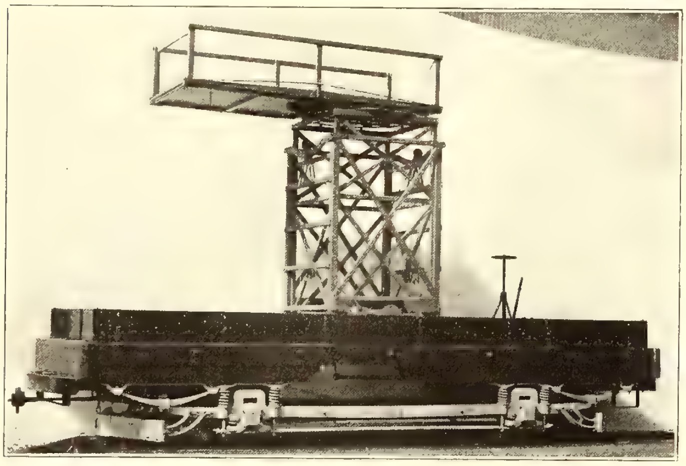
In fixing this to work with the 12-ft. boom, with the wire at a height of 20 ft. 6 ins., the most suitable measurements on the Bristol line for the position of the shunting points have been: No. 1 to be fixed as near as possible over the center of the track; No. 2 at the apex at a distance of 9 ft. from the center of the track to give a good lead in and out of the frogs. The other measurements are from center of the base of the triangle. No. 1 frog should be set at a distance of about 10 ft., the trailing point at about the same distance on the other side of this center line. An additional straining wire between the two sides of the triangle will be found advantageous for this purpose. Care must be taken that all wires are pulled up taut, in order to prevent the frogs tilting when the trolley is running under them. It is well to fix these reversers as near the end of the journey as possible, so that the outgoing car will not interfere in any way with the car standing to come into the siding.

The Spokane & Cœur d'Alene Railway has established a tent city this year in the woods bordering on Lake Cœur d'Alene and the Spokane River, which is meeting with a fair degree of success. It was established in May, and now has twenty tents occupied. Adjoining the tent city is a dancing pavilion, where the company maintains a dancing master and gives open air dances two or three times a week. This pavilion is now becoming popular with the people of Spokane.

TOWER CAR FOR LA PAZ, BOLIVIA

The J. G. Brill Company has recently delivered the type of tower car illustrated, ordered through W. R. Grace & Company, to the Ferro Carril Guaqui a La Paz, Bolivia. La Paz is a city of 80,000 inhabitants, located in the western part of Bolivia, in a deep valley, and yet 12,000 ft. above the sea level.

The car illustrated is 21 ft. over the sills and 5 ft. 9 ins. wide over the outside sills. The extension tower has a revolving platform and is completely equipped with hoisting rigging. The motive power will be furnished by a steam engine and vertical boiler arranged to drive on one axle by means of a sprocket wheel and chain, the sprocket wheel being placed on the axle between the outside of the wheel hub and the journal box. The No. 21-E type of truck, which has an unusually long wheel base, is used. This truck is particularly noted for its great strength and steady riding qualities, being almost universally used under double-deck cars. The length over the bumpers is 22 ft. 8 ins. The side sills are 4½ ins. x 7 ins., and the end sills are 3½ ins. x 13 ins. The weight of the car and truck without equipment is 9180 lbs. The No. 21-E truck has a wheel base of 10 ft. and 30-in. wheels. The builder's angle-iron bumpers and radial draw-bars are used.

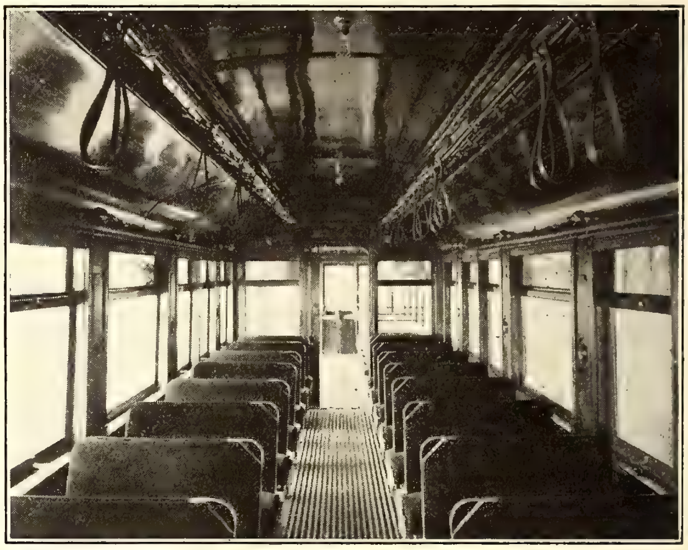


THE NEW LA PAZ TOWER CAR

HANDSOME COMBINATION CARS FOR CALIFORNIA

Three handsome combination open and closed cars, built by the American Car Company, have been placed in operation on the interurban line of the Vallejo, Benicia & Napa Valley Railroad Company, California. This road is located in the central western part of the State, and connects Vallejo, Napa Junction and Napa. Due to the favorable climate, combination open and closed cars are largely used on the Pacific Coast, being suitable for all-year service. In plan and general construction, the cars embody features that combine comfort and convenience with strength and durability. While not detracting from the comfort of passengers, the arrangement of different sized windows adds considerably to the appearance of the cars. The total seating capacity is sixty. In the closed compartment the seats are upholstered in red plush, and in the open compartment slat seats are used. The small upper sashes are stationary and the lower are arranged to drop into pockets, over which are hinged covers. The vestibule sashes also drop into pockets. Heavy curtains are provided for the open compartment. Wire net guards are fixed permanently on the outside of the posts from the vestibule posts to the closed compartments. The interiors present an elegant appearance, being finished throughout in mahogany, with the ceilings tastefully decorated. The cars are mounted on the American Car Company's No. 23-B type of M. C. B. trucks, with Westinghouse single-phase motors of 75 hp each.

The cars measure 48 ft. over all, and the length of the closed compartment is 25 ft. The length of the open compartment is 12 ft. 11½ ins. The width over the sills, including the plates, is 8 ft. 10 ins. The centers of the posts are 2 ft. 3⅜ ins. in the open and 1 ft. 5⅔ ins. in the closed compartment. The side sills are 5½ ins. x 7¾ ins., and the end sills are 5½ ins. x 7¾ ins. The sill plates are 8 ins. x ⅝ in. The thickness of the corner posts is 3¾ ins. in the closed compartment and 3½ ins. in the open compartment. The thickness of the side posts is 2¼ ins. in the closed and 3½ ins. in the open compartment. The seats are 35¼ ins. long and the aisles are 25 ins. wide. The height of the steps is 17½ ins., and of the risers, 13½ ins. The patented spcialties include Brill angle-iron bumpers, "Dedenda" gongs and channel-iron draw-bars, and American Car Company's pilots and brake staffs. The trucks have a 6 ft. 4-in. wheel base and 33-in. diameter wheels.



INTERIOR OF CALIFORNIA COMBINATION CAR

INTERURBAN COMBINATION CAR FOR THE VALLEJO, BENICIA & NAPA VALLEY RAILROAD COMPANY

The Boston & Worcester Street Railway has inaugurated this year a series of excursions from Worcester and intermediate points to the beaches in the vicinity of Boston. Arrangements are made with other companies to make the trips without change of cars, and they have been very generally enjoyed. The company provides comfortable cars, so that a ride of 50 miles or 60 miles each way is not objectionable, as the trips are made in comparatively quick time.

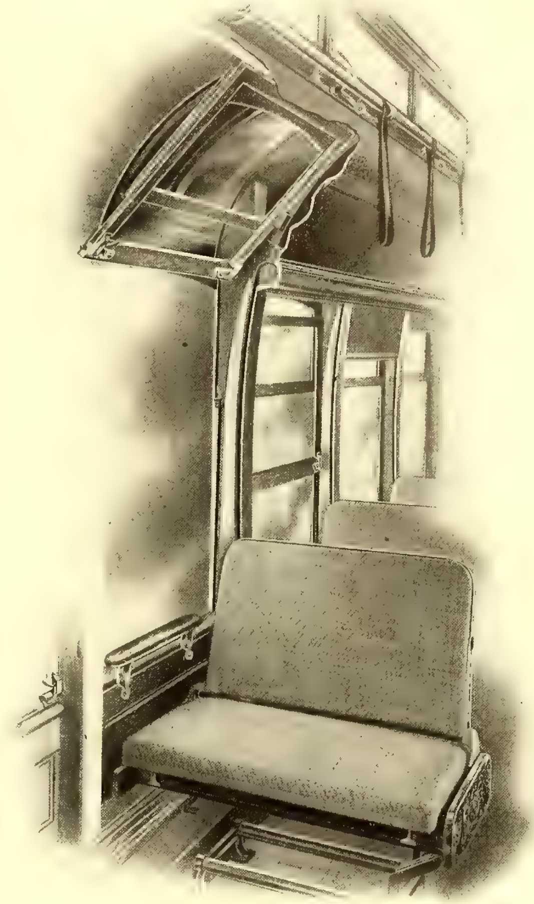
THE NEW "GROOVELESS POST" SEMI-CONVERTIBLE CAR

The "grooveless post" semi-convertible window system which has been referred to in this paper's recent articles on semi-convertible cars built by the J. G. Brill Company, is an improvement upon this well-known system, which the company has adopted as its standard construction, and which it believes to be the final step in the development of the type. When the car was introduced in 1899, a pair of sashes on being raised was automatically secured together by a button-and-eye method, the buttons and eyes being of metal and attached to the tops of the sashes. The sashes were guided into the pockets in the side roofs by means of trunnions at the sash corners sliding in grooves or runways in the posts. About two years ago the details were simplified by using metal hooks on the upper sash, in which the upper trunnions of the lower sash engaged when the sashes were raised. A few months ago this method was superseded by what has come to be known as the "grooveless

NEW GROOVELESS POST, SASH LOWERED

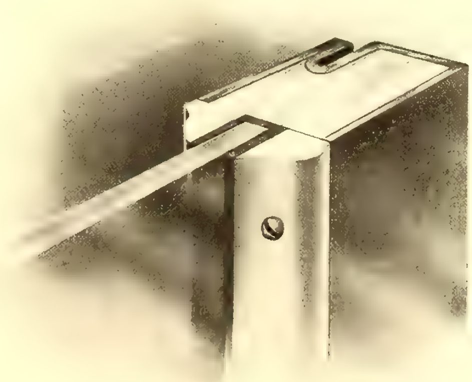
post" system, with which the company has experimented for more than a year. The chief object of the new arrangement is in that it dispenses with grooves, thereby increasing the strength of the posts. It also simplifies the mechanical details, perfects the operation and reduces the width and depth of the roof pockets.

The general plan of the "grooveless post" semi-convertible system consists of a pair of sashes, the lower attached to the upper by a sliding connection, and both conducted into the roof pocket by means of guides. Both the upper and lower sashes have brass stiles. The stiles of the lower sash have grooves in which slide tongues extending from the stiles of the upper sash. The tongues are composed of spring brass, inclined outwardly from bottom to top, so that the lower sash in being raised is moved slightly away from the surface of the upper sash to prevent friction. Small inclined metal plates upon the stiles bear against corresponding plates attached to the posts and press the frames of both sashes together in their lowered



NEW GROOVELESS POST, SASH RAISED

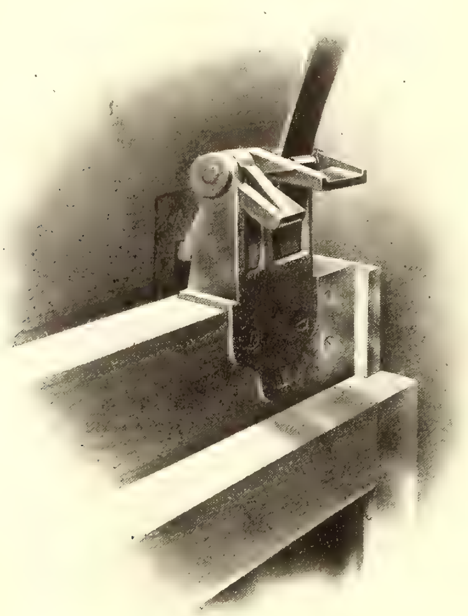
position, forming a waterproof connection. When the lower sash is raised, the top of its frame comes in contact with triggers in the roller brackets which are secured to the top of the upper sash. These triggers operate catches which spring into



BRASS SASH WITH WOODEN FILLER AND GLASS SET IN FELT, WITH WOODEN BEADING

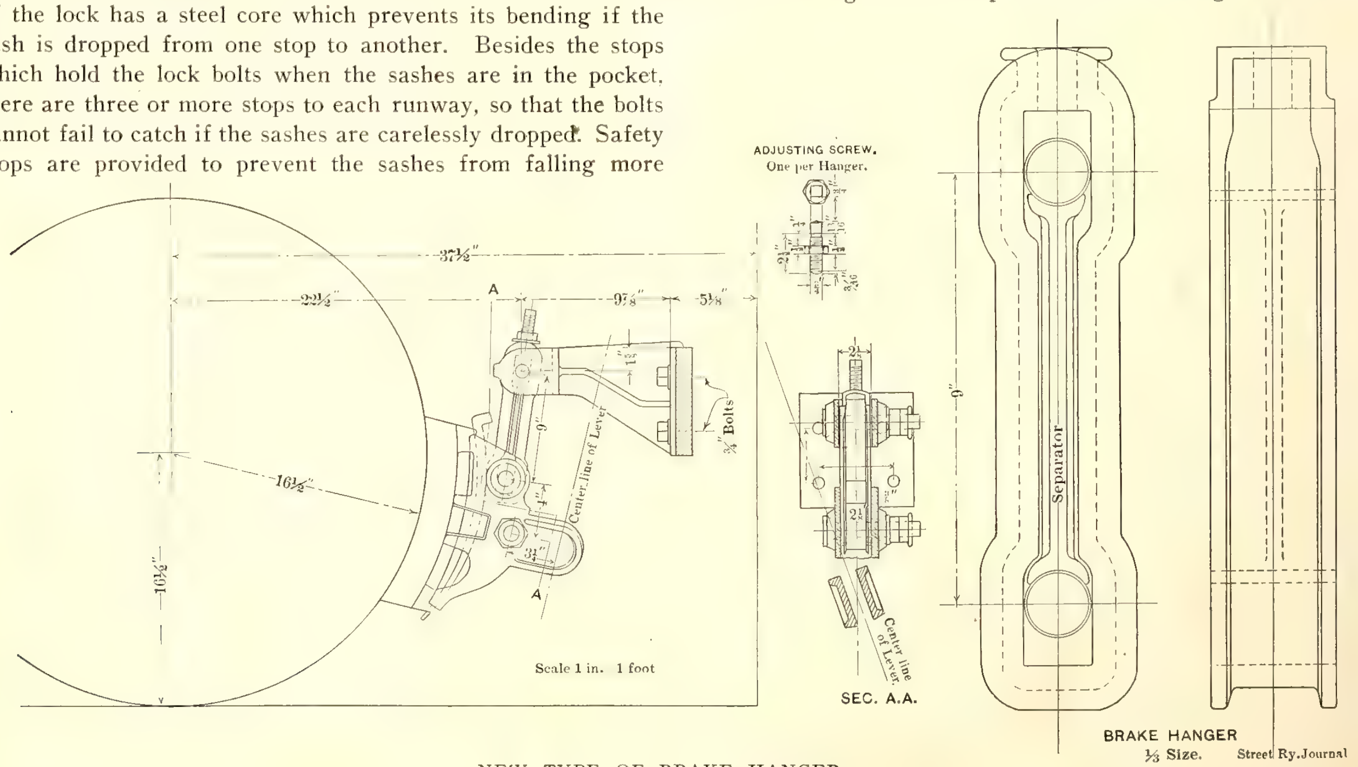
metal stops in the letter panel, while the upper sash is drawn down to prevent dislodgement. After the sash presses the triggers up it contacts with the extensions or toes, also on the roller brackets, and by them the upper sash is raised. An open space through the back part of the toe in each bracket contains

two rollers, mounted on a stout spring, and between them passes a bow-shaped guide. The guides are composed of flat steel spaced about 20 ins. apart, and which extend from the letter panel to the lower ventilator rail. Any settling of the deck cannot affect the movement of the sashes, because it is not essential for the guides to retain a fixed configuration. The



ROLLER BRACKET AND AUTOMATIC SPRING CATCH

window locks were especially designed for this system, and are equal to all the strain that may be brought upon them, even if the car should collide heavily with another. The brass bolt of the lock has a steel core which prevents its bending if the sash is dropped from one stop to another. Besides the stops which hold the lock bolts when the sashes are in the pocket, there are three or more stops to each runway, so that the bolts cannot fail to catch if the sashes are carelessly dropped. Safety stops are provided to prevent the sashes from falling more



NEW TYPE OF BRAKE HANGER

than a few inches if it should happen at any time that a passenger should not push the sashes high enough into the pocket to engage the locks in the uppermost stops.

Formerly the use of metal sash stiles was objectionable on account of the difficulty in removing and replacing the glass. This objection has been obviated by a patented method of construction which consists of combining a metal casing with a wooden filler, allowing the usual wooden beading to be used, as is shown in the illustration.

The builders claim that having the sashes slide into the roof pockets gains certain important advantages, namely, interior width, on account of absence of pockets in the side walls and the introduction of the ends of the seats between the posts and against the side linings; easier operation because one motion only is necessary, and that in a direction which permits the operator to use his strength to the best advantage. The sashes may be held at any desired height; the position of the window pockets prevents passengers from stuffing rubbish into them, and therefore they do not get foul, nor is the glass of the sashes liable to be broken.

The type has come into large favor for city service. At present the company is building forty for Baltimore, thirty-five for Memphis, twenty-three for Nashville, 107 for Philadelphia, and completing a number of smaller orders for various parts of the country.

THE OLDS BRAKE HANGER

E. W. Olds, superintendent of rolling stock of the Milwaukee Electric Railway & Light Company, is the inventor of a brake hanger which is used on all the new cars of the Milwaukee Electric Railway & Light Company. The patent is now the property of the St. Louis Car Company. This brake hanger is so designed that wear can be easily taken up so as to avoid the lost motion in the brake rigging which causes rattling and chattering. The adjustment is made by means of a single adjusting nut at the top of the hanger. By means of this adjusting nut, the pin on the brake beam and the pin on the truck frame can be brought firmly against the separator which forms the central part of the hanger. This separator is free to move up or down in the hanger. The tightening of the adjusting nut draws together the top half of the bearing on the truck-frame pin and the bottom half of the bearing under the brake-beam pin, holding the truck-frame and brake-beam pins firmly against the separator and preventing lost motion. Thus both the pin bearings can be kept tight by adjusting a single nut which is easily accessible at the upper end of the brake hanger. There can be no such thing as having these bearings loose and the other tight, as one adjustment equalizes against the other.

RECENT PROGRESS IN ALTERNATING CURRENT TRACTION IN FRANCE AND GERMANY

In a recent test made by the French Thomson-Houston Company on a Paris line, two 4-pole, single-phase, 25-cycle, 300-volt, 37-kw motors of the Latour-Gratzmuller were used. The increase in temperature of the commutator was 75 degs. C. after one hour's run, while the other parts did not increase by more than 60 degs. The efficiency was 84 per cent. The air-gap was 2 mm and the speed reduction 4.6 to 1. The tests showed that the air-gap may be enlarged without inconvenience and that the motors can be started easily at three times the normal torque.

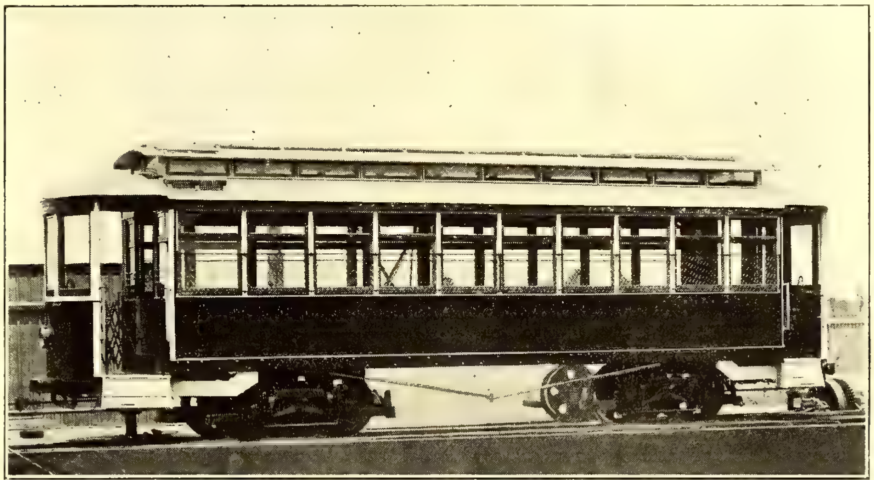
In a paper read by Mr. Schimpff before the annual meeting of the German Association of Electrical Engineers, the author reviewed the co-operation of the German Government with electric manufacturers in the development of heavy electric traction. He then sketched the equipment of the Hamburg road, from Blankenese to Olsdorf, which is now in course of erection. The single-phase system will be used and steam turbines of the Brown-Boveri-Parsons type will be installed in the power station. There will be five turbines, each of 1250 kw normal capacity and of 1700 kw maximum capacity; also two turbines, each of 600 kw for lighting. The 1250-kw turbines drive each a 2-pole dynamo, giving single-phase, alternating current of 6600 volts at a frequency of 25, the power being 1250 kw to 1700 kw at a power factor of 0.75. The lighting dynamos give a current of 6600 volts. The road, which has a length of about 14 km, with some considerable grades, will be supplied with current at 6600 volts. There are four feeding points. To one distant part of the line the current is transmitted at 20,000 volts and then reduced to 6600 volts. The construction of the trolley wire is the same as on the Spindlersfelde road. The rails are used for the return current. Double cars, each car having three axles, will be employed, each of the two cars having one truck and one driving axle. The trucks are placed at the beginning and end of the double car. One truck is provided with two motors, the other truck with one 125-hp motor. Such a double car will have seating capacity for 118 passengers, and will have a total weight, including passengers, of 180 tons. Finally some data were given comparing the cost of this single-phase system with a direct-current system with three-phase transmission and converter sub-stations. The total cost of conductors, transformers and converters for the latter system would be more than double that of the single-phase system ($729,000 against $316,000). On the other hand, the weight of the alternating-current cars is higher than that of the direct-current cars, by about 7.5 per cent, so that the consumption of power is correspondingly greater. Nevertheless, it is claimed that the combined three-phase and direct-current system, in comparison with the simple alternating-current system, would require annually an expense of about $29,000 greater, which is 23 per cent of the annual cost of power generation and distribution (about $125,000).

General Manager F. D. Carpenter, of the Western Ohio, announces that a traffic arrangement will be entered into between the Mandelbaum-Pomeroy syndicates and the Widener-Elkins people, thus making possible, with the completion of the Western Ohio's link now building between Lima and Findlay, complete through service from river to lake by trolley.

CLOSED CARS FOR BILOXI, MISS.

The John Stephenson Company has lately delivered to the Biloxi Electric Railway & Power Company two cars of the type illustrated. Biloxi is located in the extreme central southern part of Mississippi, on the Gulf of Mexico.

The new cars measure 28 ft. over the end panels and are 8 ft. 4 ins. wide over all. The window system is of the double-sash arrangement, the top sash being stationary and the lower drops into pockets which are provided with hinged covers. The vestibule sashes are of single lights, and also drop into pockets. Detachable wire window screens are included in the equipment. The seats are of spring cane and are transversely placed, with the exception of the four longitudinal seats at the corners of the car. The seating capacity is forty. Cherry, with decorated birch ceilings, constitutes the interior finish of the cars. The trucks are of the Brill No. 27-G type, with 4-ft. wheel base and 33-in. wheels, and have solid forged side frames. The motors are of 40 hp each. Among the specialties are Brill angle-iron bumpers, radial draw-bars, "Dedenda" gongs, "Retriever" bells, vertical brake wheels and folding gates.



CLOSED CAR FOR BILOXI

The length of the car over the vestibule sheathing is 37 ft. The height from the under side of the side sills to the top of the roof is 9 ft. 4 ins. The platforms are 4 ft. 6 ins. The thickness of the corner posts is 3¾ ins., and of the side posts, 2¾ ins.

An electric express train on the Lancashire & Yorkshire Railroad, bound from Liverpool for Southport, came into collision Thursday evening, July 27, with an empty stationary train at the Hall Road station, 6½ miles from Liverpool, causing the death of twenty-three persons and the injury of many others. The first car of the express, which was crowded, was smashed to pieces, and only six of the occupants escaped. The collision lifted the roof of the first car of the express completely off the steel frame and crashed it down again on the unfortunate passengers, twenty of whom were killed outright. Almost immediately after the crash, so the cable reports say, the wreckage burst into flames. Fortunately the badly injured number comparatively few.

The Aurora, Elgin & Chicago Railway has issued an "Outing" folder, one side of which is given up to a large, colored bird's-eye view map of the road. Half-tone views of attractive places on the road and some short descriptions occupy half of the remainder of the folder. The balance is taken up with the map of the downtown district of Chicago, showing the location of the new terminal station of the company and information about the service, including rates of fare.

INTERVIEW WITH MR. DALRYMPLE

While James Dalrymple, general manager of the Glasgow Municipal Tramway System, was in this country he expressed himself as adverse to newspaper interviews until his report should have been transmitted to Mayor Dunne. His report was sent to Chicago soon after his arrival in Great Britain, and in a recent interview in the "Tramway and Railway World," Mr. Dalrymple referred to his recent American visit as follows:

"I had an extremely pleasant tour, and I am glad to take this opportunity of publicly expressing my thanks and indebtedness to the municipal officials, the tramway administrators and representatives of the street railway companies with whom I came in close contact for the kind and generous way in which they received me. Any information I desired was readily placed at my disposal, and I cannot speak too highly of the courtesy I experienced on every hand. I visited Chicago, Minneapolis, St. Paul, Cleveland, Buffalo, Washington, Philalelphia, Montreal, Boston and New York, where everything that was possible was done to make me comfortable."

"Your immediate object, I believe, was to help Mayor Dunne and the Chicago people to solve their pressing tramway problem?"

"The object of my visit to Chicago was to explain to Mayor Dunne and the citizens of that great and important American city the tramway work that we have carried out in Glasgow, and to see if possibly the lessons we have learnt in Glasgow could in any way be applied to the benefit of that city. But I ought to explain that the local government system, the social and physical conditions, the climate and circumstances generally there are so entirely different from what obtains in this country, that great care has to be exercised in instituting comparisons. In fact, in many respects, accurate comparison is impossible, because everything is so different—law, habit and ideas, but of course the actual problem of locomotion, the giving of mobility to the people, is in principle the same."

THE CHICAGO TRAMWAY SYSTEM

"What did you find in Chicago as regards the tramway system?"

"The present tramway system of Chicago is, comparatively speaking, altogether out of date, and it has been rapidly going down hill of recent years from various causes. There is no wonder that the inhabitants are intensely dissatisfied with their transit facilities. One of the principal reasons for the decay has been the disputes between the municipality and the tramway or street railway companies in regard to franchise and other matters. The American franchise system corresponds somewhat to our system of Parliamentary concession, except that the franchise given to many companies in America is perpetual or for very long periods; the franchise means the original concession to work the tramways and construct the system. Of course the companies could not be expected to spend capital in improving or altering their system in any way until some definite agreement had been arrived at, and so matters have drifted. The position is complicated, not only among the owning and operating companies themselves, but also as between the companies and the municipality. The companies on the one hand contend that they still have 50 years' franchise on many of their important lines still to run, and the municipality disputes that view. The service has become so bad that the citizens, in my opinion, are quite justified in demanding a change of some kind. In the light of the experience of other cities, they not unnaturally look to a municipalized system as providing the best way out of the difficulty. In fact, Mayor Dunne was elected by a large majority last April on the distinct understanding that he would immediately take steps to municipalize or reform the whole tramway system in Chicago, so that you can see that public opinion in the city is ripe for the development."

"Would you mind explaining the features of the present system?"

"A very large portion of the present tramways is worked by cable, and in fact this was one of the first cable systems constructed in America In all there are about 700 miles of single track in the city, but the whole system is out of date, and the property has become much depreciated. There are two operating companies, with a number of underlying companies. The company that operates the north and west sides of the city is in a bad way financially, due, I fancy, to over-capitalization, whereas the company on the south side of the river is in a much better position. This company, I believe, has recently changed hands, and probably the whole system is now practically under one control. The southern company is not over-capitalized, and changed hands at about $36,000,000 as a going concern, the shares being bought at about $200 for every $100."

"Do you think Chicago offers a good field for modern tramway enterprise?"

"Indeed, I do. There are no gradients; the city is perfectly flat. There is an enormous population, immense trade, and an almost feverish activity. The streets are wide and straight, and there will be no need to spend money on widenings. But against that must be set the bad condition of the roads; the road surfaces are very inferior, and a considerable sum of money will have to be spent to have them made up; and of course the whole of the track must be reconstructed. You see, in respect of street formation, Chicago differs from English cities in having been designed and built in comparatively recent times. There is no congestion of the population as there is in most of our big towns. No doubt this is partly due to the fact that the tramways of even an inferior type have been operating for some years, and partly also to the methods of living, and the habits of the people themselves. They do not crowd together; they prefer to spread out and have plenty of room. An idea of this condition can be gathered from the significant fact that while Glasgow embraces about 19 square miles, Chicago embraces about 194 square miles. You see in America they have more land. Taking all these factors into consideration, I believe, in fact I am convinced, that Chicago provides a really magnificent opportunity for cheap and profitable tramway working. Looked at altogether, it really has the making of the finest tramway system in the world, provided it is all electrified and brought thoroughly up to date. I should propose to do away with the cable system and substitute the overhead system throughout the whole city. The City Council has hitherto objected to the adoption of the overhead system in the central parts, the consequence being that in the more central parts they have the trolley, the cable and the horse system. The whole system has gradually gone from bad to worse. This, in a modern enterprising city like Chicago, is emarkable."

THE AMERICAN MUNICIPAL SYSTEM

"Considering that the local government system in American cities is so different from the English method, do you think it will be practicable to effect the improvement you indicate by municipalization?"

"Well, the problem will be an exceedingly difficult one to solve. But I do not think that solution will be altogether impossible, because public opinion will be at the back of the movement, and public opinion must win in the long run. There exists a right to buy up the franchise or concession, and the municipality is thought to have powers under the Mueller law to issue certificates on the security of the undertaking for the equipment of the municipal system. But it is not plain sailing, for I should explain that although this law exists it has never yet been tested in practice. They have the law, but whether it is constitutional has yet to be proved. Doubtless there will be a long and hard fight in order to test this law, but I would be much astonished if the city could afford to purchase the undertaking including the value of the unexpired portion of the franchise. If the contention of the companies is upheld, that they have this period of 50 years still to run, it will be a very difficult matter indeed for the municipality to purchase the undertaking at a figure that will allow them to work profitably. Although ultimately the city will be able to obtain possession of the lines, it will take a number of years, because I do not suppose that the companies are going to give away their rights without fighting for them."

"How did this uncertainty about the franchise arise?"

"The city people say that the franchise is inoperative because it was obtained by corruption; but I cannot, of course, speak as to that, and the facts are in dispute."

"What have you advised them to do?"

"Well, that is in my letter sent to Mayor Dunne, and before speaking definitely as to that I would rather wait until it has been made public by him. I have not given my recommendations to anyone, and there will be no difficulty about getting the text when it is published."

"As to the provision of current, how will they get over that difficulty?"

"There is an electric lighting station for lighting the streets, but they do not sell any power, so there would very likely need to be a separate tramway power station if they were to municipalize the whole of the tramways. They propose to municipalize one of the lines of the city that falls in, and have actually asked for offers for the equipment of this first expired line; the offers were to be in at the end of last week. It is not a long section, just a few miles."

"In regard to the general condition of municipal affairs in Chicago, do you think under present circumstances it would be feasible and wise to introduce a system of municipal management under the control of the city council?"

"I believe the city council is a very able and intelligent body, but if they went in for municipalizing such a huge undertaking as this, there is no doubt they would require to eliminate the political element."

"If a manager were appointed would you be in favor of giving him an absolute tenure of his office?"

"Yes, certainly, he must have a fixed tenure and for a fairly long period, too. It would not do to leave him to the chances of a changing administration. Of course, I should let him be under the direction of the city council in matters of policy, but when it came to management he must be entirely free. They must make his position absolutely secure, as otherwise he would not have any chance of success, and no competent manager would undertake the work. You see things are so peculiarly managed there. Even with the companies to-day, a great many of the employees, possibly the bulk of the men, are nominees of the city councillors—I mean even the tramway companies' own servants. In the municipal departments they are absolutely the nominees of the parties in power, and you must remember they have votes which must not be lost sight of."

"Then it would be entirely new in American experience to have a fixity of tenure for a municipal tramways manager?"

"I think so. You see things are so different there. The mass of the people govern public affairs there, but I think they have a less sense of responsibility to the community than, say, the people of Glasgow. Every man above a certain age is a voter, and they consider all these questions of party largely from the personal standpoint, certainly a great deal more than the people do over here."

AMERICAN TRAMWAY METHODS

"Turning to the general condition of American tramways, we should be glad to have your experience and opinions. Take fares, for instance, have we anything to learn in that respect?"

"Not much, I fancy. They have the universal 5-cent fare with transfers, and I think that is as low as they can go. It is about 2½d. in English money. They could not work at a lower fare than that. I consider that a 5-cent fare with transfers carrying passengers the long distances they travel in America, has very much the same result to the company as a graded fare without transfers here. Of course, we do not want transfers here, and I do not believe there is a street railway man in America who would not do away with transfers if he could, and lower and grade his fares. The objection to this politic course is that American citizens are accustomed to pay the nickel and nothing else, traveling any distance they like, so that I do not think it would be popular to attempt to introduce the graded fare system."

"But what would be your alternative?"

"Well, I should say they might have a minimum fare of 2 cents, and a maximum fare of 5 cents, because they would then get very many more short-distance riders, and they would make a bigger revenue than they are getting now. In fact, for short distances, I do not consider that the American companies are carrying anything like the number of persons that they ought to be carrying, considering their magnificent opportunities. Of course, there are many advantages in the low fares for long distances."

"Did you get any figures as to working cost?"

"Yes, the working cost is pretty high, considerably over 60 per cent of the revenue. This is accounted for by the higher wages that are paid, although in my opinion they are not higher than they ought to be, considering all the circumstances. Wages are about right there. As to cost of construction, I got some figures in New York, where they are extending the conduit system. This system costs $90,000 per single mile of track, as against $35,000 for the overhead. That is the sort of proportion between the two systems, say, £18,000 against £7,000. The relative cost of working with the conduit is greater than with the overhead, and there is no doubt it is more expensive in the winter time, because it is then much more troublesome. In Minneapolis and Cleveland they have splendid systems, also a good system in Philadelphia, and a complete conduit system in Washington. That system appeared to work very well. In Boston and Montreal they have also very complete systems."

RELATION OF SPEED TO ACCIDENTS

"As to speed, do you think the American methods are dangerous or objectionable?"

"No, I think the American speed, at least in the outlying districts, is good and safe, and I do not see any objection to it at all. Of course, the great difficulty in some American cities is the abominable state of the roads and streets. In very many cases the sides of the carriage ways, where heavy traffic has to go, are so bad, the drivers are compelled to use the rail track, and in that way the tramcars are very much hindered by the slow-moving traffic. As to our own speed in this country, judging from American experience, I certainly think that some of the restrictions, necessary perhaps at one time, might now be relaxed considerably. With growing reliability of our systems and increase in the skill and experience of our men, there is a rapidly forming opinion that our speed might be accelerated. I have not the slightest objection to American speed as a whole. Modifications might usefully be made in Board of Trade regulations as to width of rail, special curves, and so forth."

"But what about accidents?"

"I think that possibly the Americans are a little more reckless than we are, but their men are not less skilled than ours. They are prepared to take greater risks, that is all. I believe they have a higher percentage of accidents proportionate to length of line and number of passengers carried, and they certainly have a higher percentage of bogus claims for alleged accidents. There they have a large number of people who are really professional accident makers, who live by their claims for accidents. These are assisted by a class of pettifogging attorneys, who do a thriving business, because a street railway company can never get justice from an American jury. The traffic is, of course, heavier, and the bad state of the roads contributes to the accidents quite as much as the tramways. In fact, the municipalities have to pay away each year large sums for accidents on account of bad streets. On the whole, I do not believe that the adoption of American speeds here would in the least increase the percentage of accidents."

"Did you see any attempts to experiment with other methods of mechanical traction than electricity?"

"No, not for public vehicles. They seemed to be convinced that electric traction is the only practicable method of tramway traction, and further that for this there is nothing like the trolley. They are quite indifferent to the advent of the motor-bus, and I did not see any electric motor-bus for ordinary purposes."

AMERICAN AND BRITISH COMPARISONS

"Speaking generally, do you think that American tramway administrators have more to learn from us than we have to learn from them?"

"Well, you see, conditions there are so different that it is difficult to answer precisely a general question like that. There is no doubt that in regard to maintenance of plant, cleanliness, and general attractiveness, they have a very great deal to learn from us. So far as methods of management go, there is nothing very much to find fault with. But I do not know that the discipline of the men is quite so good as it is here. The men in most American cities are more thoroughly organized, they are a bit more independent, and I believe on the whole have got more power than they ought to have. The men there are well treated. I spoke very strongly to the Chicago people of our own staff in Glasgow, of their discipline and behavior. I explained how they were satisfied with the conditions and service, and believed it best to work under a municipality, whose service was a guarantee that they would be well looked after, and be fairly and even generously treated. But I do not know that there is anything wrong with wages and hours in America. They get a big wage, and the fact that the condition of working men under a municipality in America would not be very much, if anything, better than it is now under a company, removes one reason for the municipalization of the tramways that has had great weight in this country, although I would like to qualify that remark in this way. I impressed upon my American friends that wages under a municipality here are very little different from the wages now given by a company. But there is a difference in this way. In Glasgow, when we took over the tramways, we paid a better wage, but we did not pay that wage to the same men, it was paid to other men; we got superior men. The tramway employee is now a better man all round. In fact, the electrification of tramways has not only educated and brightened the riders, but has sensibly improved and elevated the tramway men. We have all been brightened up by the advent of the clean and swift electric car. But I was careful to say that I did not believe wages paid by a municipality ought to be higher than the man can command. This clearly is economically sound."

TENDENCY TOWARDS MUNICIPALISM

"Do you think a tendency towards municipal methods will be likely to prevail in America?"

"Of course, municipalization is accepted here now as a principle—that the tramways should be in the hands of the local authority, and if the municipal conditions in America were the same I see nothing to hinder the eventual adoption of a similar view over there, if there were any just reasons why they should do so. There are no municipal systems there at present, but I believe the change will gradually take place. Yes, the municipal idea there is regarded as rank socialism; they think immediately anything is municipalized that their country is going to the dogs. This is with us an exploded idea. But as knowledge increases and sounder principles of communal effort obtain, I believe there will be a strong and a successful effort to municipalize American street railways, but at present they have a long way to go, and it will take a long time to graft the new idea to the municipal stock, to remove prejudice and substitute new ideas."

"Can you suggest any methods by which this important educational process can be expedited?"

"I can recommend them to study and examine English methods and English public conditions. If they could eliminate their present method of political influence, I do not see why they should not quickly make a considerable advance and improvement in municipal matters. But the system by which every municipal official becomes a little center in himself of political influence sacrifices efficiency to expediency. That is to say, it is the old idea of the spoils to the victors. If a man works to get a councillor in he expects to be paid for it. How can you expect satisfactory municipalization under such conditions as those?"

"Could you suggest any improvement in our own Parliamentary procedure for obtaining tramway powers in order to obviate the present great expense and delay?"

"No, I do not know that I can recommend any step like that, even for municipalities. I think there must be an arbitrator in these matters. After all, our own procedure is not so expensive as the American method, by which every person who has any interest at all has to be purchased. Practically there the facility for obtaining a concession or right does not exist. We have a better, a freer and a purer method after all."

"Did you notice any tendency or desire to adopt English methods?"

"Although the Americans did not just frankly express their opinion that this country was superior to them in many ways, especially municipally, I could plainly see there was among many of them a very great regard indeed for British institutions."

IMPROVEMENTS IN EQUIPMENT

"With regard to equipment, were there any noticeable features?"

"They are paying great attention now to their cars and striving to get the most perfect style of car. They are discarding the old practice of having winter and summer cars, and are adopting a very large combination car, open at the sides, which will answer for both seasons, notwithstanding the great variations in temperature. There is no doubt they are advancing very fast in that direction, and they are making a great number of very useful improvements in connection with their plant. The price of cars is much higher there than here, the cars being heavier, there is more material in them, and they have to be made suitable for fast traffic and long-distance journeys. I do not think there is any better workmanship. I do not think their style of car would be more adaptable for this country than our own. But they are paying great attention to devices for preventing accidents, through being subject to so many bogus claims, as I have already explained. They have perfect freedom as to these improvements, the principle being that each improvement must stand or fall on its own merits. They try many things for improving their plant, and there is no Board of Trade to step in the way, though in some States the tramways are under supervision. That system works well and facilitates the adoption of improvements for the service, track or plant. The control boards and the companies appear to work together well, and while I would not advocate absolute free trade in traction, yet I should like to see a practical body of men controlling our industry, so that if they saw an improvement they would at once let it be tried. The railroad companies are entirely distinct; they regard the tramways as keen competitors, and are buying up interurban lines. I do not think the railroads in any sense regard the tramways as feeders of their systems, but I think they see that the traffic within a given radius of the center of a city is not theirs, and so they have to give in to tramways and cater more for the long-distance passenger."

"Have you any idea of the cost of wear and tear?"

"Yes, I should say it is slightly higher than ours for plant and equipment, but the road-bed is not so expensive. Their construction approximates to ours, and they are now using a good deal of T-rail, with a chip off the granite, to form the groove instead of the groove rail. Their rail also approximates to ours, 100 lb. to the yard. The T-rail has proved advantageous, for the whole weight is on the head of the rail.

"I saw many more things in connection with the street railways of America that were very interesting and instructive, but I have not time at present to go into these."

"What about the financial side of the question?"

"Well, I should not care to say much in this connection. I am afraid the street railways of America have not been financed on our prudent, conservative lines. I believe, however, that the street railway men now see that they must alter their policy in this respect."

"Have you anything further that you would care to say?"

"I have a great deal that I could say, but I think I have given you quite sufficient, more perhaps than your readers will find of interest," said Mr. Dalrymple, and the interview terminated.

LONDON LETTER

(*From Our Own Correspondent.*)

The third International Tramway Exhibition was duly inaugurated on July 3, at the Agricultural Hall, Islington, London, by the Earl of Derby, who declared the exhibition open at the formal luncheon given on the occasion. The ceremony was well attended by those gentlemen who have come to be closely associated with the tramway enterprise of this country. After tracing the history of tramway development, Earl Derby made a special point of the growth, he would like to see the carriage of merchandise by tramways, and thought that a good deal of development might be done along that line. Robert Millar, general manager of the Caledonian Railway, proposed the toast of "The Industry of Transport," and said that while railway managers could not look complacently at their reduced receipts owing to tramway competition, yet they recognized that electric traction had come to stay, and that the problem of railway managers was how to utilize electric power for the benefit of the railways either by direct application or as a feeder for their traffic. H. Alexander, of Glasgow, proposed "The Tramway Associations," and was ably seconded by the Hon. Arthur Stanley, M. P., who is president of the Tramways and Light Railways Association. Mr. Stanley made an eloquent appeal for the amalgamation of the various tramway associations. Speeches were afterwards made by Alfred Baker, of Birmingham; Fred Smith, of Liverpool; Sir Guilford Molesworth and C. R. Bellamy, of Liverpool, who proposed the health of the chairman of the occasion, Jas. W. Courtenay, who, in replying, stated that he would like to induce the Colonies to come over occasionally for a conference on transport problems in connection with a gigantic exhibition of apparatus facilitating transportation.

A commencement has now been made with the new electrified trains of the Metropolitan & District Railway Company, and also of the Metropolitan Railway Company in the old underground railway tunnels. For some time past both companies have been running electric trains on portions of their lines outside the tunnel, but on the first of this month a number of electric trains were put in service by the District Company from Ealing to Whitechapel, which go through most of the tunnel on the south side of the famous Inner Circle, and a number of electric trains were also put in service by the Metropolitan Company from Aldgate to South Kensington. The Inner Circle, however, is not equipped, owing to slight differences in the collector attachment of the trains of the two companies, which do not fit each other's lines. This difficulty will soon be overcome, however, and it should not be long now before practically all the underground trains are electrically operated. Meantime the District Company is operating its Ealing-Whitechapel trains every fifteen minutes, and the Metropolitan Company is operating its trains about on the same schedule, so that one can judge of the improvement. As, however, many steam trains are still in operation, the whole benefit to be derived is not apparent, the tunnels being still full of smoke and sulphurous fumes. The quicker acceleration of the electric trains, moreover, for the present is all lost, as it simply means waiting longer at the platforms for signal to go ahead, the steam train taking much longer to get out of the way. Enough has been seen, however, to show what an immense improvement the new service will be when it gets fairly into swing. The electric trains consists of seven cars, three being motor cars and four trailers. All the cars are connecting cars from end to end, with a passage in the middle, and passengers enter at the ends and go out by doors in the middle of the car, which are opened by the attendant from the end of the car by compressed air. There is no second class in these trains, but each train has a "special" car which is reserved for first class passengers.

The tenth annual convention of the Incorporated Municipal Electrical Association was held in Edinburgh and Glasgow, with a further trip to Aberdeen for those who had time from June 27 to July 1. The meeting was convened on Tuesday at the North British Station Hotel, Edinburgh, where the Lord Provost, Sir Robert Cranston, welcomed the association in the name of the citizens of Edinburgh. F. A. Newington then read his presidential address, after which the two following papers were presented and discussed: (1) "Load Factor,—its Effect Upon an Electricity Station," by Councillor Sinclair, chairman of the electricity committee, Swansea, and (2) "Street Lighting," by E. E. Hoadley, chief electrical engineer, Maidstone. In the afternoon brakes were placed at the disposal of the members and visitors for the purpose of visiting the various electricity stations, while in the evening a reception was tendered at the City Chambers by the Lord Provost, Magistrate and Council of Clyde, Hawthornden and Roslin, all of which were well patronized. The association dinner was held in the evening and proved to be a most successful and enjoyable function. The annual general business meeting of the as-

sociation was held on Friday, at which J. E. Edgecombe was elected president for the ensuing year. In the afternoon those who desired left for Aberdeen, where on Saturday forenoon visits were made to the Electricity Works, under the guidance of J. A. Bell, the city electrical engineer. Luncheon by the Aberdeen Corporation was served at the Town Hall, after which the visitors left for Ballater and Balmoral, completing in this way one of the most successful and enjoyable meetings which the association has ever held. In closing, it might be said that one of the most interesting and certainly most enjoyable features of the convention, was the visit paid by the delegates to the new works of Bruce Peebles & Company at East Pilton. Here the most cordial Scotch hospitality was extended, a regimental band and Scotch pipers alternately vieing with each other to add to the gay scene on one of the lawns hard by a marquee containing much that was refreshing after the more serious work of inspecting the works. On Wednesday a special train conveyed the delegates and friends to Glasgow, where the Lord Provost of Glasgow, Sir John Ure Primrose, Bart., welcomed the association at the hall of the Institute of Engineers and Shipbuilders in Scotland. The following papers were then read and discussed: "Notes on Costs and Tariffs for Electric Supply," by Hamilton Kilgour, chief electrical engineer, Cheltenham, and "The Supply of Electricity in Industrial Areas, from a Municipal Point of View," by Councillor Hodgson, deputy chairman electricity committee, Salford.

In Glasgow's usual lavish manner, a most sumptuous luncheon was provided for the delegates by the Glasgow Corporation at the City Chambers, after which visits were made to the electricity stations in the city and suburbs. On Thursday the meeting was again held in Edinburgh, when the following papers were read and discussed: "Extensions to Outlying Areas," by A. B. Mountain, chief electrical engineer, Huddersfield, and "Free Wiring and Supply on the Prepayment System," by A. R. Sillar, chief electrical engineer, Colchester. In the afternoon the visitors devoted themselves to the many points of interest in and around Edinburgh, while special arrangements had been made for trips to the Forth Bridge and the Falls.

The fourth annual conference of the Municipal Tramways Association was held in the Agricultural Hall, London, on July 4 to 6, the selection of the place being due to the fact that the tramways exhibition, referred to elsewhere in this issue, was being held in this hall during the first fortnight in July. A. Baker, general manager of the Birmingham Corporation Tramways, presided and delivered an interesting address, after which the following paper was read and discussed: "Charges for Supply from Combined Lighting and Traction Stations," by J. H. Rider, chief electrical engineer, London County Council Tramways.

It was evident from the paper and the discussion that Mr. Rider was strongly in favor of a combined station wherever the lighting and the tramways were in the same hands. On the following day the two following papers were presented and discussed: "Rules and Regulations for Tramway Employees," by H. E. Blain, manager, West Ham Corporation Tramways. "Motor Omnibuses vs. Electric Tramcars," by W. A. Luntley, manager, Wolverhampton Corporation Tramways.

In the evening there was a reception and conversazione. The next day was devoted entirely to pleasure, the delegates leaving Paddington Station for Reading at 11 o'clock. Here they were received by the Mayor and entertained to luncheon at the Town Hall. At 2 p. m. they embarked on a steam launch (kindly provided by Mr. Bull, chairman of the Reading Tramways committee) at Caversham Lock for a trip down the Thames to witness the boat races at Henley, where a most enjoyable afternoon was spent. At the business meeting on the following day, J. B. Hamilton, general manager of the Leeds Corporation Tramways, was elected president for the ensuing year. Before concluding these notes it might be mentioned that an effort was made to make an amalgamation of the Municipal Tramways Association with the two other existing tramway associations, but as these are more or less associations in the interest of company management, the municipal managers took the narrow view than an amalgamation would be detrimental to their interests.

By forty votes the House of Commons has passed the second reading of the Administrative County of London and District Electric Power Company Bill, a measure which confers upon its promoters powers to supply electricity to users of machinery in and around London; the powers asked being under conditions which are far more favorable than any granted to other electricity providers in the same area, municipal or private. For once the County Council in its opposition to this bill speaks for the whole of London, for the City and Borough Corporations are also strongly opposed to it. The bill has been referred to a special committee for full consideration.

The House of Commons Committee and counsel for the County Council and the City Corporation have effected a satisfactory compromise in regard to the scheme of tramways over Westminister Bridge, along the Embankment and across Blackfriars Bridge. The committee decided last month that the bill could only proceed if an undertaking were given that Blackfriars Bridge should be widened, and this the Corporation has now agreed to do.

The Mayor and Corporation of Bournemouth have formally taken possession of the tramways running from the borough boundary to Poole railway station, which they have, by arrangement with the borough of Poole and the urban district of Branksome, districts traversed, acquired from the Poole & District Electric Traction Company. Starting from the generating station in Southcote Road, Bournemouth, in four gaily decorated cars, the Mayor and his colleagues journeyed right through to the Poole terminus, a distance of about seven miles, picking up the Branksome Urban District Council at the County Gates. On the return, the party alighted at the east gates of Poole Park, where they were entertained by the Mayor of Poole at a garden party arranged to celebrate the occasion.

The acquisition by the Electric Railway & Tramway Carriage Works, Ltd., of Preston, of the Castle Car works (late G. F. Milnes & Company, Ltd.), of Hadley, Salop, and the British Electric Car Works, of Old Trafford, has now been completed. The share capital of the first-named company has been increased from £150,000 in ordinary shares, to £300,000, by the creation of 150,000 £1 six per cent cumulative preferred shares, and the name changed to the United Electric Car Company; the present £5 ordinary shares to be split into scrip of £1 each. The debentures (£50,000 in 5 per cent stock) remain as they were.

It may be recalled that the Castle Car and the British Electric Car Works were active competitors of the Preston Company, but recently went into liquidation. Their works were offered for sale, and were purchased by a syndicate which has now sold them to the United Electric Car Company for £85,000.

In order to provide this sum, and £15,000 for additional working capital, the directors are now making an issue of 100,000 of the above-mentioned preferred shares, of which 75,000 are offered to existing share and debenture holders at par.

A committee of the House of Commons, presided over by Mr. Ashton, has passed the bill to authorize the construction of a new electric railway from Gracechurch Street to Hackney, in tube, and thence by Walthamstow to Waltham Cross in the open.

At the invitation of the chairman and directors of Raworth's Traction Patents, Ltd., a number of gentlemen this month journeyed down from London in a special saloon carriage to Birmingham to witness the practical working of the Raworth automatic regenerative system, which has been applied to forty-one cars of the City of Birmingham Tramways Company, Ltd., and which, for the past few months have been in daily operation between the Midland Railway Station, Birmingham, and the suburb of Yardley, a distance of four miles. In the line are many gradients, the most severe being 1 in 16, and there are ten right-angle curves on the round trip, which takes 63 minutes, including all stops. Since the inauguration of the regenerative control, the current consumption has averaged .97 Board of Trade units per car-mile, and as the system implies a perfect control, no new brake blocks have been fitted since the cars started. Two cars were placed at the disposal of the visitors, one equipped with the usual Raworth controller, and the other with a new controller which has just been designed by Mr. Raworth's son, and which, from the outside looks precisely like any other tramway controller, and is operated in the same way as other controllers. The old Raworth controller was operated with two levers with a "fore and aft" motion, but it has been thought advisable to construct all new controllers with a rotating motion to the handle, now so familiar to all tramway engineers. The trip to Yardley was quite successful, and the visitors were much interested in the operation, wattmeters having been attached so that the regenerative action could be observed. At Yardley a visit was made to the power house, which presents an entirely novel and interesting appearance. It is the first tramway power house in this country to be equipped with Diesel engines, and it naturally excited great interest among the visitors. There are four of these engines of 150-B. H. P. each, coupled to generators by the Brush Electrical Engineering Company. An opportunity was also afforded at Yardley to inspect the Brush radial truck, with which the cars are equipped, and which are the invention of Mr. Connaty. Without going into further details at present, though we hope to present a detailed article later, it might be said that everything connected with the trip passed off with the utmost smoothness, the regenerative system braking the cars in the hills or for stops among the traffic with the utmost ease without touching the hand-brake. After the completion of the trip, lunch was served at the Midland Hotel, and speeches were made by Mr. Raworth and Mr. Lycett, manager of the Tramway Company.

PARIS LETTER

[*From Our Regular Correspondent.*]

Work on the Mont Blanc Railway, full details of which have been published in your columns, has now been commenced. The railway will not be completed until 1911, when a four hours' journey in electric car from Chamonix will take the tourist within a four hours' walk of the summit.

The movement towards single-phase methods of traction has had its echo in France. Both the Westinghouse Company, at its Havre works, and the French Thomson-Houston Company have passed the experimental stage in this respect, and the latter company has made an installation on a short stretch of line belonging to the Tramway Sud, of Paris, and connecting two existing 500-volt lines of this company. The series compensated motor is employed, operated on the Latour system. The tension employed is 300 volts, and is transformed from 500 volts by a transformer carried under the car. The reason of the low voltage is found in the fact that existing regulations will not allow a higher alternating current voltage than this to be used on tramway circuits in the neighborhood. The motors have an output of 37 hp at 500 volts, 25 cycles. The length of line is about a mile, and of course has been equipped only to test the feasibility of the system.

The Westinghouse Company is building at its Havre works the single-phase equipments destined for the Rome-Civita-Castellana line, and just recently has obtained the contract for the equipment of a line from Bergamo to Valle Brembana. This is an interurban tramway of 30 km length, and the trolley line will be fed at 6000 volts. Five 30-ton locomotives, each equipped with 4 55-hp motors, and train-control system will be used. The generating station will include 3 units of 500 kw.

A mixed system of alternating and continuous current for railways has been arranged by way of experiment by the A. E. G. Berlin on the line between Niederschöneweide and Köpenick. The section is 6 km in length, and is, as a rule, worked by continuous currents at 500 volts. Part of the line, 2.2 km long, has been insulated from the remainder, and the overhead conductor is fed from a transformer station with alternating current. The pressure is 440 to 640 volts at 25 to 40 periods. The section can be connected temporarily to the continuous current line. The experimental car has two Winter-Eichberg motors, controlled by a slightly modified d. c. controller.

The Orleans Railway will shortly place in service another lot of locomotives and motor cars to run on the line from Paris-Juvisky.

THE ELECTRIC BOND & SHARE COMPANY

The purpose of the Electric Bond & Share Company, whose organization caused considerable speculation as to the scope of its operations, is fully set forth in an announcement made by Harvey Fisk & Sons, of New York. The company is organized under the laws of the State of New York, with power to purchase bonds, stock or other forms of securities resulting from electrical developments, such as electric street railways and electric light and power plants. The corporation has issued $2,000,000 of preferred stock and $2,000,000 of common stock. It begins business with this capital stock fully paid up, and with a surplus estimated by its officers, after careful appraisal by a special committee appointed for the purpose, to be of the value of $440,000. All of the common stock is owned by the General Electric Company.

The preferred stock has a 5 per cent cumulative preference as to dividends, is also preferred in any distribution of assets, and is further protected by a provision in the certificate of incorporation that no dividends shall be paid upon the common stock unless there shall remain, after payment of such dividends, a surplus equal to at least 15 per cent of the par value of the then outstanding preferred stock. The preferred stock can never be increased to such an amount as to exceed the amount of the then outstanding common stock, and may be retired upon any dividend date, upon ninety days' notice, at 110 per cent of par.

The corporation is forbidden by its certificate of incorporation to mortgage, pledge or in any way hypothecate any of its assets without the assent of three-fourths of the preferred stock. It is also forbidden by Article VII. of its by-laws (which article cannot be amended except by a nine-tenths vote of all stock then outstanding) to buy or contract to buy any securities unless the corporation at the time of making such contracts has cash in bank sufficient to pay for such securities or has made provision by which it will have cash to pay for the same at the time the same may be delivered. It is the intention of the company to keep out of debt, and these restrictions are designed to carry out this intention and thus preserve the present position of the preferred stock as the senior security of the company.

DISCRIMINATION IN RAILROAD RATES

One of the important questions now before the Indiana Railroad Commission is a charge of discrimination in passenger rates that the steam companies are making along their lines paralleled by the electric interurban railways. The electric railway managers charge that in order to meet the local interurban competition, many of the railroads paralleled by the electric lines have made special rates, some of which are considerably under the regular three-cent-a-mile charge. One case complained of shows the grounds for the complaint. The Big Four Railroad, in order to meet the traction competition between Indianapolis and Lafayette, has made a special rate between the two cities, so that residents of Lafayette can come by the steam roads as cheaply as by electric railway. The two roads are not parallel all the way to Indianapolis, however, the steam road coming to Lebanon, thence to Indianapolis, and the traction going first to Frankfort, thence to Lebanon, and thence to Indianapolis. Hence there is no competition. The result is that, although the steam road grants a very cheap rate from Lafayette to Indianapolis, it charges the regular rate to Indianapolis from points between Lafayette and Lebanon. As a matter of fact, residents between these two cities buy a ticket to Lebanon, where the roads are again parallel, at the regular three-cent rate, get off at Lebanon and buy a reduced ticket from that city to Indianapolis. This causes them considerable trouble, of course, and they are complaining of unjust discrimination. Situations similar to this are to be found all over the State. For instance, from Muncie, Anderson, Elwood, Kokomo, Shelbyville, Rushville and other cities the steam roads have made a rate under three cents a mile, while people not so fortunate as to enjoy the results of this competition for local business are still paying the old rate. The reduction of fare by the steam companies to meet the competition of the interurbans has also raised the question of a sweeping passenger rate reduction to 2 cents a mile.

CAR CONSOLIDATION EFFECTED—NINETEEN COMPANIES INCLUDED

The consolidation of street car building companies and allied concerns, about which rumors have been revived periodically for several years, is again under consideration. The financial management of the proposed consolidation is in the hands of Kean, Van Cortlandt & Company, of New York, who, last Saturday, made public the following plan: Nineteen companies will be taken over and capitalized under a new company at $43,000,000. The name of the new company has not been selected, but present indications seem to point to G. Martin Brill, president of the J. G. Brill Company, of Philadelphia, as president of the new company. Mr. Brill is recognized as one of the foremost car builders in this country, and if he will accept he seems the logical president of the new corporation. The preliminary negotiations for the purchase of the different properties were conducted mainly by W. T. Van Brunt, president of the St. Joseph & Grand Island Railway, president of the Furnaceville Iron Company and associate of E. H. Harriman. The companies to be taken over are: J. G. Brill Company, John Stephenson Company, Laclede Car Company, St. Louis Malleable Casting Company, American Car Company, G. C. Kuhlman Company, Cincinnati Car Company, St. Louis Car Company, Wason Manufacturing Company, Osgood, Bradley & Sons, John J. Cummings Car Company, Jewett Car Company, J. M. Jones' Sons, agents; Laconia Car Company, McGuire-Cummings Manufacturing Company, Peckham Manufacturing Company, Niles Car Manufacturing Company, Journal Bearing Company, Easy Access Door Company.

The circular issued by Kean, Van Cortland & Company descriptive of the plan does not state the terms at which the companies are to be taken over. The capital of $43,000,000 will consist of $15,500,000 6 per cent cumulative preferred stock and $27,500,000 common stock. A $13,000,000 issue of first mortgage and collateral trust sinking fund 5 per cent, thirty-year bonds is proposed, $11,000,000 to be issued upon the formation of the company and $2,000,000 to be reserved for future requirements.

The annual average of net earnings of the constituent companies is put at $1,263,391, and the estimated earnings of the first year of the consolidated company will amount to $2,400,000, the promoters say.

The company will be organized and the properties transferred to it under the supervision of the attorneys, Davis, Stone & Auerbach and Guthrie, Cravath & Henderson. It is estimated that the consolidated company will acquire quick assets of $6,400,000, consisting of cash, raw materials, cars and accounts receivable, also many valuable patents and patent rights, by the control of which considerable patent litigation will be avoided.

THE CANADIAN WHITE COMPANY

An announcement has just been made as to the purpose of the Canadian White Company, for which letters patent were issued in Canada the latter part of May. The company is incorporated to carry on a general contracting and engineering business, on similar lines to J. G. White & Company, of New York; J. G. White & Company, Ltd., London, Eng., and the Waring-White Building Company, London, Eng. The company will undertake civil, mechanical, electrical, hydraulic and building work. It will be fully equipped to handle large construction contracts for steam and electric railways, and will be prepared to design, build, equip and operate electric lighting plants and power installations, gas works, water supply, sewage systems, piers, docks, harbor works, office buildings, apartment houses, hotels, etc. The company will not engage in manufacture. The contracting and engineering departments of J. G. White & Company, of New York, will at all times be at the services of the Canadian Company, which will further have the benefit of the experience of J. G. White & Company, Ltd., London, Eng., and the Waring-White Building Company, London, Eng. The Canadian White Company, Ltd., will have upon its board and as stockholders, representative business men well known throughout Canada. The general manager will be a prominent civil engineer with large experience in railway construction, etc., who has held executive positions. H. P. Douglas, formerly vice-president and general manager of the Canadian Otis Elevator Company, Ltd., will be treasurer of the company. The superintendent of building construction will be H. C. Hitch, who has been for several years connected with the Thompson-Starrett Company, of New York, as superintendent. The company intends to make a feature of building construction and is now prepared to contract for the better class of building work; such as office buildings, apartment houses, hotels, industrial plants, warehouses, etc.

THE ST. LOUIS, ST. CHARLES & WESTERN SOLD

The St. Louis, St. Charles & Western Railway, running from Wellston to St. Charles, was sold at trustees sale July 24, to a syndicate of St. Louis capitalists, headed by Festus J. Wade and Thomas W. Crouch, for $495,000. It is reported in financial circles that the syndicate will turn over the line to the United Railways Company. The men in the deal would not confirm this, nor would they deny it. Another report was that the Suburban system had bought the line, but this also lacked confirmation. Mr. Wade bid the road in. He had for a competitor Capt. Robert McCulloch, general manager of the United Railways. The price was run up from $300,000. Capt. McCulloch said he was acting for the United Railways, but he did not know whether or not Mr. Wade was. The old owners of the road also took a hand in the bidding. The property was sold under mortgage foreclosure by the Commonwealth Trust Company as trustee for the bond holders of a $600,000 bond issue, which was financed through the old Colonial Trust Company three years ago. The transfer includes all the property, the franchise and privileges to operate over certain tracks of the United Railways and the St. Charles bridge. The receiver for the road was appointed by the United States Circuit Court on the application of the Illinois State Trust Company, of Chicago, which holds part of the bond issue. About three months ago the court ordered the receivership terminated as soon as the receiver completed his accounting to the court. Cross-claims against the receiver by former officers of the company were then filed, and the matter is still in court. J. B. C. Lucas is the president of the original company.

THE CAMBRIDGE SUBWAY

The Boston Elevated Railway Company's decision not to accept the Cambridge Subway Act passed by the last legislature unless it is amended to provide for a two-track subway, instead of a four-track layout, marks an interesting stage of rapid transit development between the Hub and its adjoining suburb across the Charles. The Cambridge situation is unique on account of its illustrating how a conservative and well-educated community can completely change its opinions after it has legally committed itself to a definite course of action, and attempt to retrace the path long since traversed.

Rapid transit between Boston and Cambridge is a recognized necessity. Under the most favorable conditions of traffic, from 20 to 25 minutes are required by surface cars to cover the route from Harvard Square to Park Street subway station in the heart of Boston, the distance being roughly 3 miles. An elevated or subway line between Scollay Square, Boston, and Harvard Square or its immediate vicinity in Cambridge, should easily cut the running time to 8 minutes. The company is anxious to provide the best possible service, and the citizens of Cambridge are practically united in the desire to enjoy the best facilities which can be placed at their disposal. The only difference of opinion is in the matter of ways and means.

By the law of 1897 the Boston Elevated Railway Company was committed to the building of an elevated line from Boston to Cambridge, with the full consent and desire of the public in the latter city. The company proceeded to build its trunk line route in Boston between Dudley Street and Sullivan Square, expecting to add the Cambridge line to the system in due season after the completion of the new West Boston Bridge. Gradually the desirability of a subway was realized by the people of Cambridge, and after a long series of conferences and discussions, estimates and surveys the Act of 1905 was passed, rescinding the Act of 1897, subject to the company's acceptance. The terms of this act were apparently advantageous to the company in the matter of rental, and to the city through the giving up of the elevated structure plan with its perpetual franchise. Singularly enough, however, the act required the building of a four-track subway—a piece of work that neither the present nor immediate future demands or Cambridge rapid transit seems to warrant. The company feels that such a subway cannot earn the interest and pay dividends on the investment; detailed estimates by its engineer, Geo. A. Kimball, W. B. Parsons, Geo. S. Rice, H. A. Carson, and City Engineer Hastings, of Cambridge, all indicate that the cost of construction would be at least $7,000,000, or $2,000,000 in excess of the preliminary figures. The road maintains that its expenses have been increasing faster than they should in the past five years, in proportion to gross earnings; that large fixed charges upon extensions are to be expected in the next three years, and that proper service for the public, fair treatment of employees, and reasonable returns to shareholders should not be jeopardized by the assumption of additional burdens not necessary for the safety and convenience of the whole service. The company stands ready to build an elevated line as provided in the Act of 1897, or to build a two-track subway, according to the desires of the people of Cambridge.

While the outcome is uncertain at this writing, it would seem that the wisest course for the people of Cambridge is to yield gracefully to the reasonable proposition of the company, which is necessitated by their own vacillating decisions, and to give up the four-track plan, which the ripened experience of transportation experts declares to be unfeasible. The company's attitude throughout the affair has been marked by openness and a desire to meet the wishes of the community in all reasonable ways.

SOUTHWEST MISSOURI IMPROVEMENTS

The principal stockholders of the Southeast Missouri Electric Railway Company have organized a subsidiary company under the title of the Webb City Northern Electric Railroad Company, which will build a branch line for the parent company from Webb City to Oronogo, Purcell and Alba, ten miles in all. The contract for the trestles and bridges for this line has recently been awarded the Reinforced Concrete Construction Company, of St. Louis, Mo. There will be 2250 ft. of this class of work, including two bridges, one over Center Creek and one over Spring River, and a viaduct over the Frisco Railroad tracks at Oronogo, Mo. The contracts for grading, track laying, etc., will be awarded during the present month, and it is expected to have this line in operation by Jan. 1, 1906.

The Southwest Missouri Company also will begin extensive improvements to its main line during the present summer. Two new water-tube boilers, 400 hp each, will be added to the main power plant in Webb City. A 400-kw rotary will be placed in the Webb City sub-station, and the 250-kw rotary now there will be removed to a new sub-station, to be located at Lakeside Park. In addition to this a 250-kw rotary will be located on the line of the Webb City Northern Electric Railroad. A double-track viaduct will be constructed over the railroad tracks between Webb City and Carterville, which will be about 2000 ft. long. About ten miles of double track will be constructed, and the old track relieved of curves at various points. An additional car house will be erected, and a series of general improvements inaugurated. The company is now building its own car bodies, six of which have recently been turned out of the shops. These cars are constructed with steel beam beds, and are equipped with four GE 70 motors and multiple system of control, and are handsomely finished. During the coming year the company expects to build in its own shop nine additional cars of the same type, to be used on the Webb City Northern branch and on the Southwest system.

A CLUB OF RAILWAY CAR INSPECTORS

A number of car inspectors of the Chicago City, Brooklyn Heights, Boston Elevated and other railway companies, who are at present stationed at the works of the J. G. Brill Company, at Philadelphia, have organized themselves into a club, which is called "The Knockers' Club." At a recent meeting of the club Myron Rounds, of Boston, was elected president and was presented with a small gavel to assist him in the exercise of the duties of his office, and to continue knocking at every opportunity.

It happened, recently, that the managers of a number of companies for whom cars are being built, visited the works to look over their cars on the same day. A number of cars, each representing a lot ordered, were placed together on tracks near the office building. After the managers had looked the cars over, the inspectors of course, all being present, and there was a general discussion on the comparative merits of the cars, one of the inspectors, an officer of "The Knockers' Club," slipped unnoticed into his car, and then, as if by magic, before the astonished and amused gaze of all the spectators, there floated from a very conspicuous part of the car a large bow of blue ribbon.

INTERURBAN ASSESSMENTS IN IOWA

The Executive Council of the State of Iowa completed the assessment of the interurban electric railways of the State of Iowa last week. The various interurban railways were assessed at the same rates as they were for the year 1904, except the Cedar Rapids & Marion City Railway. The rate of assessment of this road was increased $269 per mile. This company also reported a net increase in mileage of 2.15 miles, so the total increase of the assessment of this company amounted to $11,845. Two new companies, the Cedar Rapids & Iowa City Railway and the Iowa & Illinois Railway, were added to the list, with assessed values of $55,260 and $65,920, so the increase in the assessed values over the preceding year amounted to $133,025. The members of the council are required by law to base the assessment on gross earnings as largely as possible, and as the two new companies were only in operation for a short period of the year 1904, they are not assessed at anywhere near their actual value. The following table gives the names of the companies, mileage, net assessment per mile, total assessment, and the total actual value as determined by the council, which is four times the assessed value:

Names of Companies	Mileage	Net Assessment Per Mile	Total Assessment	Actual Value
Boone Suburban	4.70	$1,000	$4,700	$18,800
Cedar Rapids & Marion City	14.21	4,000	56,840	227,360
Interurban Railway	28.87	3,500	101,045	404,180
Mason City & Clear Lake Traction	14.62	900	13,158	52,632
Tama & Toledo Electric	2.75	1,818	4,999	19,996
Waterloo & Cedar Falls & Northern	*54.73	2,500	136,825	547,300
Cedar Rapids & Iowa City	27.63	2,000	55,260	221,040
Iowa & Illinois	32.96	2,000	65,920	263,680
Totals	180.47		$438,747	$1,754,988

* This company also leased 20 miles of track from Great Western.

ELECTRIC TRAINS IN REGULAR SERVICE ON THE LONG ISLAND RAILROAD

The electric train service on the Long Island Railroad, from Flatbush Avenue, Brooklyn, to Rockaway Beach, was put into regular operation Wednesday, July 26. Twelve round trips were made, and a total of nearly five thousand passengers carried. The first train left Rockaway Park at 7:55 a. m., arriving at Flatbush Avenue, a distance of sixteen miles, thirty-five minutes later, after making thirteen stops. This is about five minutes less than the running time under the steam schedule. As soon, however, as the work now in progress of removing the remaining grade crossings is completed, it will be possible to reduce the time of the trip still further. Three trains, of seven cars each, were in use the first day, each train making four round trips. This is to be the regular week day schedule, but on Sunday, two additional trips in each direction will be made. The old schedule provided only ten trains each way. Under the new arrangement the last train in the evening leaves Rockaway Park at 10:30 o'clock. The next section of the road to be operated by electricity will be the line from Woodhaven Junction to Jamaica and Springfield. This, it is expected, will be ready about Aug. 1.

HARTFORD & WORCESTER PLANS COMPLETED

Within 30 days construction work will be started on the air line electric route between Worcester, Mass., and Hartford, Conn., by James F. Shaw & Company, of Boston, controlling the Boston & Worcester Street Railway. At East Brimfield, Mass., a direct branch line will be run to Springfield. The original survey will be followed in general, the distance being about 60 miles, or 23 miles shorter than the steam railroad line between Worcester and Hartford. The cost of the line is estimated at $3,000,000, and the fare will probably be 85 cents, against $1.75 via the steam road, while the running time will be 3 hours, against the steam road's 2. The through rate from Boston to Hartford will probably be $1.30, with 5 hours running time, against $2.75 and 3 hours by steam. It is expected that the Worcester Consolidated Street Railway Company will take the cars of the Shaw interests between Lake Quinsigamond, Worcester, and the town of Spencer, Mass., where the private right of way of the Hartford air line begins. It is expected that operation will begin in the spring of 1907.

B. R. T. SUMMER EXCURSIONS

The Brooklyn Rapid Transit Employees' Association is holding during August its fourth annual series of Rockaway Beach excursions via elevated railroad lines, at Schillings pavillion. Excursions are run in three series—A. B. C. Series A. are on Aug. 1, 11 and 22, for employees from Crosstown, Maspeth, Ridgewood and Halsey Street depots. Series B. are on Aug. 4, 15 and 25, for employees from Fifty-Eighth Street, Twenty-Third Street and Ninth Avenue depots, Southern division elevated, East New York depot, Eastern Division elevated. Series C. are on Aug. 8, 18 and 29, for employees from Flatbush, Bergen Street, Canarsie depots, Brooklyn Bridge division. Employees from offices, power houses, line, track and building departments, shops, etc., may select any date desired. Tickets, (including transportation and dinner) are 60 cents. A special rate of 30 cents is made for children (under 12 years of age). In addition to this a special rate also is made to the excursionists for a number of attractions at the beach. There will be prize bowling for the Rockaway cup.

IMPROVEMENTS IN NEW ORLEANS

Extensive improvements have been decided upon by the reorganized company formerly known as the New Orleans Railways Company, now known, and hereafter to be known, as the New Orleans Railway & Light Company. The new board of directors is as follows: Elwin C. Foster, William Adler, J. J. Gannon, A. B. Wheeler, Hugh McCloskey, A. Brittan, W. R. Stauffer, S. P. Walmsley, T. H. McCarthy, W. E. Stauffer, A. M. Young, Geo. A. Hero, Harry Baldwin, Jr., Jos. H. DeGrange. Contracts for improvements involving the expenditure of $1,600,000 awarded by the old company was approved and ratified by the new board. The new track to the Jockey Club grounds has been completed and ready for operation. The line on Camp Street from Canal Street to Calliope is to be relaid, and the tracks repaved with Belgian block. A neutral ground is to be established on Tulane Avenue from Rampart to Galvez Streets, and the tracks of the Railway & Light Company will be rearranged to conform to this change.

THE TRACTION EQUIPMENT COMPANY

The Traction Equipment Company, of Brooklyn, has added a number of specialties to those which it has heretofore handled, and is now manufacturing quite an extensive line of electric railway supplies. It is prepared to supply the trade with ventilated spiral car starting resistance, the Weber electric illuminated signs, the Hammond sander, Flood's car holder and emergency brake, Flood's brake ratchet, the Wheeling automatic fender, the D. &. W. sidebar controller and automatic safety lock, and motor and journal bearings and car brasses. The Hammond sander is a new machine having a spiral conveyor which forces the sand out whether wet or dry. The Wheeling automatic fender is another device handled by the company that has thoroughly proved its worth. It is said to have made an excellent record in Pittsburg, where it has been on trial for some time.

STEAM ROAD TAKING OVER IOWA ELECTRICS

The statement which appeared in the columns of the STREET RAILWAY JOURNAL a few weeks ago, that the Mason City & Fort Dodge Railway, a part of the Great Western system, had increased its capital stock from $20,000,000 to $34,000,000 for the purpose of acquiring the properties of several interurban railways in Iowa, is substantiated by the fact that the Great Western has already absorbed the Waterloo, Cedar Falls & Northern Railway Company and the Mason City & Clear Lake Traction Company, and that both of these lines have been made a part of the Great Western system. It now develops that the consolidation of these two interurban lines, reported in the JOURNAL of May 26, 1905, was simply the first step in the programme, and as soon as this was accomplished the remainder of the programme was carried out easily. In acquiring control of the Waterloo, Cedar Falls & Northern interurban line, the Great Western has secured the largest interurban road in the State, and if the company carries out the original plans of constructing a connecting link between the two roads it has acquired, it will have one of the largest interurban lines west of Chicago. The combined properties will then have a mileage of about 140 miles. The acquisition of these roads by the Great Western, and the attitude of the Rock Island in bettering the service on its branch lines where possible interurban competition is threatened, show that the steam lines of the State are alarmed over the invasions of the interurban companies. Wherever an interurban line and a steam line parallel each other in Iowa, the interurban gets more than 90 per cent of the local traffic, and a large per cent of the traffic originating outside of its territory.

BOYCOTT AGAINST JIM CROW CARS

Reports from Tennessee indicate that a sympathetic movement has been started by the negroes of the State to defeat the Jim Crow law, which provides for the separation of negroes from white persons riding on street cars. Boycotts have been declared in Nashville and Chattanooga that are proving to be a source of considerable annoyance to the companies operating in those cities, and in Knoxville a boycott has been declared which has resulted in disorderly conduct. No negroes are riding on the Lonsdale cars in Knoxville, few are riding on the Highland Avenue cars, and it is seldom that a negro is seen on a Euclid Avenue car. None of the colored citizens of the northwestern part of the city, near Knoxville College, are said to be interested in the movement. It is chiefly iron moulders and other laborers. A few evenings ago there was a fracas on a car in Knoxville, in which the sheriff and his deputies took a hand. A car in which several negroes were riding was set upon by a mob, and the colored occupants were maltreated and compelled to leave the car. One negro was arrested and fined as a result of this disturbance, but his companions escaped.

PERSONAL MENTION

MR. WILLIAM B. PALMER, general claim agent of the United Railways Company, of St. Louis, resigned on July 18. No successor will be appointed at present. The claim department is now under the direct supervision of Capt. Robert McCulloch, the general manager of the company.

MR. G. A. BERRY has been appointed assistant to the principal assistant engineer of the electric zone of the New York Central & Hudson River Railroad, with headquarters at Grand Central Station. Mr. C. P. Marsh has been appointed bridge engineer, succeeding Mr. Berry.

MR. THOMAS E. MITTEN, who has been first vice-president of the Chicago City Railway Company for several months past, and its acting head, was elected president of the company at a meeting of the board of directors held July 24. Mr. Lawrence A. Young was elected first vice-president at the same meeting.

MR. GEO. R. FOLDS, assistant to Vice-President and General Manager Calderwood, of the Brooklyn Rapid Transit Company, has resigned from the company to become general manager of the South Chicago City Railway, and the Hammond, Whiting & East Chicago Railroad, and will assume his new duties on Sept. 1 next.

MR. ROBERT CRAWFORD, an associate of Mr. James Dalrymple in the management of the Glasgow Municipal Tramways, who was prevented by sickness from coming to this country with Mr. Dalrymple, is expected to arrive here soon, to study street railway and social conditions. Mr. Crawford, it is understood, will be the guest of Mayor Johnson while in Cleveland, and will be entertained in Chicago by Mayor Dunne.

MR. H. R. PARRISH, for ten years confidential secretary to Mr. T. N. Vail and American representative of La Capital Tramways Company, of Buenos-Aires, Argentina, and the Rosario Electric Lighting Company, died in Philadelphia, July 28, of rheumatism of the heart. Mr. Parrish formerly was with the Electric Storage Battery Company, of Philadelphia. He is survived by a widow and one child. Mr. Parrish was only 44 years old.

MR. E. M. VAN FRANK, superintendent of the Kentucky street division of the United Railroads, of San Francisco, on July 17 was presented with a handsome gold watch, suitably engraved, by the employees of his division, in token of the esteem in which he is held by all who served under him. The occasion was the taking up by Mr. Van Frank of his new duties as superintendent of the traffic bureau, a department newly inaugurated by the United Railroads, a promotion to which all feel him justly entitled.

MR. FRANK J. SPRAGUE'S admirable series of articles in the "Century" on "The Electric Railway," is closed in the August issue of that publication. Like the first part, this is full of personal reminiscence of a most interesting character and is profusely illustrated. The article, as a whole, constitutes a most valuable permanent addition to the history of the art, a record all the better because it is contemporaneous. Mr. Sprague closes with a glance at the future, and says: "There is not a railroad in the country which cannot be operated electrically if we are concerned only with the physical possibility of achievement." The financial factor is chiefly the determining one, related to relative density of traffic, load factor and line working potential.

MR. HINSDILL PARSONS has resigned as president of and a director in the Schenectady Railway, of Schenectady, N. Y., and with his wife has sailed for a short tour of Europe. Mr. Parsons has made his home in Schenectady since 1894, at which time he accepted his first office with the General Electric Company, that of resident attorney to look after the company's local legal interests. He was advanced from time to time, until, in 1901, he became the general counsel of the General Electric Company, and at the same time was honored with the fourth vice-presidency of the company, a position which he still holds. At that time also began his connection with the Schenectady Railway Company. Previous to his connection with the General Electric Company Mr. Parsons was a patent attorney, employed by the Wood Mowing & Reaping Machine Company, of Hoosick Falls. He is a graduate of Trinity College and the Albany Law School. He was born at Hoosick Falls, forty years ago, where he resided until he took up his residence in Schenectady. Mr. Parsons will in the future devote all of his time to the interests of the General Electric Company.

MR. W. M. PROBASCO has resigned as assistant to the president of the McGraw Publishing Company to accept the office of vice-president of the Search Light Publishing Company, an organization which promises to occupy an important field in the journalistic and publishing business of this country. The company owns a file of about 2,500,000 clippings, articles and pictures on all subjects, compiled from newspapers, magazines, engineering journals, books and reports of scientific societies, and has a carefully organized force by which this information is classified and kept up to date for the use of publishers and others who require prompt and up-to-date information on any subject. In addition the company publishes a weekly paper, called "The Search Light," which is a record of the most important events of the previous week, and which covers some sixty separate departments. As a nucleus for this paper the company purchased "The Great Round World" and "The Week's Progress," publications somewhat on the line of its own, but has improved on their plans, and especially in the completeness with which the information is compiled and indexed The company also handles the publishing and advertising accounts of important railroads, manufacturers and engineering firms, among them those of the Pennsylvania Railroad, the Long Island Railroad, the Power & Mining Machinery Company, and the Morse Chain Company. The fourth department of its business is the publication of books. Among those in hand is one on Cuba, while another perpetuates the exhibits of the Westinghouse Companies at the recent International Railway Congress. Mr. Probasco is well known in electrical circles, and his many friends will wish him success in this new departure. He was formerly assistant general manager of the Westinghouse Companies publishing, advertising and exhibition interests, and in this capacity was the designer and organizer of the Westinghouse exhibits at the St. Louis Exposition, which received the grand prize as an exhibit. He was also compiler and editor of the album recently issued for the Interborough Rapid Transit Company by the McGraw Publishing Company. Associated with Mr. Probasco in the Search Light Publishing Company are Mr. E. G. Handy, who with his brother had charge of the Bureau of Publicity and Promotion of the Chicago World's Fair, and has since been a prominent newspaper man and publisher; and Mr. W. G. Jordan, who was for six years editor of "Current Literature," was later managing editor of the "Ladies' Home Journal," and subsequently editor in chief of the "Saturday Evening Post," of Philadelphia.

TABLE OF OPERATING STATISTICS

Notice.—These statistics will be carefully revised from month to month, upon information received from the companies direct, or from official sources. The table should be used in connection with our Financial Supplement "American Street Railway Investments," which contains the annual operating reports to the ends of the various financial years. Similar statistics in regard to roads not reporting are solicited by the editors. * Including taxes. † Deficit. ‡ Decrease due to strike.

Company	Period	Total Gross Earnings	Operating Expenses	Net Earnings	Deductions From Income	Net Income, Amount Available for Dividends
AKRON, O. Northern Ohio Tr. & Light Co	1 m., June '05	85,163	45,841	39,322	23,017	16,305
	1 " " '04	80,504	43,274	37,230	23,167	14,064
	6 " " '05	425,478	236,918	188,561	137,602	50,960
	6 " " '04	397,086	228,261	168,824	135,702	33,123
AURORA, ILL. Elgin, Aurora & Southern Tr. Co	1 m., May '05	39,660	21,492	18,167	9,226	8,942
	1 " " '04	38,101	23,171	14,930	9,451	5,479
	11" " '05	413,975	236,701	177,275	101,998	75,277
	11" " '04	416,156	252,760	163,396	101,225	62,171
BINGHAMTON, N. Y. Binghamton Ry. Co.	1 m., June '05	26,226	11,961	14,265	------	------
	1 " " '04	24,665	11,374	13,291	------	------
	12" " '05	261,124	136,862	124,262	84,491	39,771
	12" " '04	241,789	130,887	110,902	77,872	33,030
BOSTON, MASS. Massachusetts Elec. Cos.	3 m., June '05	1,690,522	1,085,582	604,940	397,657	207,283
	3 " " '04	1,612,891	1,084,246	528,645	366,034	162,611
	12" " '05	4,420,753	3,225,778	1,194,955	1,165,270	29,685
	12" " '04	4,219,200	3,331,425	887,775	1,065,398	†177,623
CHICAGO, ILL. Aurora, Elgin & Chicago Ry. Co	1 m., May '05	52,071	28,474	23,597	------	------
	1 " " '04	41,778	25,033	16,745	------	------
	3 " " '05	131,441	79,001	52,440	------	------
	3 " " '04	94,746	64,625	30,120	------	------
Chicago & Milwaukee Elec. R. R. Co	1 m., June '05	53,218	22,266	30,952	------	------
	1 " " '04	40,838	15,136	25,702	------	------
	6 " " '05	211,973	104,017	107,957	------	------
	6 " " '04	163,250	72,587	90,663	------	------
CLEVELAND, O. Cleveland, Painesville & Eastern, R. R. Co.	1 m., June '05	23,941	*13,200	10,741	6,733	4,007
	1 " " '04	22,364	*13,045	9,319	6,830	2,489
	6 " " '05	99,416	*63,147	36,270	------	------
	6 " " '04	94,760	*60,465	34,296	------	------
Cleveland & Southwestern Traction Co.	1 m., June '05	48,558	26,930	21,628	------	------
	1 " " '04	44,132	24,604	19,528	------	------
	6 " " '05	237,376	148,892	88,483	------	------
	6 " " '04	204,753	144,475	60,278	------	------
Lake Shore Electric	1 m., June '05	67,969	37,443	30 526	20,804	9 722
	1 " " '04	59,596	36,224	23,372	20,404	2,968
	6 " " '05	326,629	198,132	128,497	122,425	6,072
	6 " " '04	271,002	218,690	52,312	122,391	†70,079
DETROIT, MICH. Detroit United Ry.	1 m., June '05	461,522	*266,530	194,992	93,364	101,628
	1 " " '04	411,347	*240,737	170,610	90,075	80,535
	6 " " '05	2,345,977	*1434023	911,954	553,924	358,030
	6 " " '04	2,085,319	*1345515	739,804	533,444	206,360
DULUTH, MINN. Duluth St. Ry. Co	1 m., June '05	55,456	28,376	27,081	16,826	10,255
	1 " " '04	53,377	26,258	27,119	16,517	10,602
	6 " " '05	304,742	167,465	137,277	100,579	36,698
	6 " " '04	292,745	168,953	123,792	98,878	24,914
FINDLAY, O. Toledo, Bowling Green & Southern Tr. Co.	1 m., June '05	24,885	13,731	11,154	------	------
	1 " " '04	23,545	12,512	11,033	------	------
FORT WORTH, TEX. Northern Texas Traction Co.	1 m., June '05	57,849	30,042	27,807	11,576	16,230
	1 " " 04	47,214	26,029	21,184	10,029	11,156
	6 " " '05	302,581	169,715	132,866	65,347	67,519
	6 " " '04	258,936	147,974	110,961	60,547	50,414
HANCOCK, MICH. Houghton County St. Ry. Co	1 m., May '05	‡10,993	11,693	† 699	3,627	† 4,326
	1 " " '04	16,441	11,531	4,909	3,455	1,455
	12" " '05	167,861	160,309	7,552	41,452	† 33,900
	12" " '04	188,518	130,672	57,846	36,858	20,988
HOUSTON, TEX. Houston Electric Co.	1 m., May '05	43,686	27,228	16,408	8,907	7,501
	1 " " '04	35,137	23,685	11,453	7,941	3,513
	10" " '05	366,373	234,344	132,029	84,615	47,414
	10" " '04	327,376	227,559	99,818	76,862	22,956
LONDON, ONT. London St. Ry. Co.	1 m., May '05	15,730	11,274	4,456	2,137	2,320
	1 " " '04	14,454	9,920	4,534	2,162	2,372
	5 " " '05	68,250	54,966	13,284	10,371	2,913
	5 " " '04	59,256	49,689	9,567	------	------
MILWAUKEE, WIS. Milwaukee El. Ry. & Lt. Co.	1 m., June '05	280,856	133,318	147,538	79,041	68,497
	1 " " '04	265,906	128,433	137,474	75,236	62,238
	6 " " '05	1,551,692	782,435	769,256	450,749	318,508
	6 " " '04	1,538,674	801,383	737,291	443,505	293,786
Milwaukee Lt., Ht. & Tr. Co	1 m., June '05	55,164	22,525	32,638	21,568	11,070
	1 " " '04	41,282	18,854	22,428	17,225	5,204
	6 " " '05	256,825	122,366	134,459	117,909	16,549
	6 " " '04	195,786	106,882	88,904	94,302	† 5,398
MINNEAPOLIS, MINN. Twin City R. T. Co	1 m., May '05	389,425	172,504	216,921	97,208	119,712
	1 " " '04	363,646	170,772	192,873	90,279	102,594
	5 " " '05	1,778,942	861,674	917,268	486,508	430,760
	5 " " '04	1,689,121	812,237	876,885	448,049	428,836
MONTREAL, QUE. Montreal St. Ry. Co.	1 m., June '05	248,200	137,594	110,607	29,514	81,093
	1 " " '04	232,610	131,589	101,022	26,295	74,727
	9 " " '05	1,923,992	1,258,520	665,471	199,168	466,303
	9 " " '04	1,761,917	1,149,936	611,981	175,371	436,610
OAKLAND, CAL. San Francisco, Oakland & San Jose Ry	1 m., May '05	45,556	20,051	25,505	13,425	12,080
	1 " " '04	33,418	14,389	19,029	8,648	10,381
	5 " " '05	216,223	87,705	128,519	65,863	62,656
	5 " " '04	155,973	70,867	85,106	39,003	46,102
PEEKSKILL, N. Y. Peekskill Lighting & R.R. Co.	1 m., May '05	9,580	* 5,642	3,938	------	------
	1 " " '04	7,911	* 5,245	2,665	------	------
	11" " '05	106,262	* 61,949	44,313	------	------
	11" " '04	99,672	* 60,281	39,391	------	------
PHILADELPHIA, PA. American Rys. Co.	1 m., June '05	139,565	------	------	------	------
	1 " " '04	126,934	------	------	------	------
	12" " '05	1,471,991	------	------	------	------
	12" " '04	1 406,965	------	------	------	------
ROCHESTER, N. Y. Rochester Ry. Co.	1 m., June '05	150,220	76,700	73,520	27,757	45,763
	1 " " '04	129,900	66,338	63,562	26,541	37,021
	6 '05	822,879	448,250	374,629	164,105	210,524
	6 " " '04	710,502	404,650	305,852	158,118	147,734
SAN FRANCISCO, CAL. United Railroads of San Francisco	1 m., May '05	599,407	------	------	------	------
	1 " " '04	574,970	------	------	------	------
	5 " " '05	2,830,982	------	------	------	------
	5 " " '04	2,687,936	------	------	------	------
SAVANNAH, GA. Savannah Electric Co.	1 m., May '05	50,569	27,936	22,633	10,554	12,079
	1 " " '04	45,481	25,895	19,586	10,878	8,708
	12" " '05	562,297	322,923	239,374	126,923	112,451
	12" " '04	530,608	305,502	225,105	123,130	101,975
SEATTLE, WASH. Seattle Electric Co.	1 m., May '05	208,608	132,775	75 834	24,955	50,879
	1 " " '04	197,848	133,593	64,256	23,486	40,770
	12" " '05	2,378,040	1,632,848	745,192	301,416	443,776
	12" " '04	2,213,898	1,548,917	664,981	273,068	391,913
TAMPA, FLA. Tampa Elec. Co	1 m., May '05	34,953	20,697	14,256	1,885	12,371
	1 " " '04	32,573	19,877	12,696	2,112	10,584
	5 " " '05	163,921	99,067	64,854	9,494	55,360
	5 " " '04	144,557	85,290	59,267	10,464	48,803
TERRE HAUTE, IND. Terre Haute Tr. & Lt. Co	1 m., May '05	51,749	36,143	15,606	10,854	4,752
	1 " " '04	46,637	31,227	15,410	10,250	5,161
	12" " '05	588,558	379,145	209,413	113,654	95,760
	12" " '04	517,124	346,158	170,966	102,338	68,628
TOLEDO, O. Toledo Rys. & Lt. Co.	1 m., June '05	163,226	* 80,846	82,380	41,771	40,609
	1 " " '04	148,635	* 76,941	71,694	41,642	30,052
	6 " " '05	895,793	* 463,736	432,057	253,815	178,242
	6 " " '04	825,858	* 456,964	368,894	250,349	118,545
YOUNGSTOWN, O. Youngstown-Sharon Ry. & Lt. Co	1 m., May '05	44,407	* 23,689	20,718	------	------
	1 " " '04	38,693	* 22,881	15,812	------	------
	5 " " '05	213,954	* 119,176	94,778	------	------
	5 " " '04	186,925	* 115,123	71,802	------	------

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NOTICE TO SUBSCRIBERS

REMITTANCES.—Remittances should be made by check, New York draft, or money order, in favor of the Street Railway Journal.

Change of Address.—The old address should be given, as well as the new, and notice should be received a week in advance of the desired change.

Back Copies.—After July 1, 1905, no copies will be kept on sale beyond fifteen months prior to date of issue, except in bound volumes.

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office by 10 a. m. Monday preceding the date of publication, except the first issue of the month, for which changes of copy should be received two weeks prior to publication date. New advertisements for any issue will be accepted up to noon of Tuesday for the paper dated the following Saturday.

Of this issue of the Street Railway Journal 8000 *copies are printed. Total circulation for* 1905, *to date,* 261,550 *copies, an average of* 8157 *copies per week.*

Purifying Boiler Feed-Water

In spite of the advance that has been made in the past fifteen years in practical purification of feed-water for boilers to prevent scale formation, and the fact that such purification has been virtually reduced to a science, there appears still to be an idea in many quarters that it is a kind of mysterious thing to be treated by hit or miss experiments. The fact of the matter is that, as far as any ordinary feed-water is concerned, the engineer, with the aid of the chemist, can, in this day and generation, prescribe a method of treatment of boiler feed-water which will almost entirely prevent scale. Most of the scale-producing solids in boiler feed-water can be precipitated by certain cheap chemicals either before or after the water enters the boilers. The use of an open feed-water heater also assists greatly in such precipitation. There are a number of chemicals which will produce the results if used in the right proportions. Some are cheaper than others. There are also a number of patented methods of reducing the cost and labor of mixing proper proportions of chemicals and feed-water. Or, if the user prefers, he can do the mixing with main strength and awkwardness in settling tanks without the aid of any of these improvements. The important thing, however, is to find out what solids the waters contain by chemical analysis and prescribe the exact amount of reagent needed to precipitate these solids. As to whether they are to be precipitated outside or inside the boiler, is for the user to decide. While some waters may be peculiar and call for a certain amount of experimenting, the day for this kind of thing in general has passed.

Short Headway on Single-Track Roads

The question is beginning to be raised by some of the high-speed interurban roads with heavy traffic as to how frequent a service can be maintained on a single-track road. This matter of operating cars at frequent intervals on single roads has been thrashed out pretty thoroughly on many suburban roads, especially those in the East. It is a problem somewhat different on high-speed interurban roads of the type prevailing in the Middle West, although it differs in degree rather than in kind. About the shortest headway that is being regularly maintained by passenger cars on high-speed interurban roads of this kind is a car every half hour, which brings regular meeting points fifteen minutes apart for the regular schedule, in addition to which express and freight cars and extras must be provided for. To reduce this headway on such roads is a very difficult matter. In the first place the turn-outs are located for a meeting point every fifteen minutes. As long as the running time remains the same, the only way to reduce the headway between cars, without relocating the turn-outs, is to double the number of meeting points so as to provide for a fifteen-minute service, with meeting points every seven and a half minutes. This is certainly putting the meeting points in pretty thick for a high-speed road. If less than a half-hour headway is to be maintained between cars going in one direction and a fifteen-minute headway is too frequent, the only alternative is to change the running time or to change the location of the turn-outs. The present indications are that until companies feel that there is sufficient traffic to pay for making the line double track, the frequency of regular cars will not be reduced below thirty minutes on the fast roads, but that additional traffic will be taken care of by running double-headers, or by adding trailers or by putting two cars in a train on the multiple-unit system. The last method requires a special equipment, but outside of this fact is the most desirable.

The Accident Account

The statement of income and operating expenses per car-mile presented at the New York State convention and published in our issue of July 15, offers much chance for the profitable study of many matters. One of the items which may not be a subject of very profitable scrutiny, but which is nevertheless striking, is the damage account. The most notable thing about these figures is that the percentage of the gross receipts per car-mile going to pay damages and legal expenses incident thereto is much larger in the larger cities of the State than in the smaller. In fact, there seems to be something approaching a definite ratio between the percentage of gross receipts paid out for damages and the population of the city. The reasons for this are found both in natural operating causes and in an unnatural public sentiment. It is, of course, true that the density of population in the larger cities makes many more chances for accident in a large city than in a small for each mile a car runs. These are natural conditions which nothing can overcome. But these natural causes offer by no means the whole explanation of the enormous difference between the accident expenses per car-mile of a road operating in a city of 500,000 inhabitants and one operating in a city with a population of 50,000. No small part of the difference is caused by the large number of fraudulent and semi-fraudulent damage cases in large cities. On account of the smaller liability of detection, professional fake damage claimants always seek large cities for their operations. Further than this, public sentiment toward corporations in the larger centers is considerably different from that in the smaller cities, where the officers of the company are known personally to a large number, and where it is not so easy to obtain unreasonable verdicts from juries. Furthermore, in smaller cities, the corporation is usually of limited resources, and this being generally known, there is an unconscious public sentiment which spares a corporation, where in a large city the attempt would be to "stick the company" for the biggest damages that could possibly be obtained. In looking over the New York State figures, we see that the New York City Railway heads the list, with something over 8 per cent of its gross receipts going into the damage account. This is as might be expected, because the company operates in the densest population in the State. After this come the companies in other cities about in the order of the density of population, although, of course, there are many slight variations from this rule. The abnormal conditions which for several years caused the Brooklyn surface lines to be burdened with the heaviest accident accounts of any large city in the country have apparently ceased, so that the Brooklyn companies now pay out only a little over 6.5 per cent of their gross receipts for the settlement of damages. We have not the statistics before us from all the larger cities of the Middle West, but our impression is that damage accounts there do not run quite as high as in cities of corresponding size in the East. At least they do not in cities with which we are acquainted. How much this is due to wider streets, how much to an unpaternalized public which is accustomed to looking out for itself, and how much to more favorable public sentiment, it is hard to tell. Among the smaller companies, both city and interurban, the accident account is usually almost nominal. The chief thing to be feared in connection with these smaller properties is the occasional occurrence of some unusually serious accident, which may have considerable effect on the company's finances for a year or two, or more.

Direct-Connected Motors in Repair Shops

Considering recent progress in the direct application of electric motors to machine tools of all kinds, it is singular that the individual drive has on the whole received so little attention in the street railway repair shop. In a few cases, to be sure, the problem of obtaining maximum production with minimum expense is being worked out along the line of driving certain tools by direct-connected motors, but the usual practice is to group-drive the repair shop machinery by motors which have passed their period of usefulness for car service under the severe conditions of the present day. This method is natural enough, for it manifests a familiar trait of human nature, which always finds it difficult to get rid of anything that can still be turned to account. But it is an open question if the cost of repair shop operation, in terms of the work done, cannot in many cases be lowered by the substitution of modern equipment and a more discriminating arrangement in place of the antiquated installations so common in different parts of the country at the present time.

Setting aside for the moment the respective claims of group and individual driving, it is certain that the motors now being placed on the market for machine tool work are in general much more efficient and better adapted to their class of service than those designed a decade or more ago for the radically different cycle of duty found in operating a car on a street railway. The railway motor is fundamentally a machine suited to work on the axle of a car, and, although it can be rewound with a shunt field for constant speed in repair shop service, it is still essentially a makeshift for this class of work. On the other hand, great progress has lately been made in the design of special stationary motors capable of operating throughout speed ranges as great as 6 to 1 with high efficiency, and without sparking at all outputs from no load to 100 per cent overload. These machines may usually be set to operate at any given speed within their range, and will hold that speed practically constant through wide changes in output. Very little energy is wasted in the control, while special coils in series with the armature provide the magnetic flux necessary for good commutation. These features are inapplicable to a rewound railway motor. Of course, the purchase of new and improved equipment is always an expense of more or less weight, and there is often a strong temptation to use the old motors in some way as long as they can be made to turn, just as a steam road retires its locomotives from main line limited express service through a descending scale to the inglorious haulage of milk or gravel trains. At the same time one must remember that modern rolling stock cannot be economically maintained without the best repair shop equipment, and in matters of greater moment than the mere cost of power—important as that is in its yearly total—both the direct-connected and the improved group-drive motors of to-day stand for a broad intensifying of economical production which is far beyond the capabilities of the older apparatus.

No general rule can be formulated to enable one to decide in every case, at once promptly and intelligently, between group and individual driving. In very small repair shops it is probable that the conditions will seldom justify the extended use of direct-driven tools. The individual motor specially designed for machine tool work is often too expensive in first cost to warrant such outlay on the part of the smaller roads. But as the size of repair shops increases, the opportunity to apply individual motors to heavy machines doing intermittent work, or operating with a wide range of speed variation, grows

greater, until in the highly specialized shops of large systems we find a broad field of usefulness for both kinds of drive. It is desirable to avoid the power loss of idle belts and line shafts; to be able to shut down a part of the repair shop equipment without stopping the balance of the machines, and to reduce the danger of accidents by simplifying the driving apparatus; but of equal importance with the latter, and of first consequence always, is the question of increased productivity. The operations of the small repair shop are so much more varied per employee than is the case in the large shop that in the former case there is less opportunity to enjoy the full benefits of machine organization than in the latter. Small machines like grinders, hack saws, medium-sized lathes and shapers, constantly used, are generally better driven in groups, but in the heavier work with high-speed steels and variable cuts, the individual motor deserves wider recognition. It might well pay to equip a repair shop almost entirely with direct-driven outfits, if thereby space could be gained for the better installation and operation of an overhead traveling crane, which would enable the work to be pushed through more rapidly. Doubtless in many cases local conditions will be found to preclude the use of individual motors, but there is certainly room for closer study in this direction on many of the larger systems. Unlike the factory, the product of the street railway repair shop is seldom set aside and kept "in stock;" the time element is of vital consequence, and anything which enables more work to be forced out of the equipment without increased expense per piece or delays in actual service deserves the most careful thought on the part of street railway managers and master mechanics.

The Problem of London

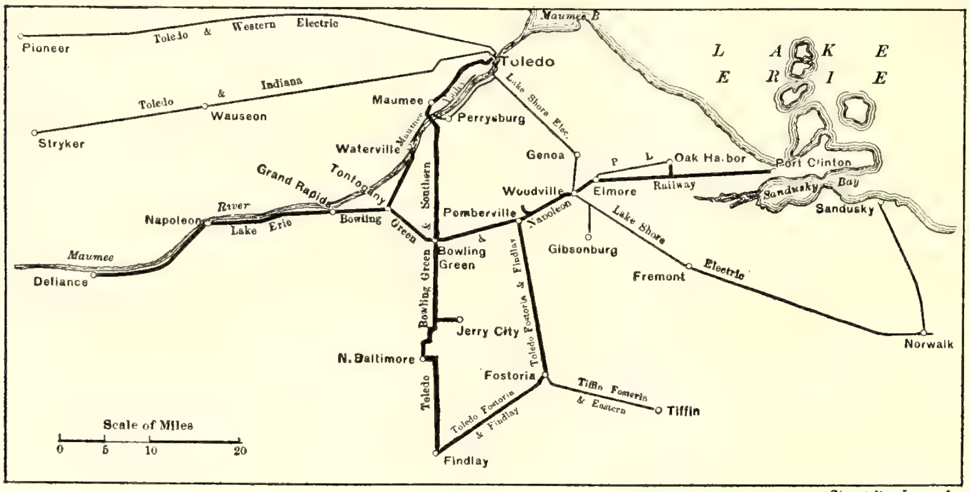
The English papers discussing the report of the Royal Commission are now before us, and emphasize the tremendous problem which the commission was set to solve, a problem which in London takes on its most intricate and generalized form. For London holds within its bounds the hugest aggregate of population that the world has ever seen. It is the heart of a world empire to which the dominions of Alexander and the Cæsars were as mere provinces. In it are centered the vital forces of the nation, and toward it every one of English birth naturally turns. As a result it now holds some seven million people, spread over a vast territory on both sides of the Thames, and the daily flow and ebb of the human tide to and from the City, or financial district—that is, the center of London's activity—is enormous in its volume. Add to this the fact that the whole metropolis is a maze of crooked streets that have been evolved from the footpaths of bygone centuries and one begins to have some conception of what rapid transit for London means. Not only must there be provision for carrying the great army of business back and forth, but there must be some adequate means of intercommunication between the great outlying districts. And as everyone knows, London to-day is almost as badly off as New York would be were we suddenly to go back to horse cars. The "tubes" do effective work locally, and so does the Underground, but the territory in the outer zones is so great and crowded that it cannot be adequately served by these or perhaps by any other means. It is a question whether transit difficulties, added to housing difficulties, will not inevitably become a limiting factor in the growth of cities.

Physically, rapid transit is entirely feasible even in London, but the cost of it is a matter very seriously to be reckoned with. At present, counting in local railways, omnibuses and trams, the traffic amounts to about 200 annual rides per capita, so that the aggregate cost, not including that to the credit of the largely patronized and excellent cab service, must rise to some £10,000,000. To meet the growing demand, added accommodations are imperatively necessary, and the recommendations of the commission to this end are valuable not only to London, but to every great city that in the future must deal with the matter. At the root of London's difficulties lies the fact of narrow streets that choke vehicular traffic of every kind. In an old metropolis this condition is very hard to remedy, and the commission's recommendation of two great avenues, each 140 ft. wide, crossing the city, strikes one as more magnificent than feasible. In the location suggested, the project would cost well-nigh as much as the Panama Canal, and the London papers may well be staggered, as they are, to conjure up practicable sources of revenue adequate to the need. In the long run it would seem wise at least to consider the advisability of building new avenues, not so as to perpetuate the present center of business, but so as to open radically new territory and to form new centers. An extended business area considerably simplifies rapid transit by averting the intense central condensation of traffic. Subways will undoubtedly help matters, but in old London conditions are such that the deep tubes will too often have to be used. The weak point of a subway system is its enormous cost, forbidding the extensive ramifications which are really necessary to secure general rapid transit, and we are not surprised that the commissioners went squarely upon record in favor of tramway extension.

From our American standpoint this is the most interesting part of their recommendations. Not only is it practicable commercially to build up a very complete system of communication by tramways, but in streets wide enough to allow double tracking the presence of the cars certainly does keep ordinary vehicular traffic in orderly motion. Those who remember lower Broadway in the horse car and omnibus days will realize the change that has been wrought. The electric car can handle more passengers per running foot of street than any other vehicle yet devised, and can do it more quickly and cheaply. And we note with interest that the commission lays no interdiction upon the trolley in its suggestions. The overhead trolley properly installed is at once the cheapest and most reliable means of getting current to a moving car, and makes it commercially possible to give a more complete network of tramways than any other system yet devised. In London or any other great city, surface tramways are a necessary part of the rapid transit systems, and ought to be encouraged. The judgment of the commission on motor omnibuses is interesting in this connection, for while the motor 'bus is far more thoroughly developed in London than anywhere else, the commission advises against any postponement of tramway extension on the ground of any visible prospect of the supersession of tramways by motor omnibuses. Another interesting suggestion is the recommendation of traffic crossings by bridges or sunken roads at certain important points. This plan might well be introduced at many points in New York, notably along West Street. Finally, the commission lays great stress upon the widening of many streets to give room for trams and other vehicles, and urges the immediate organization of connecting links between the existing tramway systems, which, strangely enough, are at present widely separated. It is a tremendous programme of reform, and in its entirety touches upon almost every phase of rapid transit. It is most unfortunate that reform has been so long delayed, since to-day it can be carried out only at prodigious cost.

IMPROVEMENTS TO A TOLEDO ROAD

The Toledo, Bowling Green & Southern Traction Company, which operates an interurban line from Toledo to Findlay, Ohio, together with the city lines in Findlay and the lighting system in that place, has recently completed extensive improvements to its system. The interurban line was built up piecemeal, being a consolidation of the Toledo, Bowling Green & Fremont Railway and the Findlay Street Railway, the former operating from Perrysburg to Bowling Green and the latter from Findlay, north to Mortimer. The two lines were



MAP SHOWING ROUTE OF THE TOLEDO, BOWLING GREEN & SOUTHERN RAILWAY AND CONNECTING LINES

connected and consolidated under one management about three years ago. For a long time the system was handicapped by inadequate power furnished by three small direct-current stations, one of them a water-power; also by a poor entrance into Toledo, its chief terminal point. In securing this entrance, it was necessary to make traffic arrangements with two companies—the Toledo Railways & Light Company, operating the Toledo city lines, and the Maumee Valley Railway & Light

MAUMEE RIVER BRIDGE, TAKEN FROM SITE OF FORT MEIGS, TOWN OF MAUMEE IN DISTANCE

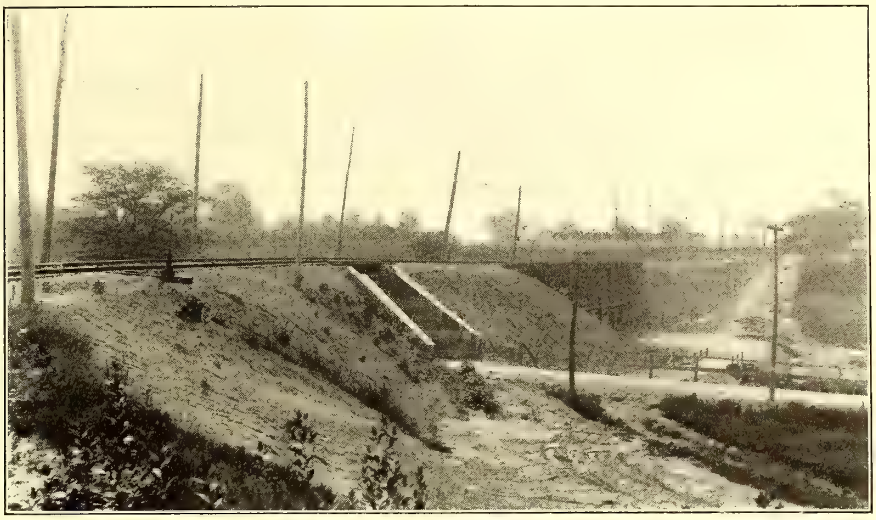
Company, operating a belt line from Toledo to Maumee, on the west side of the Maumee River, returning by way of Perrysburg, on the east side of the river, the latter point being the northern terminus of the Bowling Green Company's property. The entrance was over a poorly constructed track, with numerous grades and long city haul, and the traffic arrangements were such that the interurban company got very little out of the long haul from Toledo to Perrysburg.

In preparing to take care of the greatly increased business on the interurban line, as well as to improve the road to take care of through business soon to be offered by lines building from the south, the owners decided on three important improvements, viz., the building of an independent entrance into Toledo, the erection of a large central power station and the thorough rebuilding of the interurban line. These improvements are now nearing completion and constitute perhaps the most complete rehabilitation of an old road ever attempted in Ohio. To take care of this work, the Toledo Urban & Interurban Railway Company was formed, and the old properties have since been leased to and are now operated by this company.

While a shorter entrance to Toledo could have been obtained by paralleling the west side of the river and entering Toledo from the south, it was deemed more advisable by the engineers to strike off south of Perrysburg and cross the river through Maumee, entering the city from the west, securing a portion of the business from Maumee and tapping a rich farming and manufacturing district southwest of the city. The new line is 10 miles long, and brings cars to within 3½ miles of the center of the city, which is entered as before over the tracks of the Toledo Railways & Light Company, to the union passenger and freight stations. The line was built on 50-ft. private right of way, with easy grades and curves. The track is laid with 70-lb. rail, with Weber joints and Ohio Brass Company's soldered bonds, and the overhead is all Ohio Brass Company's heaviest type. The new track, as well as the whole of the old line, has been heavily ballasted with rock. The old track was raised from 8 ins. to 20 ins., affording excellent drainage. Several good sized fills were made, and the maximum grade on the entire line is now less than 1½ per cent. There are, in fact, few grades as great as this, as the country is exceedingly level. Excellent crushed stone was secured at the uniform price of 40 cents per yard on the cars from two quarries to which sidings were laid. Between Cygnet and Van Buren the road makes a number of sharp turns to take in the village of North Baltimore and several smaller towns. It is the intention to build a direct line between the points mentioned, which will shorten the route between Findlay and Toledo from 49 miles to 46 miles, rendering it practically tangent for 40 miles. T-rail has been laid through all towns, including Findlay, which further improves the speed possibilities. The new entrance was opened about sixty days ago, and with inadequate power still to contend with, the running time from

Toledo to Findlay has been reduced from three hours and eleven minutes to two hours and thirty minutes. In the near future three limited trains each way will be instituted, with a schedule of one hour and fifty minutes. When the new cut-off is completed there will be a further quickening of schedules.

In crossing the Maumee River the company could have made use of a county bridge, but it preferred to erect a structure of its own which would give better grades and unobstructed traffic, enabling it to handle carload freight into Toledo, a feature which will be pushed extensively as soon as the new power house is completed. The bridge is one of the largest and most expensive ever constructed by an electric railway, the total length being 1800 ft. Crossing the stream there are five 100-ft. deck girder steel spans resting on solid concrete piers. A portion of the approach is timber trestle, while the balance crossing the high-water section of the valley is steel trestle. The foundations of this portion are protected from ice gorges by timber cribs filled with stone. The cost of the bridge was about $80,000. The steel work was erected by the American Bridge Company, while the structure, as well as the engineering work for the entire new entrance, were designed by Riggs & Sherman, of Toledo, and Mr. Darrow, the company's consulting engineer. The accompanying illustrations of the bridge and fills approaching it were taken from the ancient earthworks of Fort Meigs, a fortress commanding the Maumee River, erected by the Americans in the war of 1812. There is much of historic interest in this immediate district, and the road secures considerable pleasure traffic.



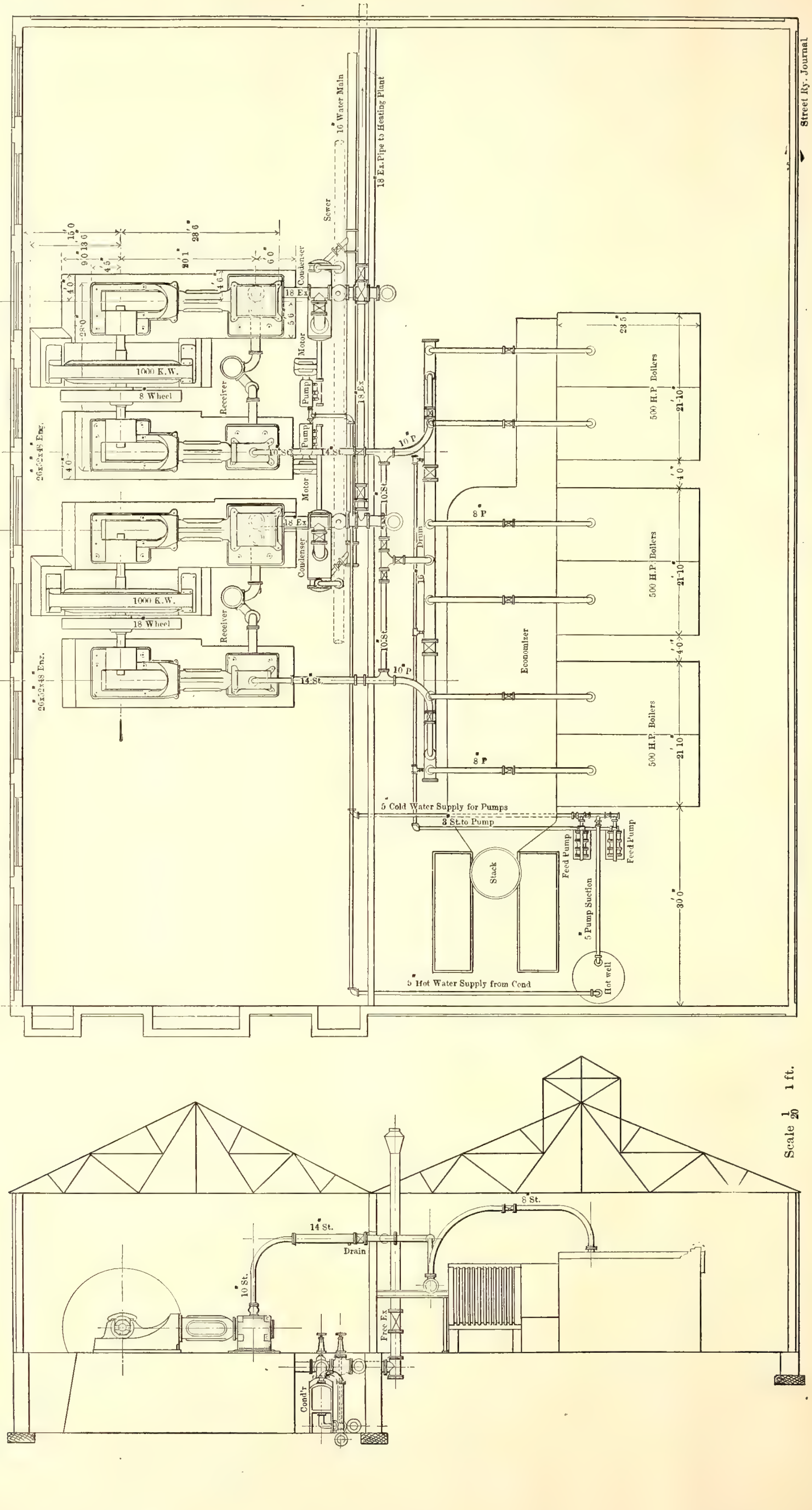
TRESTLE AND CONCRETE CROSSING, TOLEDO, BOWLING GREEN & SOUTHERN RAILWAY

FORT MEIGS STATION, HEAVY FILL APPROACHING MAUMEE RIVER BRIDGE, TOLEDO, BOWLING GREEN & SOUTHERN RAILWAY

In planning for its power station, the engineers decided to locate it in Findlay. Although at one end of the system it was considered most desirable, because of the company's lighting and heating system in that place, also because the Western Ohio Company's extension into Findlay will soon complete a chain of lines from Cincinnati to Toledo, and it is logical to suppose that some day these lines will be consolidated into one system. In this event there would be three large power stations located about equal distances apart and capable of taking care of the entire system of some 250 miles, viz., the new Cincinnati Northern station at Hamilton, the Western Ohio station at St. Marys and the Findlay station, and the station equipment and transmission lines were designed to handle 33,000 volts in common with the potential used on the other systems mentioned.

The building is located in the heart of the business district, adjoining the company's old station. It is of plain but pleasing design, 120 ft. x 150 ft., built of machine brick, with stone trimmings, having structural steel trussed roof. It is divided into two sections by heavy fireproof wall. The engine room is 52 ft. wide and the boiler room 60 ft., inside measurements, and both are on the same level. The building foundations, engine foundations and floors are all concrete. Each of the engine foundations is 30 ft. x 40 ft., and contains 500 cu. yds. of concrete. A steam-driven concrete mixer was set up in the building, the composition used being one part best American Portland cement, three of crushed rock and five parts sand.

The main units are two McIntosh-Seymour cross-compound condensing engines, cylinders 26-in. and 52-in. x 48-in. stroke, direct connected to 1000-kw revolving-field type General Electric a. c. generators, supplying 25-cycle 380-volt current and having an output of 1562 amps. per terminal at 94 r. p. m. The engines have water-jacketed bearings and pressure automatic lubricating system. They have a large overload factor, and with a normal temperature of 35 degs., they are guaranteed to run with 50 per cent overload for four hours with a 10-deg. rise in temperature. They have heavy duty frames and tail rods on both high and low-pressure cylinders. They are packed with Cook's metallic packing, no hemp being used. The main engine shafts are 24 ins. in diameter, and on each shaft is a 100,000-lb. 18-ft. fly-wheel. Each engine has an



GENERAL PLAN AND SECTION OF POWER HOUSE

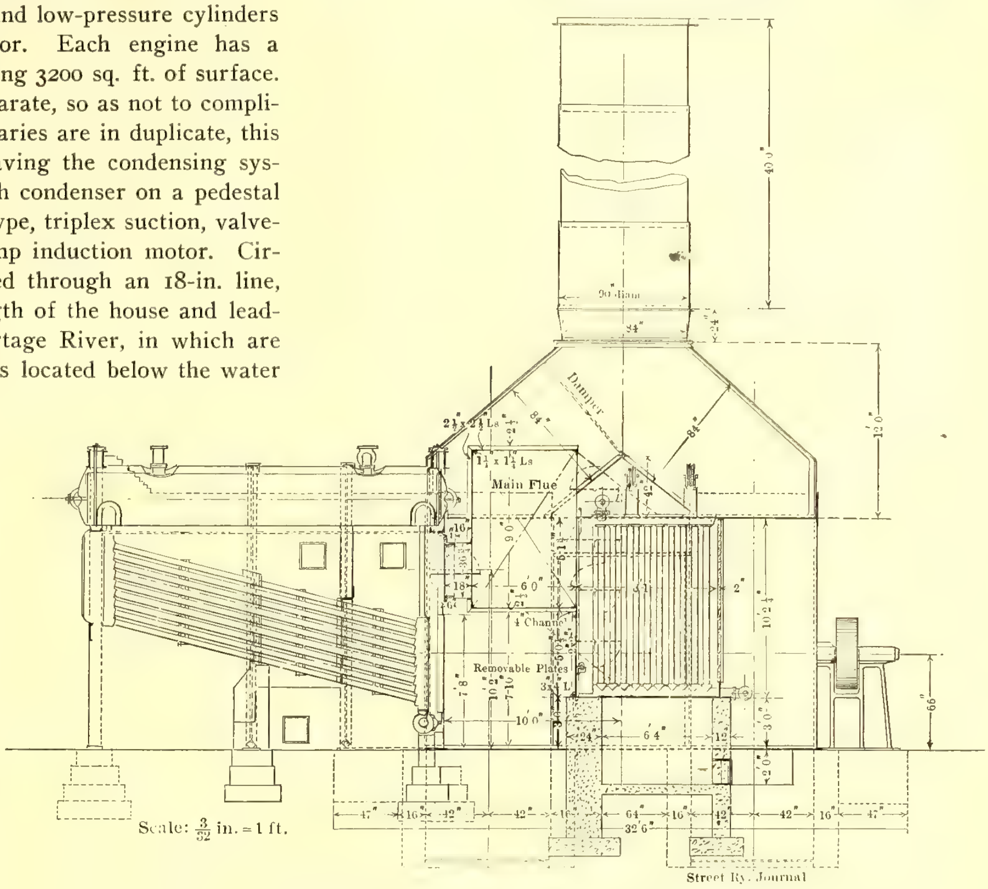
electrical governor acting on the throttle for synchronizing; also an auxiliary safety stop operating at 105 r. p. m. There is space in the engine room for a third unit of the same size, and the auxiliary equipment is designed for the extension. Between and below each pair of high and low-pressure cylinders is a Stratton receiver and separator. Each engine has a Worthington surface condenser, having 3200 sq. ft. of surface. The condensing systems are kept separate, so as not to complicate the piping, and, as all the auxiliaries are in duplicate, this was deemed more desirable than having the condensing systems interconnected. Adjoining each condenser on a pedestal is a vertical Worthington Edwards type, triplex suction, valveless air pump, gear-driven by a 20-hp induction motor. Circulating and feed-water are obtained through an 18-in. line, 2000 ft. long, extending the full length of the house and leading from a pump house on the Portage River, in which are three motor-driven centrifugal pumps located below the water line, so that they are always primed. The motors are controlled by switches in the station.

The company has a hot-water heating system, including about 5 miles of pipe and covering an area of 1½ miles from the power station. This has been supplied by independent heating apparatus in the old station, but in the future, under ordinary conditions, it will be taken care of by the hot water from the condensers in the new station, reinforced by the old apparatus in extremely cold weather. The condensers have two inlets and two outlets, and are provided with valves for cutting out the system. Half of the discharge passes to the sewer, while the balance passes through the heating system, leaving the station at about 150 degs. and being available at the limit of the system at about 100 degs. It returns, at a considerably lower temperature, to the station, where it furnishes half the condenser supply, the balance of the supply being taken from the cold-water main. The condensed steam is

EXTERIOR OF FINDLAY POWER STATION

forced by the air pumps through a 6-in. line to a hot well in the boiler room. In case of loss of vacuum or accidents to the condensers, the engines may exhaust through the roof through 18-in. risers, which are provided with Blake automatic relief valves.

Many engineers in designing a station of this capacity do not consider it economical to install economizers and forced draft, particularly the latter, but there were unusual conditions which caused the designing engineer to adopt them in this case. Owing to quicksand and bad bottom, it would have been necessary to have done considerable pile driving to have secured a



CROSS-SECTION OF BOILER ROOM ON LINE A-B, SHOWING MECHANICAL DRAFT APPARATUS

solid foundation for a self-supporting 175-ft. brick chimney of the kind considered, bringing the cost up to $10,000. The guarantee with the economizer installation provides that with water entering the economizers at 120 degs. and flue gases at 500 degs., to save 10 per cent of the coal burned under the boilers when developing 500 hp with 30 lbs. evaporation. The fan system, if operated to its full capacity, takes less than 3 per cent of the fuel consumption. Assuming a net gain of 7 per cent and a consumption of 50 tons per day of $2 coal, the saving would be $7 per day, or $2,500 per year, on an investment of $6,000 for the entire economizer installation and the short stack erected.

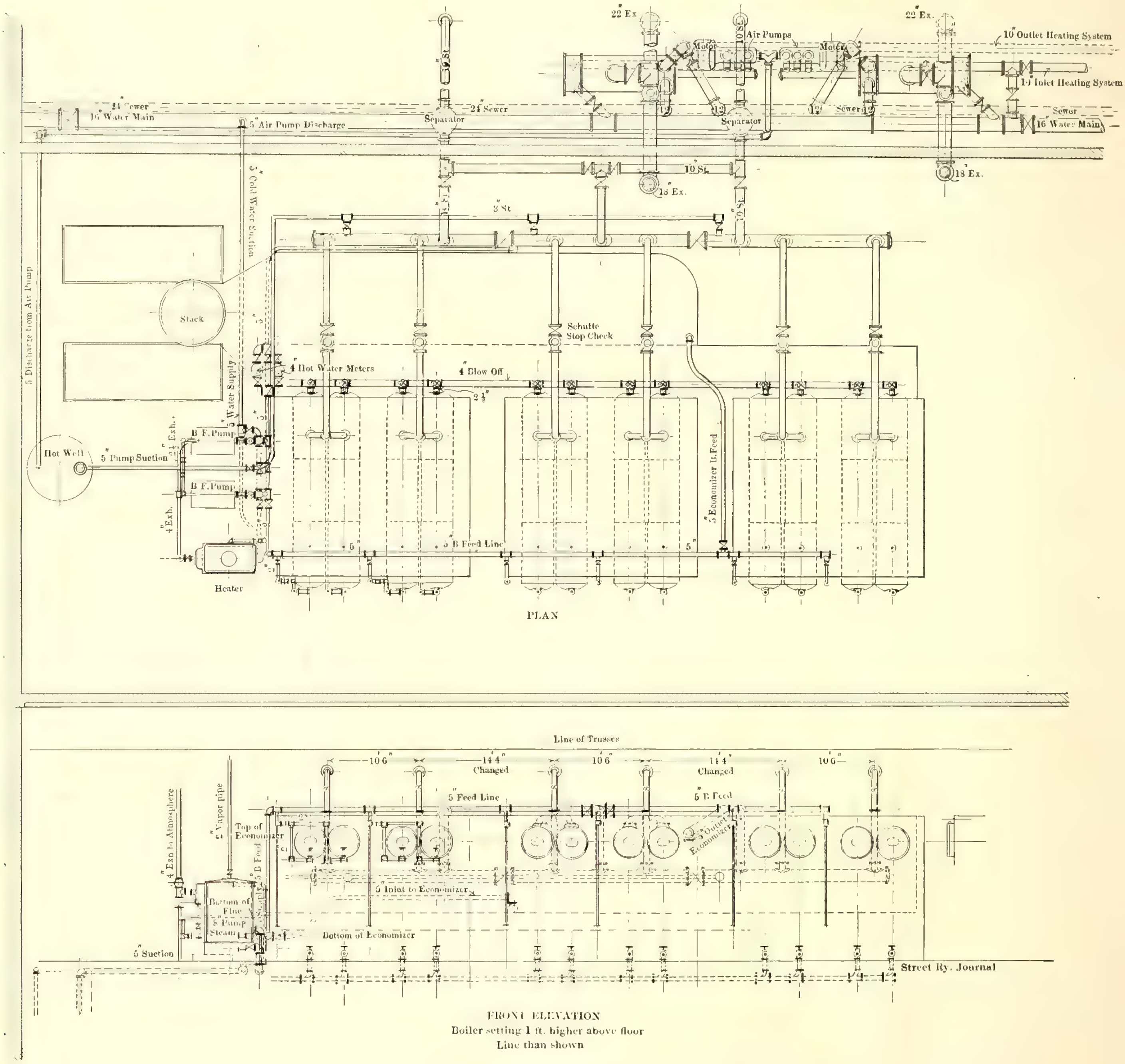
The economizer outfit occupies the entire space back of the boilers, and was installed by the Green Fuel Economizer Company. At one end of the boiler room are two fans in 25-ft. casings and having blades 15 ft. high and 7 ft. wide. Between them is a 55-ft. steel stack 10 ins. in diameter. Each fan is driven by an 8-pole 50-hp induction motor. The control of the motors is arranged so that 4 poles can be cut out, making it a 25-hp motor and giving half speed of 60 r. p. m., or all the poles can be used, giving 50 hp and 129 r. p. m. Either fan is sufficiently large to take care of 3000 hp of boilers, or double the present boiler capacity of the plant. The furnace gases are carried forward through a steel smoke drum, and then back through another breeching containing the economizer tubes. These tubes are provided with scrapers for removing soot; scrapers being driven through bevel gears by an induction

motor. The economizer breeching is provided with dampers so that the gases may pass through the fans without going through the economizer, if desired.

The boilers are the horizontal tubular type, built by the Aultman & Taylor Machinery Company, Mansfield, Ohio. They are arranged in three batteries, two 250-hp boilers to a battery. The boilers, as well as all high-pressure steam piping in the house, are designed for 250 lbs. pressure, although normally they will be run at 175 lbs. The grates are fired by Jones underfeed stokers. There are 2 ins. of draft in the breeching between the boilers and the fans. Steam from each pair of drums passes through an 8-in. line, provided with a Schutte stop check valve, to a 16-in. main header. The header rests on a platform, making all parts accessible for repairs, and it has recessed lap joints with steel flanges. The header may be cut into three sections by means of two 16-in. Chapman outside screw valves. Steam then passes through three 10-in. bends to a 10-in. auxiliary header along the rear wall. Each engine is supplied from this through a 10-in. bend to the high-pressure cylinder, steam passing on the way through a Stratton receiver separator, which removes any moisture. The scheme of using an auxiliary header gives a very flexible high-pressure system, enabling any pair of boilers to supply any engine.

The boiler feed-pumps adjoining the engines were supplied by the Advance Pump & Compressor Company, of Battle Creek, Mich. They are of the outside center packed plunger type, designed for a working pressure of 250 lbs., and constructed with 14-in. steam cylinder, 7-in. water plungers and 12-in. stroke. The valves are particularly accessible, being on top of the pump and provided with removable caps. On each valve is a device which acts as a throttle, so that the suction in the pumps may be broken while they are working against full pressure and at high speed with perfect safety. This feature will appeal to engineers who have had experience with pumps running away and wrecking themselves. A Cochrane open-type heater, made by the Harrison Safety Boiler Works, adjoins the feed-pumps. This receives exhaust steam from the boiler feed-pumps and from the stoker engines.

The feed-water pumps may take water either from a 6-ft. x 8-ft. hot well at the end of the boiler room, from the heater, or direct through a 5-in. cold-water suction from the circulating main. The hot well and heater are both elevated, so that the



GENERAL PLAN OF PIPING AND FRONT ELEVATION OF BOILERS AT FINDLAY POWER STATION

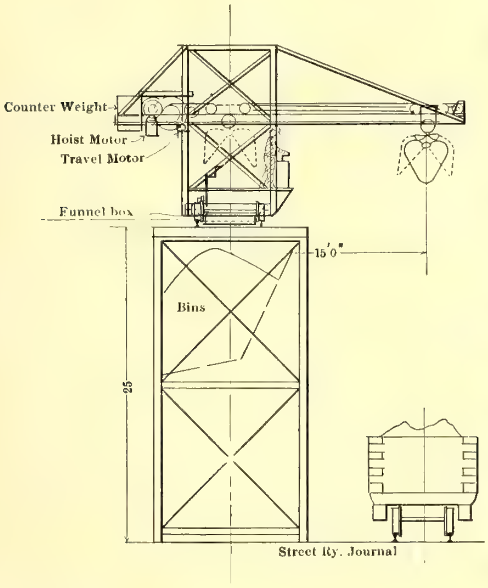
water flows by gravity to the pumps. The water in the heater is about 150 degs., and after being passed through the economizers it is raised to 250 degs. for the boilers. Between the pumps and the economizers the feed-water line is split into three sections, two of which are provided with Worthington 4-in. hot-water meters. Water and fuel will be carefully measured for the daily station log.

An interesting fueling outfit has been worked out. Over a timber structure outside the boiler room are sloping bins, above which travels a coal hoist of 2 tons capacity. A clam shell bucket having a transverse travel of 15 ft. is operated by a motor. The bucket has a capacity of 1000 lbs., and takes fuel from cars on a side-track adjoining the bins. The travel of the crane on the elevated tracks is by means of a hand gear, as it moves very slowly and only a few feet at a time. Fuel from the bins is fed through chutes to the stokers. The bins have a capacity of 250 tons, and nut and slack will be used.

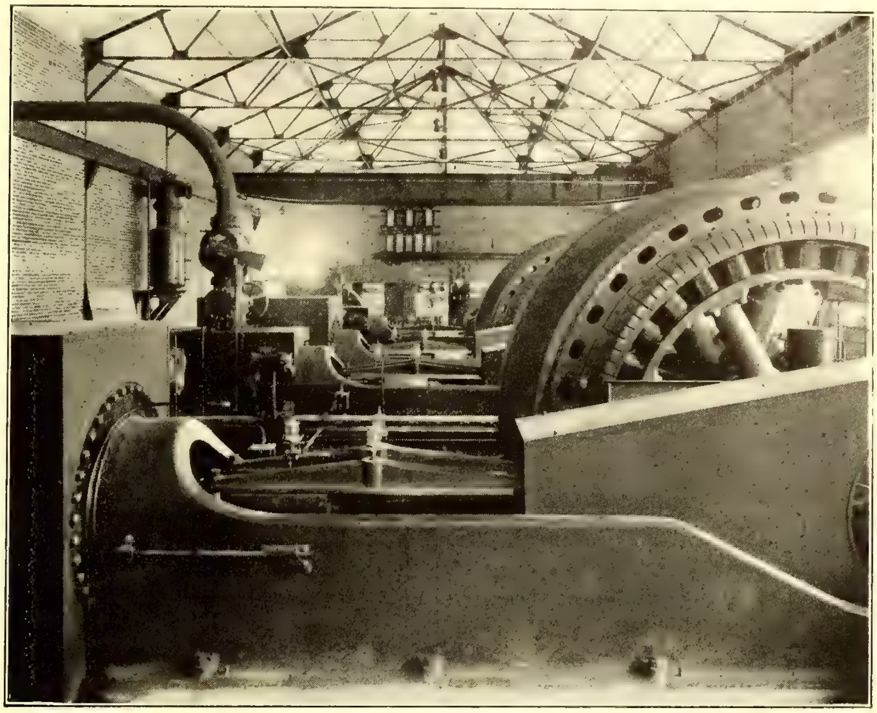
Going back to the electrical equipment, current for exciting the fields of the main generators is supplied by 50-kw 125-volt d. c. generators, belted to the fly-wheels of the large engines.

As stated, the company supplies light and power in Findlay. The present lighting output is about 4000 kw-hours daily, including 250 city lights, a three-wire, three-phase incandescent system operating at 110 volts, besides several hundred horsepower of a. c. motors. It was not desirable to install separate generating apparatus for these various systems, especially as it was figured that the lighting load would have a steadying effect upon the regulation of the entire load. It was therefore necessary to install frequency changers, changing the lighting portion of the load from 25-cycle current to 60-cycle current. The frequency changers consist of two 330-kw, 25-cycle, 370-volt, three-phase synchronous motors, each direct connected to a 300-kw, 60-cycle, three-phase generator. Taps are taken off from the primary side at 1150 volts for the incandescents and at 5000 volts from the series side for the city lighting, this current passing through five 50-light air-cooled tub transformers. Exciting current for the two generators just mentioned comes from the main generator exciters, and each of these is also large enough to supply the station lighting. Lighting current, when the station is closed down, is supplied by a small steam-driven exciter set.

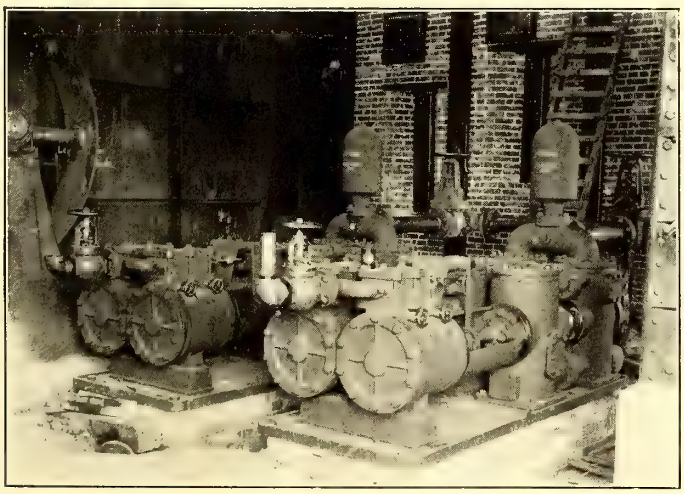
Twelve 1,500,000-circ. mil asbestos-covered cables lead from the main generators to a set of 370-volt buses, consisting of



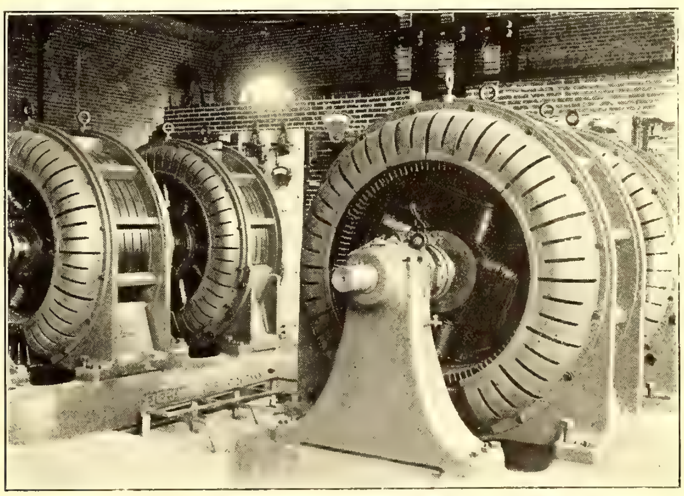
COAL TRAVELER HOIST, 2-TON CAPACITY



INTERIOR OF FINDLAY POWER STATION



FEED-WATER PUMPS, MAIN STATION



FREQUENCY CHANGER, MOTOR-OPERATED SETS, FINDLAY STATION

flat copper bars extending nearly the full length of the switchboard; the switchboard, consisting of thirty-two panels, extends across the room at one end of the house. The generator leads pass through circuit breakers between generators and buses. Instead of the usual oil switches, these are motor-operated laminated brush carbon circuit breakers. They are located back of the switchboard and have small control switches on the front of the panel, together with automatic trips and overload releases. From the bus-bar, lines run

FRONT ELEVATION AND SECTION OF COMBINED SUB-STATION, PASSENGER AND FREIGHT DEPOT AND RESIDENCE AT MAUMEE

through similar circuit breakers and through a brick wall back of the switchboard and into a transformer room, where they connect with the low-tension deltas of two sets of 375-kw self-cooling oil transformers. The transformers are connected up so that by throwing a switch on the board any one of a bank of three may be cut out without interfering with the action of the other two, two transformers being of sufficient capacity to carry the load in case of emergency. The primary sides of the transformers have five taps, giving varying voltages from 19,050 volts to 33,000 volts. From the high-tension sides of the transformers the lines are taken through standard form-H motor-operated oil switches back of the transformers, and from the switches to a set of high-tension bus-bars mounted in brick and concrete compartments in the basement. One outgoing high-tension line is at present connected direct to the high-tension buses. Some time in the future a second set will be installed, and form-H motor-operated switches will be interposed between the outgoing lines and the bus-bar. Single-pole knife-blade disconnecting switches are placed in each leg of the high-tension circuit between the form-H switches and the buses, and between the buses and the outgoing lines. The outgoing lines leave the building through a standard GE line anchorage. The line is protected by standard GE lightning arresters and choke coils interposed in the outgoing lines between the point where the arresters are tapped off and the disconnecting switches. The lightning arresters are elevated back of the oil switches and are accessible from a small balcony.

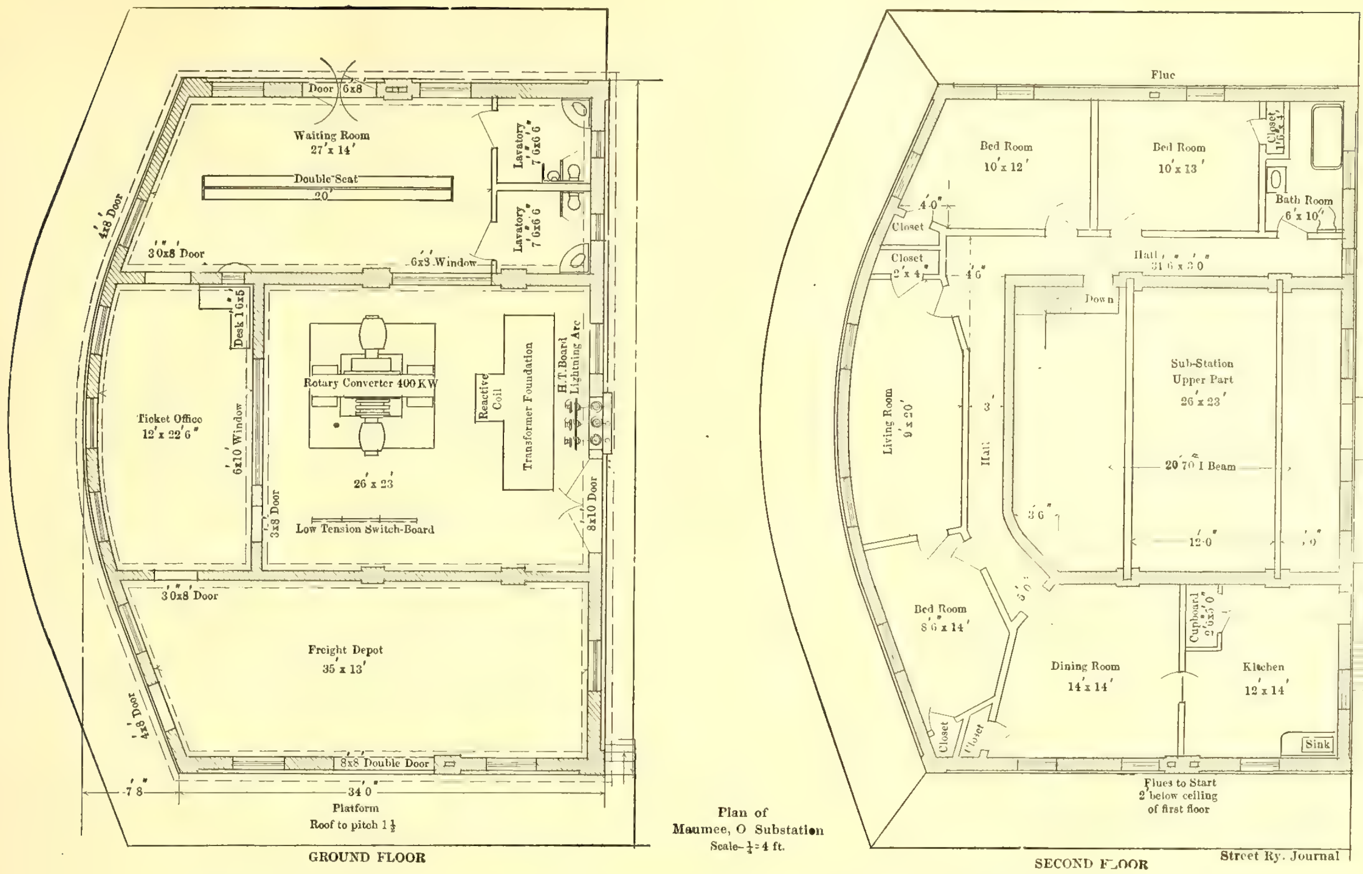
There is a 400-kw rotary in the station, and between this and the motor-generator frequency changers is a board of four panels, one controlling the rotary, two the motor-generator sets and the fourth being a transfer panel for half-voltage current from the main transformers, which is used for starting both rotary and motor generators. The switches on the four panels are double pole, double throw, the half-voltage transfer panel throwing current from half-voltage taps from either bank of transformers into a set of bus-bars extending across the four panels. Full voltage is brought from the main 370-volt bus-bars to a set of bus-bars extending across the lower side of three of the panels. The switches on these three panels when thrown into upper position will give current to either rotary or motor-generator sets at half voltage, and full voltage when the switches are thrown down. The current for the rotary and motor-generator sets after leaving these starting panels passes through solenoid-operated form-K triple-pole switches located in the basement, and in the circuit of the rotary the usual reactive coil for compounding is interposed. The rotary has the usual end play and speed limit and field reversing switch for bringing polarity right side up.

Only the two outside legs of the three-phase circuit go through starting switches, the center leg being carried direct to form-K oil switches.

The switchboard is gray Vermont marble, with black instruments. Beginning from the left, the first two are exciter panels with switches throwing excitation current to main generators and to the frequency changer generators. The next two are the main generator panels. Each has a balanced three-phase indicating wattmeter, balanced three-phase recording wattmeter, voltmeter and ammeter, and double-throw switches for throwing the potential circuit of the indicating wattmeter across the two outside legs of the three-phase circuit to measure the wattless component; also double-throw switch controlling the engine-governor motor on the generator; also a control switch for controlling the motor-operated circuit breakers in the main generator circuit. The next two are trans-

MAIN STREET IN FINDLAY, LAID WITH T-RAIL

former panels, each having two control switches, one controlling the motor-operated circuit breaker in the low-tension side of the step-up transformers, the other controlling the form-H switches in the high-tension side of the step-up transformers. The next two panels control the a. c. and the d. c. sides of the rotary, respectively, and the next is a d. c. feeder panel. Then there are four panels, the first two controlling the motor ends of the frequency changers and the other two the generator ends of these machines. The next two are feeder panels controlling the outgoing lines for the motor gen-

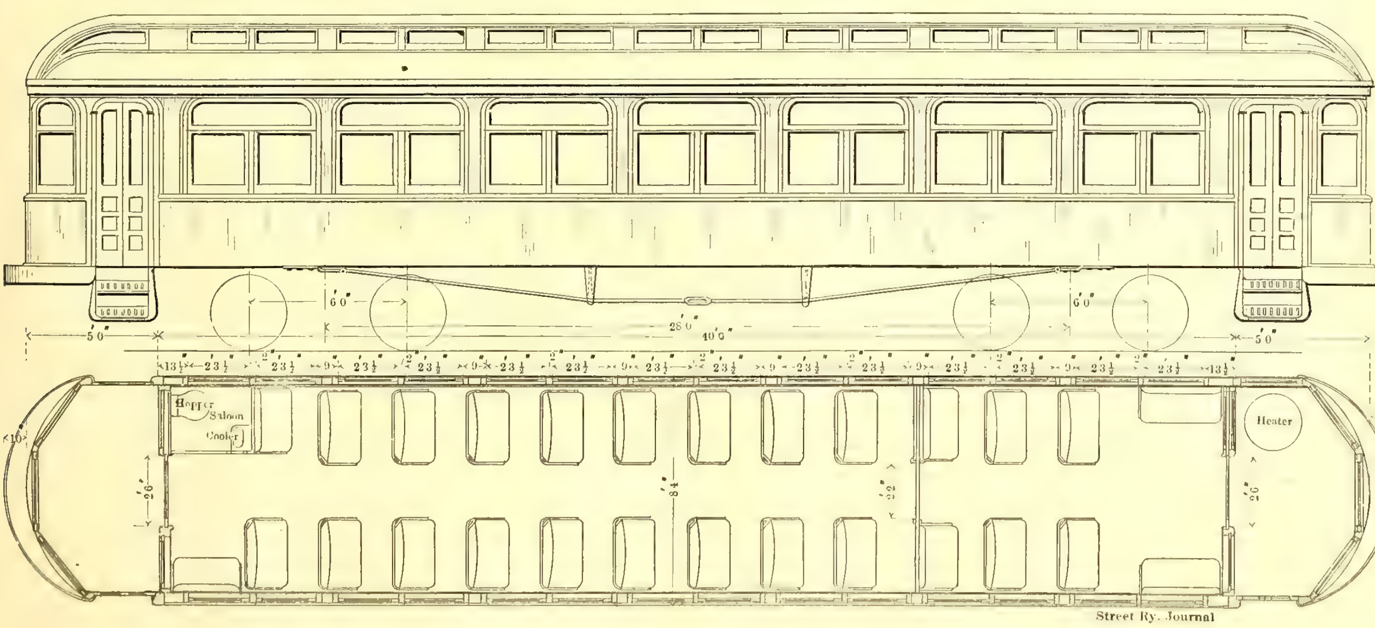


PLAN OF GROUND AND SECOND FLOORS OF SUB-STATION, DEPOT AND RESIDENCE AT MAUMEE

erators supplying three-phase lighting throughout the city. At the extreme end of the board five panels will be added to control the arc lighting and the single-phase a. c. now being done from the old plant. At the right-hand end of the board is a synchronizer for synchronizing the motor-generator sets, and on the left-hand end is a synchronizer for the generators; also an exciter voltmeter. The electrical outfit was installed by the General Electric Company, with E. K. Dewey and W. S. Culver erecting engineers.

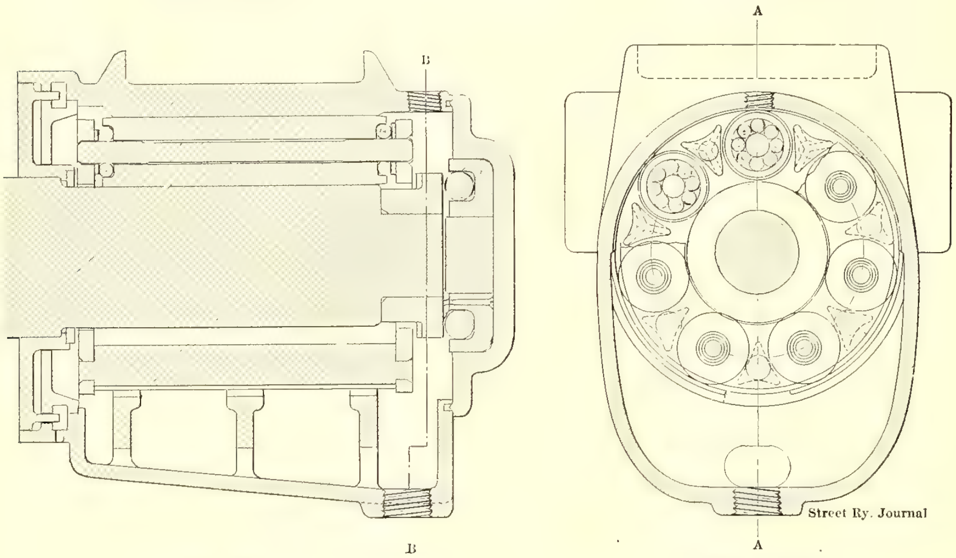
In addition to the sub-station in the house, there will be three sub-stations, each equipped with a 400-kw rotary, the average distance between rotaries being about 12 miles. The sub-station at Bowling Green and Maumee are of particularly attractive design. They are two-story buildings, built of concrete blocks, with tile roofs, and having sub-station room, waiting room, ticket office, freight station and lavatories below, and a dwelling house including bath room, three bed rooms, living room, dining room and kitchen above. Attendants will be paid $50 per month, with house rent free. The fourth sub-station is in a portable car, the outfit being a duplicate of that of the Cincinnati & Columbus Traction Company, described in the Street Railway Journal of July 8.

The company has just received for its limited service three very fine cars built by the Cincinnati Car Company. They are 50 ft. over all, and are equipped with Curtis trucks and four Westinghouse No. 93 (60-hp) motors. On account of the character of the country through which the road passes, a large proportion of its patrons being oil men who wear greasy



PLAN AND SIDE ELEVATION OF STANDARD CAR

clothes, all cars are equipped with cane seats in both smoking and passenger compartments. On several of its cars the company has been experimenting with roller-bearing axles, and is so pleased with the results that it will adopt them on all cars. The device is an adaptation of the Moffett roller bearing for other vehicles, and in the future the electric railway field will be cultivated by a company to be known as the Moffett Electric Railway Bearing Company, of Cincinnati, the outfits referred to herewith being the first experimental work done by the company. The bearing portion of the axle is 4¼ ins. in diameter, and is case-hardened and ground. Surrounding it are seven solid steel rollers. They are kept apart by separators and have rows of balls at either end to provide against end thrust. The rollers revolve in a casing which is case-hardened and ground, and the whole bearing is in an elliptical cast-steel box, which serves as an oil reservoir. The bearing is oil-tight and practically dustproof. In practical tests, the company used two cars identical in every item of equipment, except that one had plain bearings while the other had roller bearings. An accurate record of current consumption was taken at frequent intervals, and between March 23 and May 6, 1905, each car covered 10,000 miles. The plain bearing car consumed 3.62 kw-hours per



Section on Line A A

Section on Line B B (Thrust Button Removed)

SECTIONS OF ROLLER BEARING

car-mile, while the one with the roller bearing used 3.01 kw-hours per car-mile. The bearing showed no perceptible signs of wear and required no attention or reoiling. With a saving of 12 per cent in power consumption at the car, the engineer figures that it represents a saving of 18 per cent to 20 per cent at the power station, and with current at 1 cent per kw-hour, that the saving is something like $2 per car per day, or $750 per car per year. The bearing adds but a trifle to the cost of car.

On the old portion of the road the high-tension lines were placed on separate poles ranging from 50 ft. to 70 ft. in height, so as to clear all trees and other wires. There are two cross-arms, designed for two sets of high-tension lines. The high-tension wires are No. 4 bare copper, and the insulators are Locke porcelain, 8 ins. x 8 ins., designed for 90,000 volts. For protection against lightning, a barbed iron wire is carried at the top of the pole and grounded at every tenth pole. No line lightning arresters are used, the station and sub-station choke coils being considered sufficient.

Heretofore the company has had most of its repair work done outside, but it is now fitting up a shop at Bowling Green. It has installed a 36-in. lathe, 150-ton wheel press, small lathes, drill presses, etc.; also four 20,000-lb. air jacks for lifting cars and equipment. Air will be used throughout the shop for cleaning car seats, blowing out armatures, etc.

The Toledo, Bowling Green & Southern Traction Company has been one of the most prosperous interurban roads in Ohio, despite the handicaps of poor terminals and expensive power production. Last year the earnings were about $300,000, or about $6,000 per mile. With current costing over 2 cents per kw-hour, it operated for less than 60 per cent. With the new power station producing current at less than 1 cent per kw-hour, and with the advantages of an improved entrance to Toledo, together with the possibilities for developing the freight and through passenger business, it is figured that the property will show immense improvement in net earnings within the next year.

George B. Kerper, of Cincinnati, is president of the company; John Kilgour, Cincinnati, vice-president; A. J. Becht, Cincinnati, secretary-treasurer, and C. F. Smith, general manager. Eleazar Darrow, E. E., is chief engineer of the company, and had entire charge of the designing and installation of the power station and sub-stations, and practically all other recent improvements to the property. This paper is indebted to Mr. Darrow for most of the information presented herewith.

Since the above was written, it is understood that the property described has been leased to the Widener-Elkins syndicate, of Philadelphia, which controls a number of Ohio and Indiana interurban properties, and that it will be used as a link in the through system from Cincinnati to Toledo.

DAILY NEWSPAPER SCIENCE

In describing a new power station near Wabash, Ind., a daily paper of that city indulges in the following:

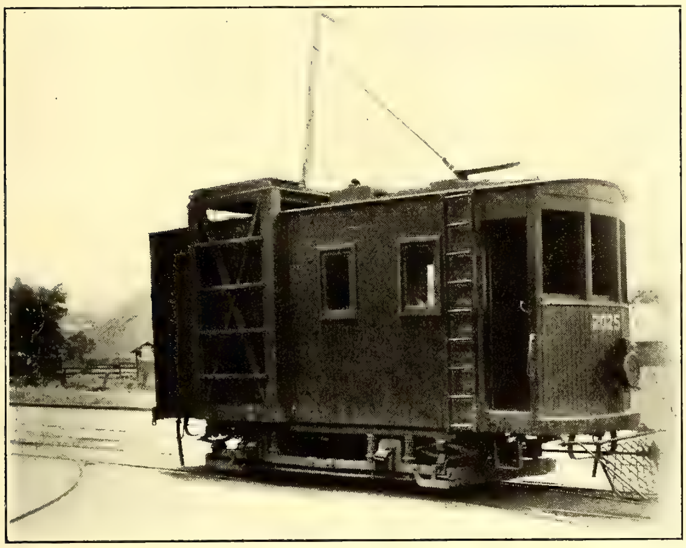
> The power house will be a place of miracles to the lay mind which may then watch electricity sucked from the air at 370 volts and multiplied to 33,000 volts by processes which electricians know as phenomena, and not as science. The reason why, is apparently beyond mortal ken, but the results satisfy the commercial purposes, and the tendency of the great mass is "to let it go at that." The transformer that by the power that is called "induction," for lack of a better name, will step up the number of volts, will be enclosed in oil, and the apartment walled in will have doors so that if it gets out of repair it can be easily and safely handled. It will be dangerous to approach it within 6 ft., and will be controlled at a safe distance by those in charge.

AN OVERHEAD LINE CAR FOR THE SCRANTON RAILWAY COMPANY

A new design of tower car has recently been placed in service by the Scranton Railway Company. It is 20 ft. in length over the body and has an interior width of 6 ft. Ample space is thus afforded for transporting all kinds of material. In many respects it follows the general lines of construction of cars for this service, but has an interesting and novel arrangement of elevating platform or tower, as well as a reel for paying out new wire. As the car has been found very serviceable in Scranton, diagrams showing its construction in detail are presented herewith.

The framework is simple, yet strong, involving 4-in. x 6-in. sill members and 4-in. x 4-in. side posts, surmounted by a heavy roof framing for carrying the linemen. On the outside of the body are two sets of guides, one on either side of the car, in which the four legs of the platform framework slide. The guides consist of 4-in. x 4-in. timbers, covered by ¼-in. x 5-in. straps. The platform itself is provided with hinged railings,

and is supported upon four 4-in. x 4-in. timbers, which are strongly cross-braced. It is lifted from within the car by a hand windlass, which is connected by a chain on each side to the lower side of the platform framework. The total lift provided for is approximately 8 ft. When lowered and with the railings folded down, the top of the platform is only about 10 ins. above the car roof.

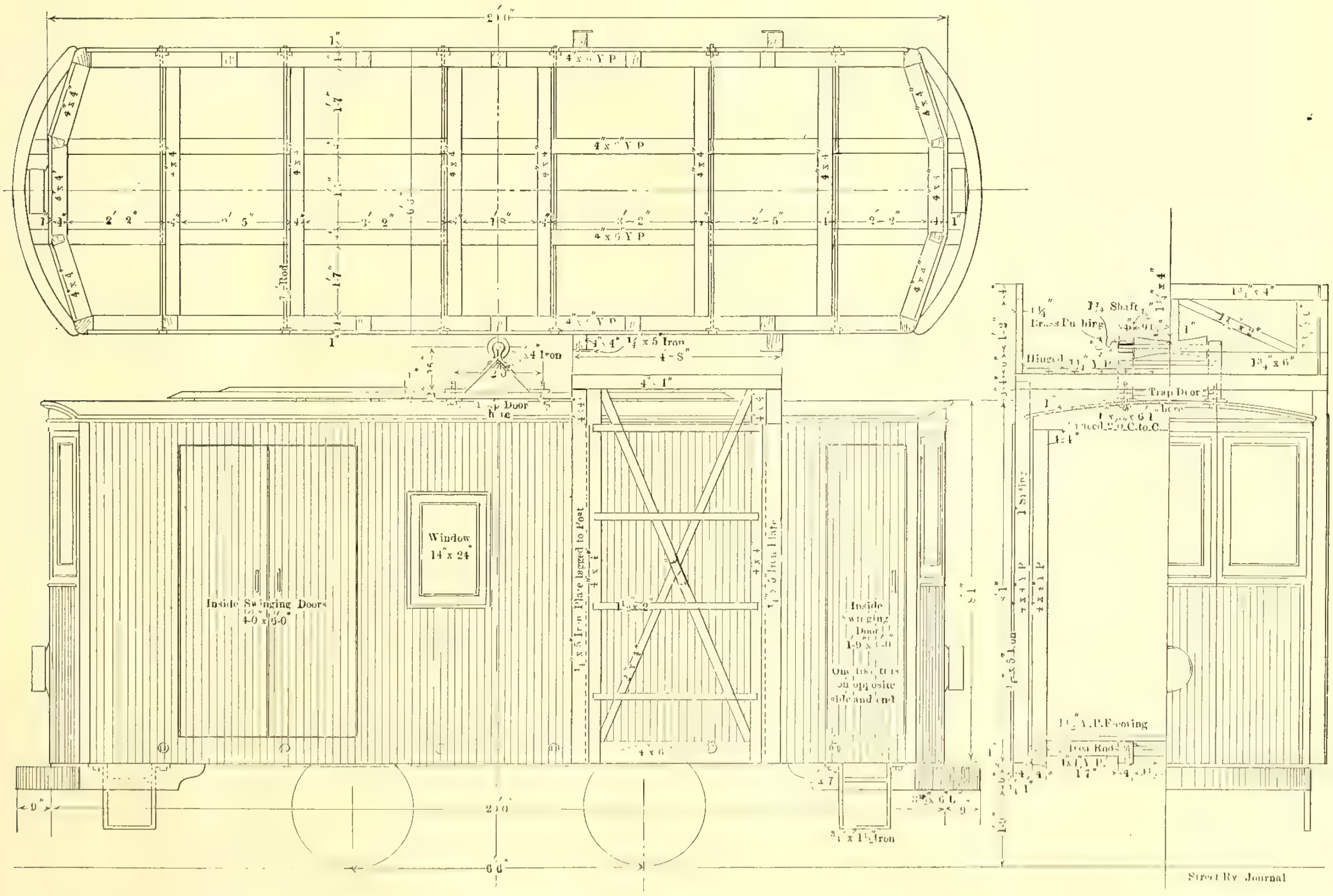


TOWER CAR WITH TOWER DOWN

TOWER CAR WITH TOWER RAISED

When used for erection purposes, the trolley wire is paid out alive through a trap door in the roof. The roller over which the wire runs is supported on the roof by brackets, as shown, and is well insulated by the car body. The reel carrying the new wire is mounted in a pair of wooden struts on the car floor, and is provided with a band brake, so that the wire will not pay out too rapidly. With this car it has been found possible to remove and replace the trolley wire upon over a mile length of track in a single night of five hours.

A finding for $120,023.43 for the owners of the Hotel Essex, Boston, against the Boston Elevated Railway Company, on account of the operation and maintenance of its elevated structure, has been handed down by the Superior Court.



FLOOR PLAN, SIDE ELEVATION AND SECTION OF SCRANTON TOWER CAR

THE QUESTION BOX

With one or two exceptions, the answers in the Question Box this week relate to problems confronting the mechanical departments. A variety of subjects is discussed, and answers are to be found to a number of questions about which there seems to be considerable difference of opinion. Foremost in interest, perhaps, is the discussion by D. A. Hegarty upon despatching systems for interurban roads.

A 49.—Information is requested relative to good despatching systems on interurban roads.

The trains running one way have even numbers, and those running the opposite way have the odd numbers. All orders given out by the despatcher are recorded in a book known as the "Despatcher's Order Book." These orders are forwarded to the motorman along the line who copies the same on his order blank, handing a copy to his conductor. The conductor then repeats the order over the telephone to the despatcher as it has been given him by the motorman, and if the repeated order is correct, the despatcher O. K's. the same, marking the O. K. in his book opposite the conductor and motorman's names, the conductor and motorman marking the orders O. K. also. These orders are all kept in cases made for that purpose, and are turned in at the terminal at the end of the run. The orders are then compared by the chief despatcher with the orders in the book to see that there is no discrepancy in them. By this method, both the conductor and motorman would have to forget their orders before carrying them out incorrectly. We have schedules printed especially for employees showing the passing point of each train, in heavy type, and all rules in regard to running the trains are printed on the bottom of the schedule. All motormen and conductors must know these rules perfectly, and are liable to be called for examination at any time by the chief despatcher in regard to orders and signals. No excuse is taken for misinterpretation of orders, as the risk of accident is too great to allow of any excuse by the trainmen. In case conditions arise that might cause an accident, and the cars should be in such location that they could not be reached by the despatcher, we have a direct wire from the despatcher's office to the power house, and at the ringing of the alarm signal, the man at the power house immediately cuts the power off from the road. The conductors and motormen have strict orders to bring cars to a standstill immediately in such cases. This is, however, only provided for cases of emergency, and as yet we have had no occasion for using this means. We use standard despatchers' train sheet, showing the location of trains, the same as in use on steam railways.

D. A. HEGARTY, Gen. Supt.,
Railways Company General, New York City.

E 53.—Are you in favor of having the gear case cast as a part of the lower half of the motor frame? Why?

No. The bottom half of gear-cases generally have holes punched into them by too high or misplaced street pavings. Also if car should leave the track suddenly, the gear-case would strike the rail and break the case, destroying the lower half of motor.

J. L. SULLIVAN, Foreman Motor and Truck Dept.,
United Railways Co., St. Louis, Mo.

E 57.—A road has had trouble with wheels becoming loose on axles. What is the probable cause and what the remedy?

Fitted too loosely. Make fit so tight that 30 to 50 tons are required to press wheels on axle.

J. CHAS. ROSS, Gen. Mgr.,
Steubenville (Ohio) Tract. & Lt. Co.

Cause.—Wheels pressed on axles with probably 18 or 20 tons pressure. (This would be sufficient if wheels were used under light cars, for light traffic, with hand brake). If the wheel is bored too large, and in pressing it on axle it does not reach 20 tons pressure until it is almost to the proper position on axle, you are almost sure to have a loose wheel, especially where air brakes are used, as the power is often applied to the motors while the brake is set. Remedy.—See that all wheels are pressed on axles with from 30 to 40 tons pressure.

J. L. SULLIVAN, Foreman Motor and Truck Dept.,
United Railways Co., St. Louis, Mo.

Wheels should be pressed on 4-in. axles at a pressure of from 35 to 45 tons. MASTER MECHANIC.

Improper fit. Should require at least 5 tons pressure to press wheels on axle. H. A. TIEMANN, New York City.

Poor fit between wheel and axle; too loose when pressed on. A new wheel should be put on and the loose wheel kept until an axle large enough to make a tight fit is found.

FRANCIS G. DANIELL, New York City.

E 58.—When pressing wheels on axles, what difference do you allow between diameter of axle and wheel bore?

This depends largely on the metal in wheels, some are very hard, others soft. On a hard wheel allow about the thickness of writing paper, or a little less than 1-64 of an inch; on a soft wheel 1-32 of an inch. J. L. SULLIVAN, Foreman Motor and Truck Dept.,
United Railways Co., St. Louis, Mo.

E 59.—At what pressure should wheels be forced on oxles?

After wheel is half-way on, the pressure should not drop below 30 tons the rest of the way.

J. L. SULLIVAN, Foreman Motor and Truck Dept.,
United Railways Co., St. Louis, Mo.

E 69.—What is the best size and shape of trolley wheels for city service?

On this road trolley wheels that have been in service on interurban cars and have become too badly worn for high-speed work are taken off, turned down in the lathe, refitted and used on local or city cars. We do not have to buy new trolley wheels for city work, as there are enough worn wheels taken from the interurban lines to equip all the city cars. We use a 6-in. trolley wheel.

Schenectady Ry. Co.

E 107.—If a car is sent out of the shop in good, all-round condition, what part of the equipment—accidents barred—will first require the return of the car to the shop?

As a general rule the renewal of shoes will be the first thing that requires the return of the car to the shop after it has been thoroughly inspected. MASTER MECHANIC.

E 108.—When a car is sent to the shop for some particular trouble—say low bearings—how much additional general inspecting and overhauling should be done at that time?

When a car is sent to the shop for any trouble, every part of it should be inspected, and it should go out in first class working order, and with the expectation that it is not to be returned for at least the life of the shoes. MASTER MECHANIC.

E 152.—How do you straighten a bent trolley pole?

Take a hardwood block 8 ins. thick, 12 ins. wide, and 4 ins. long, bore a hole through this the wide way, about 8 ins. from the end. The hole should be just large enough to allow the large end of the trolley to pass through easily. Fasten to a post in the car house or shops in some convenient place. This is a very good method of strengthening poles when they are not so badly bent that they have to be straightened by heating.

J. L. SULLIVAN, Foreman Motor and Truck Dept.,
United Railways Co., St. Louis, Mo.

If kink is short we use swage and heavy hammer. If pole is only slightly bent, straighten in vise or between two posts.

J. CHAS. ROSS, Gen. Mgr.,
Steubenville (Ohio) Tract. & Lt. Co.

E 184.—Suggestions are requested as to the best layout for car houses and shops. What do you consider the "ideal" arrangement for car house and shops? Please give your ideas, suggestions, sketches, etc.

What we consider the ideal car house is one that is built up of brick or stone, using angle-iron beams for uprights; eye beams for cross connections; steel rolling doors, and pits underneath cars, the track being laid on heavy piling of slow-burning construction.

R. H. YOUNG, Master Mechanic,
Lincoln (Neb.) Tract. Co.

E 184b.—What is the best form of roof for car houses?

Gravel roofing. R. H. YOUNG, Master Mechanic,
Lincoln (Neb.) Tract. Co.

E 184d.—What is the best material for car house floors? How should floors be laid?

For car house floors use 2 x 4-in. hard pine, tongued together, diagonally laid. R. H. YOUNG, Master Mechanic,
Lincoln (Neb.) Tract. Co.

E 184e.—What is the best form of pit for car houses?

One that affords plenty of room underneath, with track laid on 12 x 12 in. upright beams, and 2 x 4-in. hard pine flooring.

R. H. YOUNG, Master Mechanic,
Lincoln (Neb.) Tract. Co.

E 184f.—What are good ways of lighting pits?

Side lights on level with track; also one lamp on each beam, using five-light series and test on the ground end of the circuit.

R. H. YOUNG, Master Mechanic,
Lincoln (Neb.) Tract. Co.

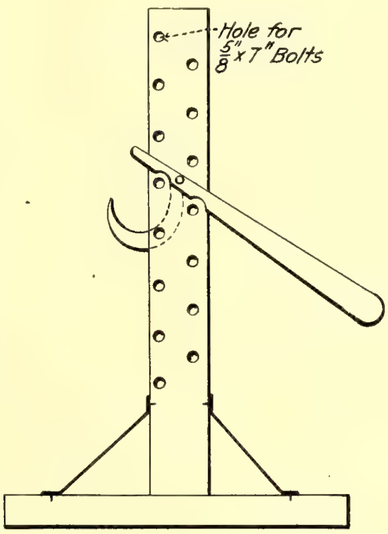
E 184g.—What are good ways of heating pits?

Steam radiators or pipes. R. H. YOUNG, Master Mechanic,
Lincoln (Neb.) Tract. Co.

E 184h.—What form of hoist or jack do you use for lifting car bodies? If the hoist was made from your own plans, please give details and drawings.

We have a home-made car jack made of 2-in. x 7-in. hardwood, as per sketch.

R. H. YOUNG,
Master Mechanic,
Lincoln (Neb.) Tract. Co.



HOME-MADE CAR JACK

E 184i.—For the average repair shop, what is the best method of driving the tools?

Electric drive.

R. H. YOUNG, Master Mechanic, Lincoln (Neb.) Tract. Co.

E 184j.—What specific acts or precautions instituted by your company have resulted in reducing fire risks at your car houses and shops?

By the placing of hose racks, hydrants and other means of extinguishing fires; making all wiring according to the underwriters' rules and regulations; placing galvanized-iron tanks for the deposit of oily waste; using steel or iron as much as possible, and allowing no combustible material to accumulate.

R. H. YOUNG, Master Mechanic,
Lincoln (Neb.) Tract. Co.

F 20.—What is a cheap and simple method of determining amount of feed-water used in boilers at a small or medium size plant?

By using two measuring tanks.

E. J. HINDERT, Chief Engr.,
Cleveland & Southwestern Trac. Co.

F 9.—Without mentioning trade names, can you give any suggestions on best ways of securing good boiler steam pressure regulation on railway loads?

A damper regulator coupled to the damper at the opening of the flue into the stack base will hold the steam pressure at almost constant pressure under ordinary variations of trolley station loads.

D. F. CARVER.

F 12.—Describe what you consider to be the proper method of blowing down a boiler.

If boiler is equipped with a surface skimmer and settling chamber, open valve slowly and leave open about five seconds, then close. On ordinary boiler open valve slowly and then slowly close immediately.

E. G. HINDERT, Chief Engineer,
Cleveland & Southwestern Trac. Co.

F 14.—What is a practical method of keeping a boiler in service when a leak develops in the tubes, either fire-tube or water-tube?

If a leak develops in a tubular boiler, get two plugs made out of a piece of soft pine. Drive one into each end of the tube. This can ordinarily be done without shutting down the boiler. The water soon soaks into the wood, making it very tight. Iron plugs can be used and last longer. Also rods can be run through tube, and plates with gasket underneath can be used for drawing up the nuts. This will answer, but I would prefer plugs. A water-tube boiler would have to be cut out of service long enough to drive in plugs if there is no time to obtain new tubes.

E. G. HINDERT, Chief Engineer,
Cleveland & Southwestern Tract. Co.

G 4.—To what various uses do you employ compressed air in the engine room?

Compressed air is used to clean all generators, and for cooling purposes.

E. G. HINDERT, Chief Engr.,
Cleveland & Southwestern Trac. Co.

Compressed air at about 20 lbs. pressure is used for cleaning generator armatures, windings, etc., where it would be impossible to clean with waste or a brush.

O. A. HONNOID, Opr. Engr.,
Utah Light & Ry. Co., Salt Lake City.

Compressed air in the engine room may be employed to very great advantage for various purposes; namely, blowing carbon dust and other foreign accumulations from the exposed armature windings and field windings, as well as for general dusting around the station. With the air hose the station attendant is able to reach the accumulation of dust and dirt that cannot be readily reached by any other method.

CHAS. H. COX, Gen. Mgr.,
Lincoln (Neb.) Tract. Co.

Air is used for blowing dirt out of dynamos, blowing whistles for signals, cleaning around witchboards, etc.

FRANCIS G. DANIELL.

G 5.—How do you obtain compressed air for the various uses about the power house? At what pressure do you use the air?

Compressed air is obtained by means of a portable air compresser, which is also attached to a system of piping. Air pressure is kept at about 80 lbs.

E. G. HINDERT, Chief Engr.,
Cleveland & Southwestern Trac. Co.

Compressed air is obtained by a small Christensen electrically-driven air pump, discharging into a reservoir about 6 ft. high by 20 ins. in diameter.

O. A. HONNOLD, Opr. Engr.,
Utah Light & Ry. Co., Salt Lake City.

By either a steam or motor-driven air pump. If the repair shops are in the same building with the engine room, or are within a reasonable distance of the engine room, it will be found to be an excellent idea to pipe the air to the armature winding room and car house pits for the purpose of cleaning out motors and armatures, beating and dusting the cushions, and otherwise cleaning the inside of cars.

CHAS. H. COX, Gen, Mgr.,
Lincoln (Neb.) Tract. Co.

Motor-driven air compressor similar to those used on cars for air brakes. Pressure should be 85 lbs. per square inch.

FRANCIS G. DANIELL.

G 6.—Please state in detail what trouble you have had with lightning at your power house. Then please state in full what steps you have taken to prevent damage from lightning.

Speaking of transformer work particularly, we have never had more serious damage from lightning than transformer windings burning out, the same being replaced in about three days by new coils kept in stock. Many heavy discharges, of course, will shut down the station for a minute or two, but with proper lightning arresters and choke coils installed, the ordinary discharges are taken

care of. We do not believe, however, that a lightning arrester has ever been built that will take care of the heavy discharges, and a shut down cannot be prevented. Speaking of direct-current railway feeders, generators, etc., we believe in connecting as many different types of arresters as there is room for, both of the standard manufacturers' types, but particularly is the "home-made" water tank arrester of good large capacity, one of the most effective that can be used. Good large contacts should be allowed, and the conductivity such that when the arresters are connected, a considerable amount of current may flow. In most severe storms it is perhaps the most advisable to open the circuit breakers and thus take away the temptation for damage by lightning that might prove far greater than the loss due to the service being interrupted.

O. A. Honnold, Opr. Engr.,
Utah Light & Ry. Co., Salt Lake City.

We have but little trouble with lightning. We have had generators grounded, but during the past three years beyond machines flashing, have had no trouble. We have a tank arrester and standard arresters on feeders. The high-tension system is also protected by standard lightning arresters.

E. J. Hindert, Chief Engr.,
Cleveland & Southwestern Trac. Co.

We have had switchboard circuit breakers opened with lightning, but since installing the ordinary wooden box arresters about every mile of trolley line, with three arresters just outside our station, all of different types, and one arrester on each switchboard panel in the building, we have had no trouble.

L. M. Levinson, Mgr.,
Shreveport (La.) Tract. Co.

I 28.—What is a good method of testing rail-bonds?

In the writer's private opinion the best method to test bonds is by means of a testing instrument which gives readings across the joint in comparison with straight lengths of rails.

J. Stanley Richmond, Consulting Expert,
New York City.

I 31.—In using bond tester on special work in which each joint is bonded in addition to long bonding, what is the method of procedure in case the tie-rods span two or more joints?

Bond testing across special work is carried out in the same way as on straight rail.

J. Stanley Richmond, Consulting Expert,
New York City.

I 32.—What is the best form of portable rheostat to use in connection with bond-testing instrument?

In the car shops can generally be found (near the armature repair shop) a barrel-rheostat. This can usually be borrowed and rigged up on a flat-car or some other sort of car to serve the purpose of giving current in the rails from the trolley during such periods as no cars are in operation.

J. Stanley Richmond, Consulting Expert,
New York City.

ADDITIONAL QUESTIONS RELATING TO THE POWER HOUSE

Replies to the following questions are particularly requested:

F 74.—What has been found to be the best construction for ash hoppers under boilers?

F 75.—What is the most economical method of handling ashes from the hoppers to a storage bunker or to receptacles for their removal?

F 76.—What satisfaction do belt or bucket conveyors give when used for this purpose? Are conveyors better than cars?

F 77.—Is it possible to remove oil from exhaust steam mechanically? If it is done, what make of commercial separator is best for the purpose?

F 78.—What results have been attained by the use of the open heater? Are open heaters giving satisfaction? Would the users of open heaters please give their experiences?

REPORT OF THE ROYAL COMMISSION ON LONDON TRAFFIC

A brief digest of the report just issued by the Royal Commission on London Traffic was published on page 152 of the Street Railway Journal for July 22. The more complete copies of the report which are now available indicate that the commission made a most thorough study of the traffic conditions and requirements of London and permit of a longer abstract.

The Royal Commission on London Traffic was appointed on Feb. 9, 1903, and consisted of Sir David Miller Barbour, K.C.S.I., K.C.M.G. (chairman); the Right Hon. Earl Cawdor, the Right Hon. Viscount Cobham, the Right Hon. Lord Ribblesdale, the Right Hon. Sir Joseph Cockfield Dimsdale, Bart., K.C.V.O., M.P.; Sir John Poynder Dickson-Poynder, Bart., D.S.O., M.P.; Sir Robert Threshie Reid, G.C.M.G., K.C., M.P.; Sir John Wolfe-Barry, K.C.B., F.R.S.; Sir Francis John Stephens Hopwood, K.C.B., C.M.G.; Sir George Christopher Trout Bartley, K.C.B., M.P.; Sir George Stegmann Gibb, Charles Stewart Murdock, C.B.; Felix Schuster and Lynden Macassey, M.A., B.SC., LL.D. (secretary).

The report issued is entitled Part I. In addition to Part I., the commission will issue seven other parts or appendices, devoted principally to the evidence taken, maps, diagrams, etc.

The commission held 112 meetings, not including many subcommittee meetings, and examined orally 134 witnesses. The chairman and four other members of the commission (Lord Ribblesdale, Sir John Dickson-Poynder, Sir George C. T. Bartley, Sir George S. Gibb), together with Lynden Macassey, the secretary, visited, in September, 1903, New York, Boston, Philadelphia and Washington. On this visit evidence on the subject of transportation was secured by personal study as well as by interviewing prominent American railway experts, among them H. H. Vreeland, William Barclay Parsons, B. J. Arnold and Gen. W. A. Bancroft. Mr. Vreeland also gave testimony before the commission in London.

The report states that the population of Greater London in 1901 was 6,500,000 persons, and the number of rides per capita per annum was 200, compared with 300 in New York and 270 in Berlin. The facilities for locomotion in the district occupied by the working class are particularly deficient. In the central districts the population per acre is 148; in the rest of the county of London, 54; in districts adjacent to the county, 16.6, and in the rest of "Extra London," 2.5. Upward of 1,500,000 persons live in the central districts. In the central districts the average weekly rent of newly-erected working class houses is 3s. 3½d. per room; in the rest of the county, 2s. 4½d., and in "Extra London," 2s.

The commission states that the importance of cheap locomotion is not confined to the working class, but affects the comfort and efficiency for work of the whole community. The vast majority of people who go to their business in the center of London possess very limited incomes, and the payment of fares for transportation constitutes an appreciable pecuniary burden. In this connection the commission states: "It is sometimes said that London is a city under conditions special to itself, and in respect to facilities for locomotion cannot be judged by the standard of other cities. The remark appears to us to be true in the opposite sense to that in which it is generally used. The magnitude of the population of London, and the extent of the area over which that population is spread, make the problem of locomotion specially important for London, and, if the standard of movement cannot be raised to the level attained elsewhere, London must fall behind in competition with other cities, and the life and growth of the metropolis will be slowly, but not the less surely, strangled by the choking of the great arteries of traffic."

The recommendations of the commission relate principally to the widening of streets, the installation of tramways and

railways, and the regulation of traffic. One of the most radical recommendations of the commission is for the construction of two main avenues through London, one 4¾ miles from west to east, and the other 4½ miles from north to south. Each avenue would be 140 ft. in width, from house to house, with subways for water mains; with four lines of tramway on the surface and four lines of railway below the surface for express and local stopping trains. The east and west avenue, with its subways, railways and tramways, is estimated approximately to cost about £15,550,000, and the north and south avenue about £8,550,000. The commission does not recommend the immediate establishment of these avenues under existing conditions, but believes that their advantages should be carefully considered. It also recommends the widening of other streets.

RECOMMENDATIONS AS TO TRAMWAYS

One of the most important and interesting of the recommendations relates to surface tramways, which figure prominently in the recommendations of the commission for the relief of the present conditions. The report points out that London is conspicuously deficient in tramway facilities, and that there are extensive districts, especially in the West End and the center of London, which are entirely unprovided for. Even where tramways exist there is an absence of through communication. At the six principal present tramway terminals nearly 250,000 passengers alight daily in the street, resulting in great congestion and confusion.

The competitor for the tramways for a short distance is the omnibus, which many think will always serve a useful purpose in London. The commission evidently considers, however, that if the tramways are extended, the omnibuses, or at least the horse omnibuses, will largely disappear, and that even if motor omnibuses are developed tramways will continue to be the most efficient and the cheapest means of street conveyance. The commission therefore cannot recommend the postponement of tramway extension in London on the ground of any visible prospect of the supersession of tramways by motor omnibuses.

WIDTHS OF STREETS FOR TRAMWAYS

Considerable consideration is given to the width of streets for tramways. The report says: "The opinon is widely held that the streets of London are too narrow for tramways on a great scale. No doubt many streets are too narrow. The real question is whether this disadvantage is so widespread as to necessitate the postponement of a great tramway extension until costly operations of widening have been carried through."

In this connection the commission states that the London County Council aims at a minimum width of 33 ft. between the curbs, but the commission thinks that a greater width than 33 ft. is desirable, as a rule, for a double line of tramway, save that for short distances or in less frequented thoroughfares even a less width may be accepted. A single line might be laid in still narrower streets, either for traffic in both directions, with passing places at intervals, or for traffic in one direction only. Such an arrangement is common abroad, and appears to work satisfactorily.

"Judged by the above standards of width," the report proceeds, "many of the main thoroughfares of London will admit of tramways. Of course, the decision must depend partly upon the extent to which the street is crowded as well as upon its width. Certainly some street improvement is necessary in places, from any point of view; and we have already recommended that preference should be given, as far as possible, to improvements which would widen roads intended for tramways; but we are persuaded that a great deal can be done in the way of tramway extension without any great expense of this kind."

THROUGH ROUTEING AND MUNICIPAL OPERATION

Great stress is also laid on the necessity of running through cars over tramway systems, even if separately owned. The commission does not deal directly with the question of the municipal operation of tramways as being outside the terms of its reference. The report states, however, that the commissioners think it reasonable that some profit should be derived from the tramways for the benefit of the municipality; but that it does not follow that the best way of securing the largest profit will be that the municipality, even if it finds the money for construction, should undertake the task of operating.

UNDERGROUND RAILWAYS

The commissioners then discuss the practicabilty of securing the construction of further underground railways in London. They express their reliance on private enterprise in the following terms:

"A sufficient number of successful underground railway schemes, however, remain to justify the hope that there is no need, as yet, to make an alteration in the present system of private promotion in the direction of looking to public sources for any part of the funds required for railway enterprise, unless undue financial obligations are thrown upon the railway undertakings, either in respect of works or compensation, or in regard to the carriage of passengers at unremunerative fares, or otherwise.

"All that, in our judgment, is necessary is to see that no discouragement shall be created for private enterprise by the system of procedure under which railway undertakings are authorized, or by the imposition of undue burdens proposed on or exaction of impossible conditions from promoters."

TRAFFIC REGULATION

Considerable space is devoted to the question of regulation of traffic in the streets and measures which should be taken to prevent and remedy obstructions in the streets. One grave cause of obstruction is the standing of vehicles at the sides of streets. For example, the report says that "where a business is of such a nature that the owner practically converts the street opposite his place of business into a private yard, to the serious inconvenience of the general public, we think he might not unreasonably be required to provide a suitable place for loading and unloading. In regard to future buildings this should be made compulsory."

PERMANENT BOARD

In conclusion, the report recommends the establishment of a Traffic Board which should report yearly to Parliament, and which would have jurisdiction over the entire subject of traffic in London.

The West Chester Street Railway has introduced a new wrinkle in its passenger department, that of running a thrice-a-week excursion over its Downingtown and Kennett lines. Large open cars, brilliantly lighted, are used, and the trip occupies three and three-quarter hours. An excursion fare of 50 cents is charged, and the service has been well patronized.

The Chattanooga Electric Railway has increased the wages of its employees who have been in the service exceeding a year 1 cent per hour. Prior to July 1, the wages received by these men was 17 cents; from henceforth they will receive 18 cents, which increase in the course of a month runs up a considerable total. It is understood that another new feature will be introduced by this company relative to the wages of its employees. Each successive year of service will bring a specified raise in salary, thus affording an inducement to the best men to remain with the company.

THE LEWIS AND CLARK EXPOSITION

While not so large as the St. Louis or the Chicago fairs, the Lewis and Clark Exposition, now in progress at Portland, Ore., is attracting a large attendance and possesses many interesting exhibits. The provisions made by the Portland Consolidated Railway Company to handle the traffic to the fair are noteworthy and will be described in an early issue of this paper. In the present article a few particulars of the most important buildings will be given, together with a description of the principal electric railway exhibits.

THE GOVERNMENT BUILDINGS AND CONNECTING BRIDGE

The site is a tract of 190 acres on a lake of nearly 300 acres, which divides the grounds into two portions, connected by a monumental bridge. On the south side the land rises to an elevation of 100 ft. above the lake, and here the important buildings have been located and a park laid out. Across the lake are the Government buildings.

The United States Government buildings are five in all, the main structure being connected with three smaller ones by ornate peristyles, while the fourth smaller building, the United States Life Saving Station, is located west of the group, on the shore of the lake. The front of the main building is spanned by five arches, each 40 ft. wide, supported by Corinthian columns 44 ft. high. The building is graced by two towers, each of which is 260 ft. high and surmounted by a dome. The roof of the main building is arched, the highest point being 130 ft. from the ground, while at each end is a half dome. Constructed in the Spanish Renaissance style of architecture, in harmony with the other main exhibition palaces, the building is, from an architectural standpoint, one of the finest in exposition history. The minor buildings are in the same style as the main structure, but they have less ornamentation.

The Mines and Metallurgy Building is 200 ft. long x 100 ft. wide, and contains 20,000 sq. ft. of exhibit space. It is covered with decorative staff, which has been tinted a pleasing gray, restful to the eye. Decorative effort has been expended principally on the main entrance, located in the center of the south facade. Three wide doorways are separated and flanked by fluted pilasters with Ionic capitals. The windows of the building, except a few over the doors, are set high up on each of the four sides, and are composed of a number of small, ground glass panes. Overhanging eaves, made wider by the fact that underneath them the walls swell out for a considerable distance, produce an unusually attractive effect. The Mines and Metallurgy Building has an addition 30 ft. wide x 60 ft. long, which extends across part of the west facade. The addition was necessitated by the unexpected requirements for space in which to house the unusually attractive displays from the Oregon mines.

The longest building on the Exposition grounds is that devoted to machinery, electricity and transportation, which has a length of 500 ft. The main building is 100 ft. wide, but at each end, where projecting wings 100 ft. square are added, the width is doubled. The wings were made necessary by the unexpected demand for exhibit space on the part of large manufacturing concerns. The building is a plain structure, with comparatively little attempt at ornamentation. A red hip roof covers the building, with the exception of the wings, which are flat-topped. Decorative efforts have been confined almost entirely to the main entrance, which is located in the center of the west facade. The entrance is through an arch ornamented with flanking pilasters, a cornice of liberal projection supported by classic brackets adding to the attractiveness. Above the cornice an extending wall is adorned in the center by a star window, and at each angle supports a pinnacle and flag staff.

THE MACHINERY, ELECTRICITY AND TRANSPORTATION BUILDING

The Forestry Building is the unique structure of all expositions. It is a gigantic log house, exemplifying in its composition the forest wealth of Oregon and Washington. In its construction 2 miles of 5-ft. and 6-ft. fir logs, 8 miles of poles and tons of shakes and cedar shingles were used. The logs have been left in the rough with the bark on. The base logs of the building are 6 ft. in diameter and 52 ft. long. The logs above the base are 3 ft. through and vary in length. Colonnades of immense fir trees 30 ft. high and 6 ft. in diameter support splendid loggias or galleries over the main entrances. The portico over one entrance is supported by giant spruce trees, and the other shows a colonnade of magnificent hem-

locks. The upper part of the building is supported by cedar bark shingles laid 18 ins. to the weather. An overhanging roof adds much to the attractiveness of the structure.

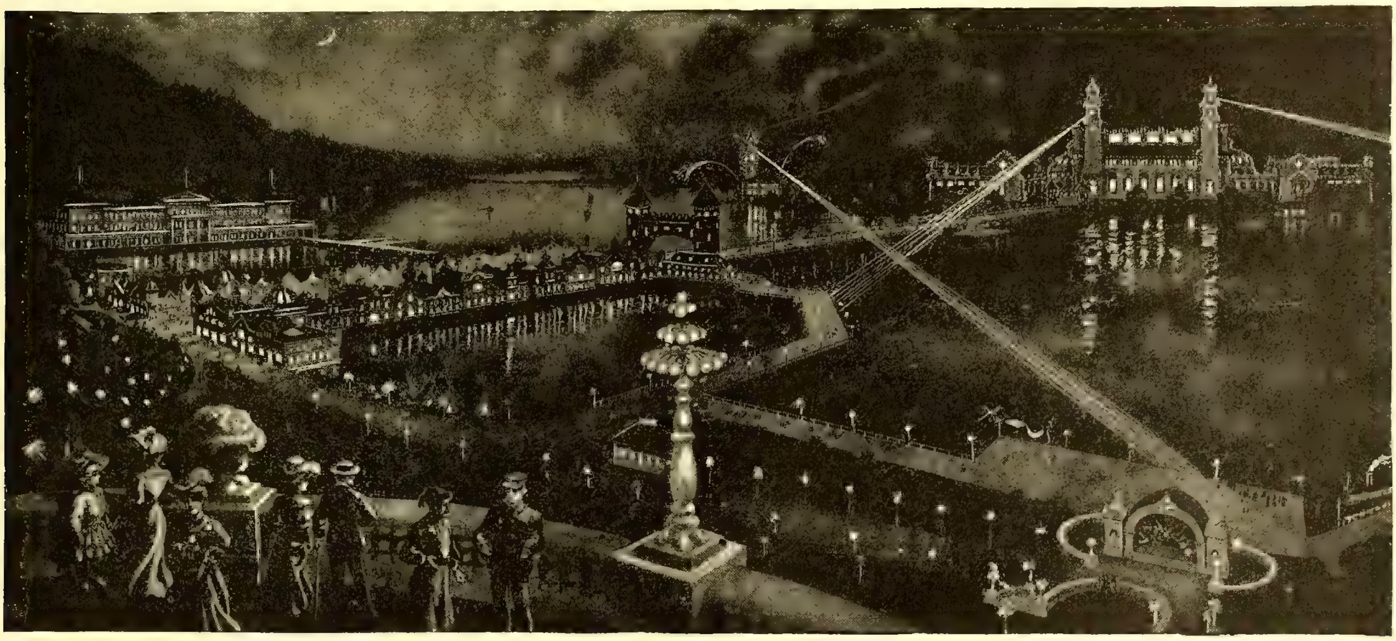
In the construction of this building no carpentry work was employed, the logs being framed together with tree-nails and old-fashioned wooden pins. The trees used were cut in the forests bordering on the Columbia River. They were formed into rafts and floated down the Columbia and Willamette Rivers into the lake. From the lake they were raised to the site of the building in Centennial Park by means of a skidway 1500 ft. long. The distance traveled by the logs in the water was 75 miles.

The grounds, buildings and parks are lighted by incandescent lamps, 7000 of them being required for the park alone. All the buildings are outlined with frosted 8-cp lamps, and the roadways and bridge have post electroliers, which are shown in the view of the Government Building. The design and installation of the lighting equipment has been under the direction of James R. Thompson, current being furnished by the Portland General Electric Company, whose president, Henry W. Goode, is also president and director-general of the Exposition.

Following are descriptions of the principal railway exhibits:

THE EXHIBITS

The General Electric Company has an exhibit covering 6000 sq. ft. in the Machinery, Electricity and Transportation Building, already described, and occupies the largest space consigned to any exhibitor on the grounds. In the center of the exhibit is a colonial office and reception booth, comfortably and tastefully furnished and carpeted, while radiating from it are several aisles passing through different sections of the exhibits, and leading to the exits and entrances. Near one of the many entrances is a 60,000-volt oil switch in operation, and also a four-motor equipment of the GE 67-hp motors mounted on Brill trucks, with K-10 controllers. This equipment, by the way, is identical with that supplied to the Washington Water Power Company, of Seattle, Wash. The power machinery comprises new types of single and three-phase a. c. motors; the "CR and CQ" types of direct-current motors, as well as a Curtis direct-current turbo-generator set. The latter has aroused a great deal of interest among the visitors. The new power house of the Portland General Electric Company has lately installed two 1500-kw three-phase Curtis turbo generators, which supply all the current used for illuminating and operating the machinery of the Exposition. The display of street railway appliances is very thorough in every detail, comprising all classes of line and track specialties, as well as high-capacity railway switchboard equipments. In the southern portion of the exhibit, and near one of the side entrances, is an 8-ton electric mining locomotive with special cable reel, operated by either reel or trolley on a 30-ft. track. Exhibits of wire, cable sockets, fuses, lightning arresters and porcelain specialties occupy another section, and nearby is a complete line of indicating and recording instruments, mounted on display boards, where the operating parts may be readily inspected. A 30-amp. mercury arc rectifier changing 220-volt, 60-cycle alternating current into 110 volts direct current is seen in operation near the reception booth, and a complete display of the incandescent lamps manufactured at the company's works in Harrison, N. J., is situated in an adjoining section. In the department of motor applications the General Electric Company, in conjunction with a number of manufacturers, has a very instructive and interesting display. The exhibit which would more particularly attract the casual sight-seer in this section is probably that of a generator direct connected to a 30-in. Pelton water wheel. A three-phase induction motor is shown direct connected to a Platt Iron Works triplex pump; an electric hoist manufactured by the Willamette Steel & Iron Company, Portland; a Price centrifugal pump, direct connected to an induction motor, as well as many other motor applications.



GENERAL VIEW OF EXPOSITION GROUNDS AT NIGHT

The Westinghouse Electric & Manufacturing Company has 1500 sq. ft. of space. The section devoted to the display of power machinery is particularly attractive, a very prominent feature being a Westinghouse-Parsons steam turbine direct connected to a 400-kw generator, set up immediately adjoining the main entrance to their exhibit, and so arranged as to show the interior mechanism of the turbine. Several types of smaller generators, and a small Ohmen high-duty steam engine, direct connected to a 2-kw type "S" Westinghouse generator, are situated in the western section of the display space and facing one of the main aisles of the building, while the interior is occupied by more power machinery, comprising, among others, a motor-generator set, type "TR" motor, revolving field a. c. generator, 100-hp induction motor, type "HF." In the extreme southern portion the Sanitary Devices Manufacturing Company displays, in conjunction with this exhibit, a complete one-sweeper outfit, driven by a type "S" motor. Near by is a hoist having for motive power a type "F" induction motor

with controller and requisite appliances. The rear section contains some distinctive types of the Westinghouse transformers, a special feature in this connection being a 110-kw air-blast machine. Immediately adjoining on the floor and suspended against the wall are type "OD" transformers, ranging in capacity from ¼ kw to 25 kw. Standard switchboard instruments mounted on display boards, and comprising voltmeters, wattmeters, ammeters, power factor indicators, etc., so arranged to exhibit their mechanical operations, are also seen in this vicinity. Among the railway appliances exhibited are a 50-hp motor, showing the interior construction of the same; a No. 107 a. c. single-phase street railway motor of 75 hp capacity, having the commutator thrown back; and the unit-switch system of multiple control, placed on a stand with the cover taken off to show the operating details. The portable instruments manufactured by the company are displayed in a show case opposite the main entrance to the exhibit, and directly in the rear are the following: a type "C" 3-pole 33,000-volt electrically-operated circuit breaker; a type "B" circuit breaker for 2300 volts; lightning arrester and choke coil; a static interrupter; and a type "D" double-throw oil switch with fuses arranged on display boards. The display space is surrounded on three sides by Westinghouse enclosed arc lamps, hung on artistically designed iron goose-necks, and in this connection it may be mentioned that the Machinery, Electricity and Transportation Building is illuminated by Westinghouse lamps of similar pattern.


THE MINES AND METALLURGY BUILDING

Facing one of the main aisles of the exhibit building the Baldwin Locomotive Works have installed two steam locomotives, each typifying a standard example of its class. One is a Southern Pacific consolidated type Harriman standard locomotive, 208,000 lbs. weight, with 32-in. x 30-in. cylinders and 57-in. drivers, using an oil burner. The other is a logging engine. Across the aisle opposite, and facing the steam locomotives, is a Baldwin-Westinghouse 70-hp electric locomotive, weighing 20,000 lbs., designed for industrial plants and contractors' use, and fitted with 250 volts, direct-current Westinghouse motors. In another section of the exhibition is displayed the company's interurban railway truck, identical with those at present used by the Twin City Rapid Transit Company, of Minnesota. The truck is made entirely of wrought iron and steel. The company manufactures several sizes of railway trucks, ranging from 5300 lbs. weight, suitable for street railway service, to 12,500 lbs. for interurban service.

Adjoining the Baldwin Locomotive Works, the Standard Steel Works, of Philadelphia, Pa., exhibit steel springs of various kinds, as well as wheels and tires, showing several rolled steel wheels, suitable for steam or street railway service, made from a steel ingot hammered and rolled into shape.

The Western Electric Company, of Chicago, occupies a space of some 2400 sq. ft., every available portion of which is utilized by exhibits typifying the various products of the company. Situated in the center of the exhibit is a 500-kw, single-phase, revolving-field, engine-type Western electric generator, while on a pyramidal form adjoining are shown the different types of motors manufactured by the company, and ranging in size from a 1-12 hp to a 50 hp. Opposite the motors is a section devoted to the display of arc lamps from ⅜-in. carbon to the series alternating lamps in operation, suspended from iron trees, and capable of being lowered for closer examination when desired. This section includes, among others, five series-multiple, 500-volt lamps; 220-volt, 2-in. series-multiple lamps, and 110-volt multiple alternating and direct-current lamps. Encircling the entire display space of the Western Electric Company and hung about 8 ft. or 9 ft. from the floor, are fifty alternating enclosed arc lamps, with transformers and regulators, making an exceptionally fine showing. In another section near by, arranged on display board and stands, are the various supplies handled by the company, among which may be mentioned Bryant & Perkins' goods, Thomas high-potential porcelain insulators, Electrose overhead railway material, D. & W. enclosed fuses as well as ventilator exhaust, desk and ceiling fans, several of which are in operation. A Rateau steam turbine direct connected to a 15-kw Western Electric 220-volt, direct-connected generator, is soon to be added to the display, and will, no doubt, prove a valuable adjunct to this already interesting and instructive exhibition.

The exhibit of the Fairbanks-Morse Company, of New York City, N. Y., has already been described in this paper. It is devoted almost entirely to the various electric sign clusters and lights for their display. Near this unit are gas, gasoline, kerosene and crude oil engines, which this company manufacture. Its display in their railway department is especially thorough, comprising gasoline motor cars, push cars, railroad jacks and general track tools and a 100-ton railroad scale with printing beam. The company is also exhibiting a full line of scales, comprising everything from a grocery to the above-mentioned 100-ton railroad scale.

A scheme has just been adopted for the transformation of a steam railway line into an electric railway by the public authorities of Tunis. The line is a single road, which starts from Tunis and leads to summer resorts on the seashore. The length is, roughly, 18 km. It belonged originally to an English company and later to Italians. Finally it was bought for 8,000,000 francs by the Compagnie de Bona-Guelma (French), which holds all the railways in this country. Negotiations are pending between the 13me Guelma, the local tram company (Cie. Francaise des Tramways de Tunis), and the Director of Public Works. The line would be bought at the original price, it is said, by the tram company. One drawback is the tariff of fares, which is higher than usual rates. A similar scheme is on hand to cover the opposite side of the lake of Tunis. The idea is to build a tram line (electric) 16 km in length to join localities situated on the seaboard. The concession will probably be awarded to the Compagnie Francaise des Tramways de Tunis.

SOME EXPERIENCES WITH DRAW-BARS FOR ELECTRIC CARS

BY W. T. VAN DORN

The question of draft rigging and couplers for electric railway cars has been given but little attention by operating electric railway men generally. Probably this is because comparatively few of them have of recent years needed anything worthy the name of car coupler, as the decreasing use of trailers for several years made it unnecessary to couple cars together except in rare emergency cases. A large part of the most valuable experience with automatic couplers suited to electric roads has been gained on the elevated railroads of this country, where it has been necessary to operate cars in trains and where the best obtainable automatic coupler is necessary. Recent developments, however, have revived interest in couplers for surface roads, as they have shown a tendency to get back to the use of trail cars during the rush hours of the day on city railway systems and the use of cars connected together in multiple-unit trains for carrying extra heavy traffic on interurban roads. Some of the writer's experiences on coupler matters may therefore be of interest and value at this time.

I have frequently made the statement that for the operation of multiple-unit trains a very much heavier draw-bar is required than would be necessary if trains of the same weight were to be pulled by a locomotive at the head of the train. As this assertion seems rather peculiar at first thought and has been questioned many times by those to whom I have made it, a statement of a few observed facts may be in order. This question first came up when the engineers of the Boston Elevated Railway Company discussed with me the question of automatic couplers for the elevated lines of that company. At that time the Metropolitan Elevated in Chicago, which was equipped with Van Dorn couplers, was operating five-car trains with a motor car at the head of the train, the couplers having stems 1⅞-in. x 2⅜-in. solid iron. The engineers of the Boston Elevated, in placing the order for couplers, maintained that there would not be any use for as heavy draw-bars on the Boston Elevated lines as had been formerly built for this class of service, because the multiple-unit system was to be used in Boston with motors under every car, whereas on the Metropolitan Elevated in Chicago the single-motor car system was employed. The theory, of course, was that on a multiple-unit train there would be almost no strain upon the draw-bars, as each car had its own motive power, and all that the draw-bars would have to do would be to equalize any slight differences between the motors or between the brake adjustments of the various cars. I felt, nevertheless, that it was best to be on the safe side, and furnished couplers for the Boston Elevated roads with stems 2-in. x 2½-in. solid rolled steel. After these couplers had been in use eighteen months in Boston, 171 stems were either broken or kinked. I was called to Boston to look over the situation and see what could be done. After running special trains through the subway and over the balance of the road to learn what had caused all this trouble, we found that when the trains went over certain grades or rounded short curves there was considerable strain on the draft rigging; in fact, so much that it would occasionally give way. There was evidently something wrong in the theory as to what multiple-unit draw-bars had to do, as here we had draw-bars of considerably greater strength than those in service on the Metropolitan in Chicago, and still they were evidently not strong enough. I recommended the trial of a coupler of considerably greater strength, with draw-bars having 3-in. x 3-in. stems instead of the 2-in. x 2½-in. stems, with which the road was equipped. A few trains were equipped for test to see what effect this increased strength would have. The results can best be judged by the fact that after thirty days' test the heavier stems were ordered for fifty more cars, and a short time afterward all the cars in service were so equipped. These have been running now some two years, and nothing has gone wrong from that day to this. A somewhat similar experience was had in the equipment of the first trial train for the New York Subway. This had couplers with 2-in. x 2½-in. stems, which were later changed to 3-in. x 3-in. In Brooklyn all the motor cars were equipped with a heavy stem, 3-in. x 3-in.; the trailers with a heavy section of T-rail. As the result of this experience, I believe in nothing lighter than a draw-bar with 3-in. x 3-in. stem for use on multiple-unit elevated trains of six cars. The Metropolitan Elevated in Chicago, in changing from the motor car to the multiple-unit system, has adopted heavier draw-bars with heavy stems. I do not think anyone connected with that road can be found who would favor a retention of the lighter draw-bars which were used with the motor-car system. These are the facts found by experience, account for them how we will.

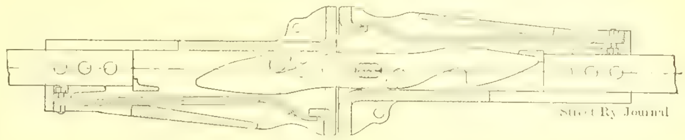


FIG. 1.—1902 COUPLER, AFTER COUPLING

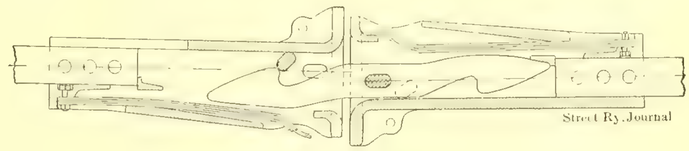


FIG. 2.—1902 COUPLER IN PROCESS OF COUPLING

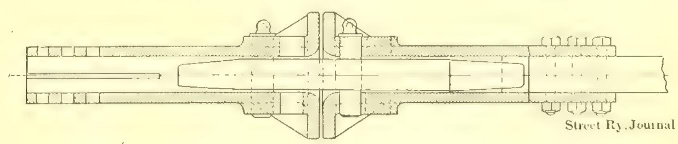


FIG. 3.—VERTICAL SECTION THROUGH 1902 COUPLER

While a multiple-unit train may start, stop and run and seem to have comparatively little draw-bar pull for days at a time, all at once something may happen to give the draft rigging a severe strain. Something may for an instant prevent good contact between the third rail and the contact shoes on one or more cars near the head of the train. The brakes may temporarily stick on the first cars, the head of the train may be in a curve or on a grade, or any one of a number of little things may happen which will cause the motor cars on the rear to push temporarily those further ahead in the train. It is well known that the first rush of current into motors as a train is started is usually sufficient to start every motor car in the train with something almost approaching a jerk, and if there is anything in front of those motor cars in the way of an obstruction to be moved, there is considerable shock. Consider in connection with this another still more important point. On a train with a motor car at the head and with all cars equally braked, the principal strain on the draft rigging is in pushing rather than pulling, except, of course, at the instant cars are being coupled. In the multiple-unit train, the strain on the draw-bars is likely to be a pushing strain. Now, if it were possible to equip electric roads with fixed draw-bars like those on steam railroads, providing for but little sideway movement, this pushing strain would not be troublesome. Electric cars, however, have usually to be built to go around short radius curves, and this calls for a swivel draw-bar. With both draw-

bars swiveling, it is only the rigidity of the coupling device proper which prevents the whole draft-rigging apparatus from buckling and ultimately bending or breaking one way or the other. By providing a coupler with a minimum of lost motion at the point of coupling, the tendency to such buckling and bending is very much reduced. Nevertheless, with any form of commercial coupler that can be devised there must be some lost motion, however slight. It is therefore the push and not the pull that needs most consideration.

This brings us to the importance of a design of coupler which shall have the smallest possible amount of play or lost motion between the coupler heads when the coupling is made. In steam railroad practice the principal object in doing away with lost motion is to obviate jerk or shock. In electric railway practice we must go still further, because, with draw-bars which swivel, the amount that these draw-bars can be pushed one way or the other from a straight line depends on the amount of lost motion between them. When one car is pushing another, then the lost motion determines the liability of that draw-bar to injury and governs the amount of material that must be put into a draw-bar in order to make it withstand sudden pushing stresses. It is evident that no draw-bar can be a success in electric railway work where swiveling draft rigging is necessary that does not insure a very small amount of play or lost motion after the coupling is made. Much of the success of the Van Dorn coupler is due to a recognition of this fact. It is a rule in the manufacture of these couplers to let nothing leave the factory with more than 1-16 in. lost motion after the coupling is made, and frequently this lost motion is not over 1-32 in. It is hardly necessary to say that as accurate work as this cannot be obtained from tough castings, but accurately forged links, and the faces of the couplers machined off.

The real action of the present form of Van Dorn automatic coupler is probably but little understood even by its users. Figs. 1, 2 and 3 have been prepared showing sections through the 1902 form of coupler. Fig. 1 shows the position of the link and coupler heads after a coupling has been completed.

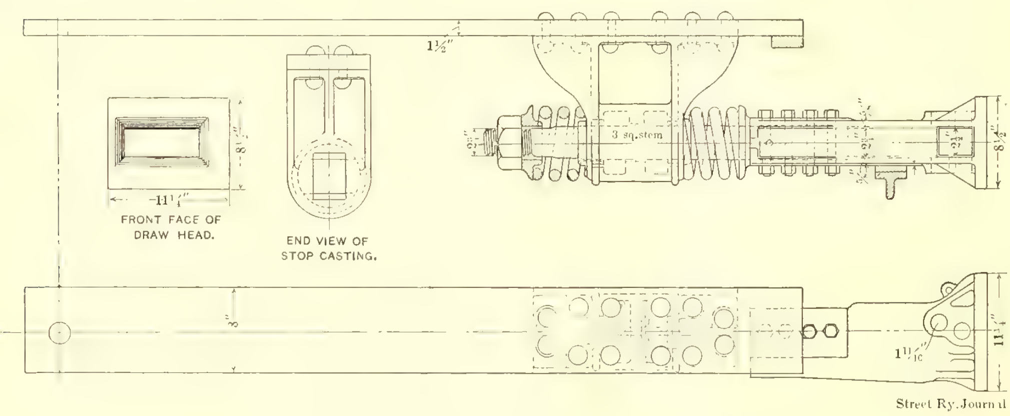


FIG. 4.—ROUND PIN DRAW-BAR

In Fig. 2 the couplers are shown in the process of coupling. Fig. 3 is a vertical section through the same coupler, Figs. 1 and 2 being horizontal sections. The first thing to notice is that in Figs. 1 and 2 the link has been inserted in the right-hand coupler and fixed by the center pin which has been dropped through the link. The point of the link that is inserted into the head is held in position by the abutment block, as shown, and the part of the link that projects out is in position for automatic coupling with the opposite head. When the cars come together the point of the link will strike the pin that is against the side wall. The link is deflected past the pin and comes in contact with springs in the side of the draw-head, which are forced out until the point of the hook passes the pin. It is readily seen from Fig. 2 that with a link having an elongated point sufficient in length so that when the strain sideways is brought to bear, the point of the link on the spring is close to where the springs fulcrum in the side wall of the draw-bar; the link under no conditions can be twisted out in train service, no matter what the strain may be.

The design of a link to prevent the uncoupling of cars under all conditions has been a matter of much thought. Previous to 1902, a form of link was used with shorter points, and when they became badly worn they could be accidentally disengaged on the shove, although they served their purpose admirably in the work which draw-bars were called upon to perform at that time. The 1902 pattern was designed to prevent any possibility of trouble with the unusual strains of the multiple-unit system.

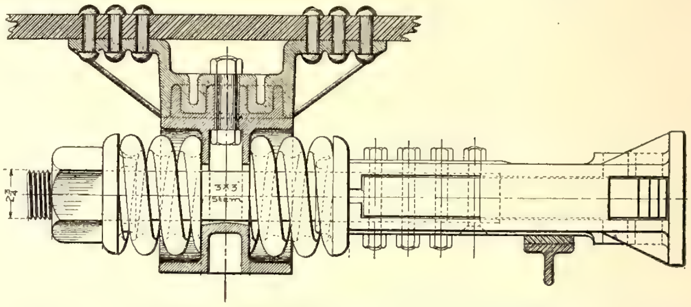


FIG. 5.—DRAW-BAR FOR STEEL MOTOR CARS WHERE THE BAR HAD TO MAKE A SHORT SWIVEL AND WHERE NO OTHER STYLE COULD BE APPLIED

All Van Dorn draw-bars are now made of the pattern shown.

The tight coupling with little lost motion, before mentioned as such an important matter, is made possible by the present design of coupler, which is such that the essential dimensions—that is, the location of the holes with reference to the coupler faces and the dimensions of the links, can be made a matter of accurate machine work.

A coupler having once been made accurately, it is next in order to inquire what are the chances that, after the wear of years, it will remain reasonably accurate. The wearing points are evidently the coupler faces, the pin holes and the hooks on the link. In the first place each coupling head had two pin holes, and that insures double the wear. Each link is automatic at each end. Place the bar in either head and the pin through the center aperture and couple automatically to the opposite head (the wear on pins is only on the pull and not on the shove), and the wear is only on the two pin holes that are in operation at this time. Place the bar in the opposite head and it is vice versa; and that assures double the life of both coupling heads and coupling bar. The coupling bar is made out of the best quality of steel forgings, and after years of wear can be readily upset to a standard length. One of the greatest features of the Van Dorn couplings is their great durability and the possibility of making them as good as new with a very slight cost, and of their maintaining a tight lock over a long period of years.

Besides performing an important function in the simple act of coupling cars together, the spring in the coupler head has to perform another part with which it is probably not generally credited. It requires about 1 ton pressure to couple two large draw-bars. This helps to cushion the shock at the instant of coupling.

The company with which the writer is connected has lately brought out a very heavy type of coupler, and in this heavy type has embodied some new features, including large round

pins. This assures great durability as well as strength, and longer life of pins and links. The round pin draw-bar, No. 19, illustrated in Fig. 4, is of this design. It is sufficiently heavy for such use as would be given in any steam railroad service or on an electrically-equipped steam road.

It takes more than a pair of coupler heads and a coupling device to successfully operate cars and trains. The draft rigging under the car is no less important. In this connection it may be interesting to look at some of the common forms of draft rigging used on elevated and interurban roads. Fig. 4 shows a general form of draft rigging which is quite commonly used. The stem of the draw-bar goes through a stop casting, on either side of which are the buffing springs. The stop casting is riveted to a solid steel plate 8 ins. wide and 1½ ins. thick. This plate runs back to the king bolt of the truck on which it swivels, or to any other swivel that may be provided. A modification of this plan is shown in Fig. 5, where nothing but a short swivel can be used because of the arrangement of car and platform sills. Fig. 6 is another way of securing a long swivel, and can be used where plenty of room is available.

In conclusion, it can be said that the production of a successful automatic coupler for electric roads is much more difficult than the production of an automatic coupler for steam roads, because of the necessary introduction of the swiveling feature on any electric railway draw-bar and the frequent pushing strains with the multiple-unit system. At the same time good automatic couplers are even more necessary on electric than on steam roads, because of the dangers in coupling on electric railways with makeshift types of non-automatic draw-bars, as the radius bar in such times is liable to shift in position or buckle out, and this makes it more dangerous than it was formerly on steam roads with a hand couple.

Many people have been under the impression that the M. C. B. type could be used to work on a radial bar. I have had plenty of experience with this, and have found it is absolutely impossible to make a successful draw-bar on these lines. There is trouble making a tight lock, and further, for interurban service, the cars overhang so far from the trucks that unless the tracks are free from sudden changes of grade and almost perfect, the draw-bars oscillate up and down, and one will go right over the top of the other. The coupling must be such that they are held rigidly together, so that no difference what the unevenness of the track may be, they cannot separate. If the lock is not absolutely tight, the bars will swing sideways and buckle on the push.

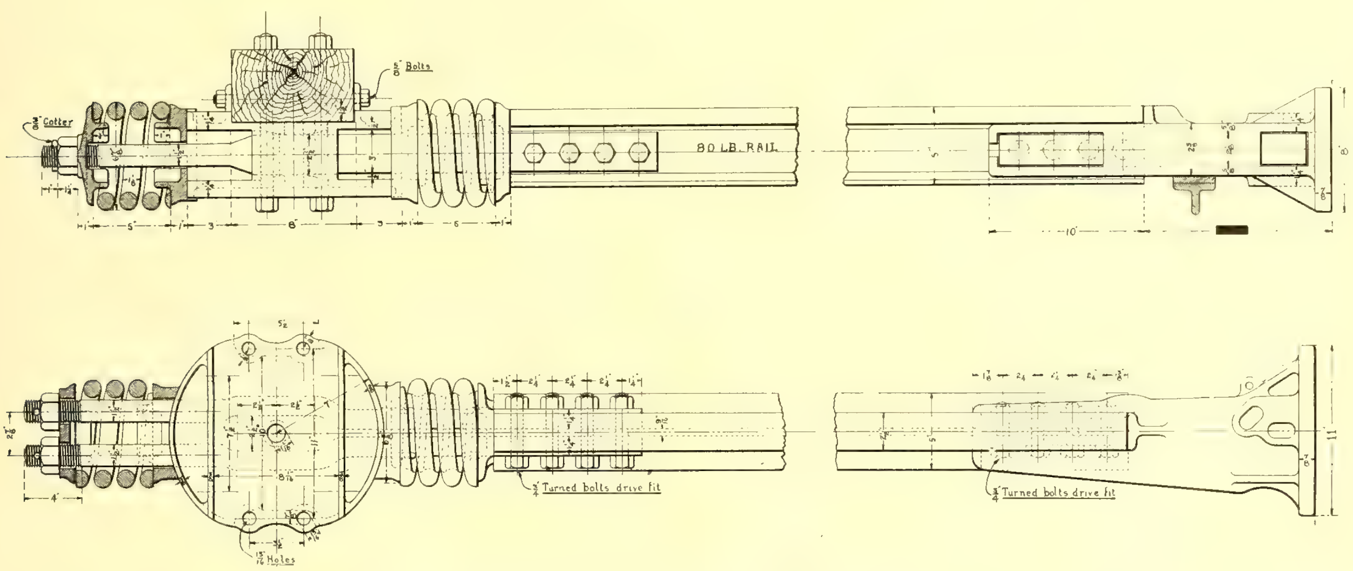


FIG. 6.—LONG SWIVEL DRAW-BAR

PROGRESS OF THE ELECTRIC RAILWAY IN GERMANY

A recent number of the "Elektrotechische Zeitschrift" contains some interesting statistics on the electric railway in Germany. The report is divided into three parts. The first part relates to those electric railways which were in operation on Oct. 1, 1904; the second, the electric railways in course of construction; third, trackless trolley system, of which there are six in Germany. The following table shows the state of electric traction in the years 1896, 1900, 1903 and 1904:

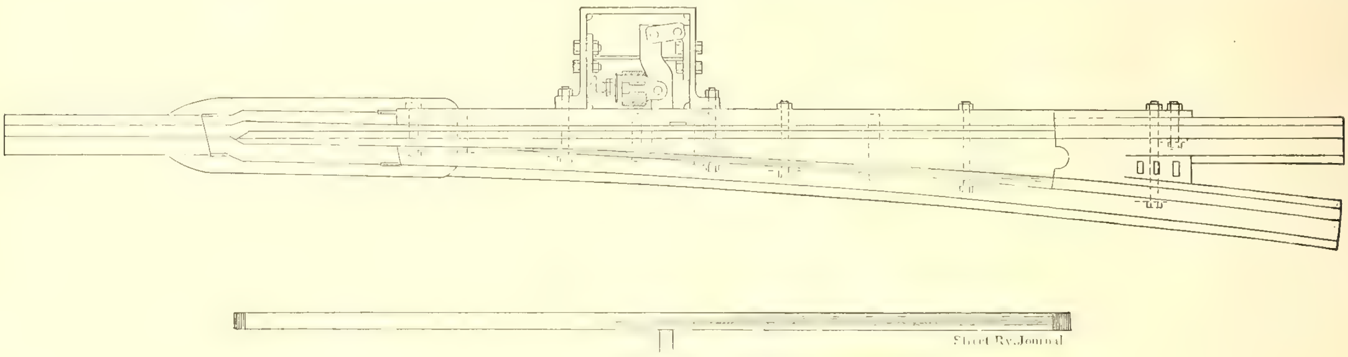
	1896	1900	1903	1904
Number of main centers of electric railway systems	42	99	134	140
Length of roads in kilometers...	582	2,868	3,692	3,791
Length of single track in kilometers	854	4,254	5,500	5,670
Number of motor cars..........	1,571	5,994	8,702	9,034
Number of trailers.............	989	3,962	6,190	6,477
Capacity of electric machines in kilowatts	18,560	75,608	133,151	133,326
Capacity of storage batteries in kilowatts	.....	16,890	38,736	39,809

A table is also given which shows the capacity of the generators per kilometer of single track and per motor car. These figures vary, of course, greatly in different cities, according to local conditions. The highest figures for track are for Gotha (maximum grade 6.7 per cent), namely, 61.1 kw per kilometer of single track and 33 kw per motor car. On the Barmen rack railway, with a maximum grade of 20 per cent, they are 40.4 kw and 28.4 kw, respectively. In Wiesloch, with a maximum grade of only 1.6 per cent, the machine capacity per motor car reaches the very high figure of 60 kw. The lowest figures are in the case of Bremerhafen and Frankfurt; here these figures are 7.8 kw and 8.6 kw per kilometer of single track and 6.6 kw and 6.0 kw per motor car. The average figures from seventy-four cities are 20.7 kw per kilometer of single track and 17.0 kw per motor car.

The various traction companies using the Indianapolis Traction & Terminal Station have moved their freight department into the new freight houses at Capitol Avenue and Ohio Street. The Indianapolis & Northwestern will occupy the east building in company with the Indianapolis, Columbus & Southern. The Indianapolis & Eastern, the Martinsville Rapid Transit Company and the Shelbyville and Rushville divisions of the Indianapolis & Cincinnati will occupy the middle building, and the west building will be occupied by the two divisions of the Indiana Union Traction Company.

ANTI-STRADDLING TONGUE SWITCH

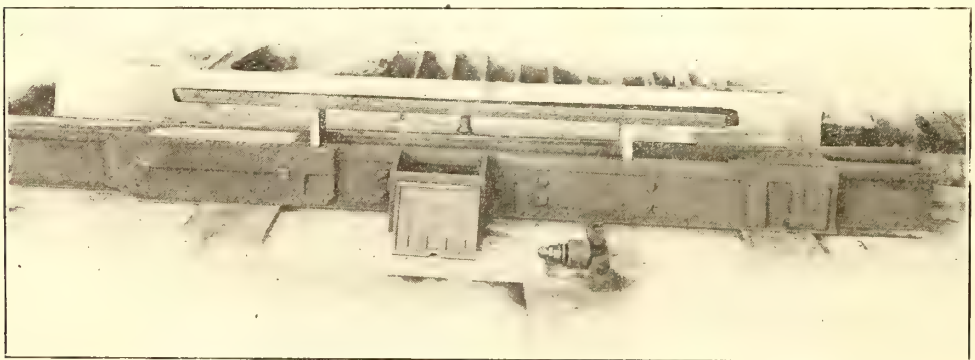
One fault with the ordinary type of tongue switch is that there is nothing positive to hold the tongue to either side of its travel. This may be a cause for accidents with a facing switch, because when a car passes into the switch the first truck leaving the tongue may shift it so that the rear truck will take the opposite track, and there is trouble. Another defect is that the heel or large end of the tongue drives down into the bed of the switch when the line of travel is running from the point. This driving or grinding down of the heel of the tongue is owing to a slight movement of the tongue every time a car passes over it. The tendency of the tongue is to go with the travel just the same as rails, and the only thing that prevents it from creeping ahead is the heel pin, which soon wears, leaving the tongue loose.



PLAN OF ANTI-STRADDLING SWITCH AND SIDE ELEVATION OF TONGUE

To overcome these defects the New York Switch & Crossing Company has perfected a self-locking device tongue switch which keeps the tongue with spring tension to either side of its travel, as well as firmly down on to its bed, so that when the wheels strike it from either direction there is not the slightest motion. By being held firmly down, the company claims there is no wear between tongue and bed, therefore no driving down at the heel. A short description of this switch was published in the STREET RAILWAY JOURNAL for Oct. 8, 1904, but a diagram of its construction is now available.

Instead of the usual heel pin, the tongue is beveled at the heel end—that is, the bottom is longer than the top, and the receptacle, or socket, which the tongue fits into has the same bevel reversed, so that when the spring tension is applied to the pin at about the center of the tongue it forces the tongue down as well as back, insuring a perfect fit at the heel, and also holds it firmly down on to its bed.



SIDE VIEW OF SWITCH WITH TONGUE SHOWN ON BLOCKS ABOVE BED

The locking device is located in a cast-iron box at one side of the switch. It consists, as shown, of a lever, one end of which is pivoted to the under side or side of the tongue, while the other end is pivoted to a short link or strut. This strut forms a short radius center, which prevents the tongue from resting except at either side of its travel. The lever is held in position by a strong spring placed about midway between pivot points of lever. When the spring is tightened it causes pressure on tongue, holding it to either side, back into its socket and down on to its bed. This tongue can be thrown with the switch iron as readily as any tongue, and it will stay where it is put.

A CURTAIN-ROLLER SPRING ADJUSTER

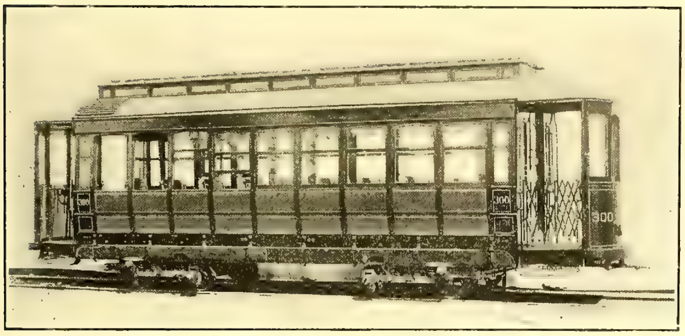
The J. G. Brill Company is manufacturing a curtain-roller spring adjuster—one of its recent inventions—which does away with all guess work in winding up springs. The gage upon it enables any workman to determine the proper amount of tension and to tighten all the springs alike in a car. Instead of the nuisance of having cars with some curtains that fly up at the slightest provocation and others that crawl down continually, companies that provide themselves with this tool are able to keep their car curtains in perfect condition for raising and lowering, save them from being pulled out or torn by the rough handling of passengers or conductors irritated by what they consider to be pure perversity on the part of the curtains, and save much time in winding. The adjuster is 6 ins. long, of simple mechanism that can never get of order, and will operate with any brace.

CURTAIN-ROLLER SPRING ADJUSTER

As an experiment, the employees in the ticket office of the Michigan Traction Company, at Kalamazoo, Mich., placed a fare register near the window for the purpose of registering every question asked. At the end of twenty-five minutes it was discovered that 156 questions had been asked, or an average of more than six a minute; a question every ten seconds and a word or two more.

CONVERTIBLE CARS FOR PHILIPPINE ISLANDS

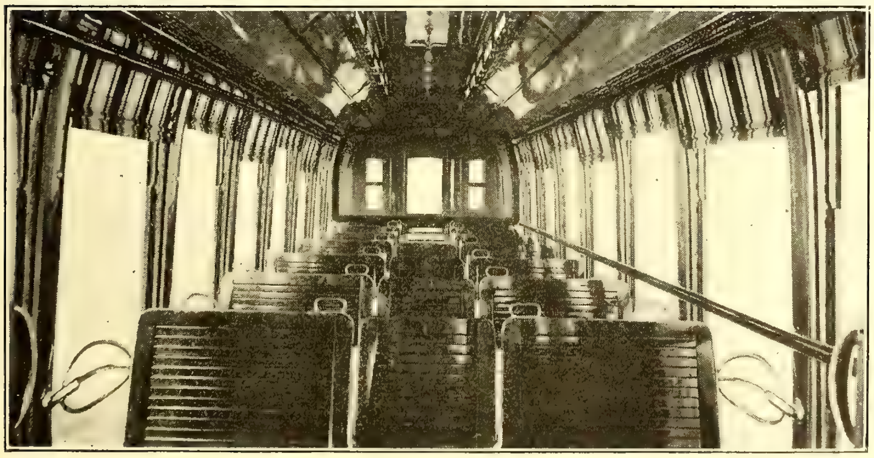
The J. G. Brill Company has recently shipped fifteen of its patented convertible cars, ordered through the engineering firm of J. G. White & Company, to the Manila Electric Railroad & Light Company for use on the lines which were opened to traffic April 10, 1905. The railway system was fully described on page 766 of the STREET RAILWAY JOURNAL of April 29, 1905.



EXTERIOR OF CAR, CLOSED

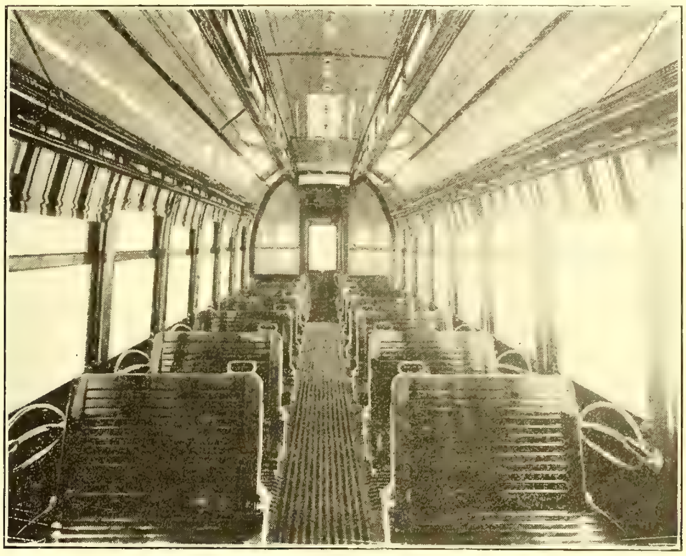
EXTERIOR OF CAR, OPEN

Both the framing and the finish of the cars are of teak, a durable East Indian timber. This wood is used because of the peculiar climatic conditions of Manila and the presence in great quantities of white ants. An interesting innovation of the cars is the arrangement whereby aisle "filler" seats are provided for use when the settled summer weather has set in, the heavy duck curtains, which may be drawn to the floor, serving as a protection against storms. Thus in summer the cars have as large a seating capacity as the standard open type, and during the other seasons the "filler" seats are stored in the car houses, and the cars may be quickly and easily converted or partly converted, and are always prepared for any sudden change of weather. The social conditions of Manila demand two compartments to a car, and in this case a partition is used, consisting, as the illustrations show, of a wooden frame of the same material as the cars, with a fine brass screen. The frame is adjusted by means of brass bolts which slip into sockets in the backs of the seats and in the curtain roller box. This partition, while serving all the purposes of a wooden partition, permits the conductor to see the entire car from any point, and also economizes space. The partition is arranged to be used in different parts of the car. The illustration shows the style of partition used when the cars are closed.



INTERIOR OF CONVERTIBLE CAR, OPEN, SHOWING EXTRA SEAT IN AISLE

The cars are mounted on the Brill "Eureka" maximum-traction trucks, which carry them practically as low as a single truck, and are easier on the rails. The seats are 31½ ins. long, with the exception of the corner seats, which extend only to the door opening, and the aisles are 16½ ins. wide. The backs of the seats are reversible. Brackets connect the backs of the seats with the posts, forming convenient handles, which encourage passengers to face in the right direction when leaving the cars. The ceilings are of aluminum. The vestibule sashes are composed of single lights and are arranged to drop into pockets. The general dimensions of the cars are as follows: Length over end panels, 25 ft. 9 ins.; over crown pieces and vestibules, 34 ft., and over bumpers, 35 ft.; from panel over crown piece, 4 ft. 1½ ins.; width over sills and panels, 6 ft. 8 ins., and over posts at belt, 7 ft. 3 ins.; sweep of posts, 3½ ins.; side sills, Z-bar, 8 ins. x 3 ins. x ½ in.; end sills, 4¾ ins. x 7 ins.; thickness of corner posts, 3¾ ins., and of side posts, 3⅜ ins.; height from track to running board, 18½ ins., and from running board to car floor, 16 ins.; height from track to top of roof, not including trolley board, 11 ft. 5¼ ins. The "Eureka" maximum-traction trucks have a 4-ft. wheel base and 33-in. and 20-in. wheels. Among the Brill patented specialties are angle-iron bumpers, "Dedenda" gongs, "Retriever" signal bells, "Dumpit" sand boxes and folding gates.



INTERIOR OF CONVERTIBLE CAR, CLOSED

The third annual picnic of the Schenectady Railway Benefit Association was held at Forest Park, on the line of the company, on Aug. 8. There was a varied programme of athletic and aquatic events in the afternoon, for which the cash prizes for winners and those who showed totaled $75. At 9 p. m. there was a display of fireworks. A special feature of the day was a prize waltz, the winner of which was to receive a cash prize of $10.

OPEN CARS FOR MEXICO

A number of open cars of the type illustrated have lately been delivered to the F. C. Urbano y Agricola de Oaxaca, Mexico, by the American Car Company. The cars will be operated in Oaxaca, a city of some pretensions in the southern part of Mexico. The railway company operates fifty cars on its 18 miles of track in and about the city. The American Car Company has supplied a large number of horse cars to Latin America, the car illustrated being a representative type.

The new cars have a seating capacity of forty, the seats having reversible backs. Curtains are provided which may be drawn to the floor, the Brill patented round-corner seat-end panels which are used being so arranged in connection with

OPEN CAR FOR OAXACA, MEXICO

the grooves in the posts as to permit the curtains to come down over the post outside of the panels, a continuation of the grooves of the posts being formed in the exterior surface of the panel. The panel also provides for an easy entrance, as there are no sharp projecting corners, and increases the safety of passengers compelled to stand on the running board. The interiors are finished in cherry and ash, with ceilings of carline finish. Brill gear trucks with a 7-ft. wheel base and 30-in. wheels are used. "Dedenda" gongs, ratchet brake handles and "Retriever" bells of the same manufacture are also included.

The cars measure 17 ft. 3 ins. over the end panels and 22 ft. 11 ins. over crown pieces; from panel over crown, 2 ft. 10 ins.; width over sill facing, 5 ft. 10 ins., and over posts at belt, 6 ft. 6 ins.; center of posts, 2 ft. 5 3-14 ins.; side sill size, 3½ ins. x 5 ins.; thickness of corner and side posts, 2¾ ins.; height of steps, 17 ins., and of risers, 13½ ins.

PASSENGER STATION FOR ROCHESTER

Plans are being considered for the construction of a central terminal station for the use of the interurban lines entering Rochester. The station will be built by the Rochester Railway, which has given considerable thought to the project, and over whose lines the interurban roads enter the city. Plans are still in embryo. On the return of President C. M. Clark, of the company, from Europe the project will be formally taken up, however, and the plans finally perfected. According to R. E. Danforth, general manager of the company, several sites are under consideration that offer special advantages for the kind of station it is proposed to build. Within the next two years, it is figured, more than ten interurban lines will run into the city, and all, or nearly all, of them will use the union passenger station. The lines that now enter Rochester, or which will do so within a short time, are the Rochester & Sodus Bay division, the Charlotte division, the Summerville division, the Rochester & Suburban, or Sea Breeze division, of the Rochester Railway, the Rochester & Eastern Rapid, the Rochester & Interurban, the Lockport, Albion & Rochester line, the Rochester & Southern, and the Rochester, Syracuse & Eastern.

ANNOUNCEMENT OF THE PHILADELPHIA CONVENTION

The official announcement of the Philadelphia convention has been issued by the secretary of the American Street Railway Association, giving the details decided upon. As already stated, the meetings will be held in the South Building, Philadelphia Museum, Thirty-Fourth Street, Philadelphia, Sept. 25-30, 1905. The Mechanical and Electrical Association and the Claim Agents' Association will meet Monday and Tuesday, the 25th and 26th; American Street Railway Association, Wednesday and Thursday, the 27th and 28th; Accountants' Association, Thursday, Friday and Saturday, the 28th, 29th and 30th.

The report of the reorganization committee will be presented and acted upon, a new constitution and by-laws have been prepared, and it is the desire of the executive committee that as many of the members as possible be present to consider them. Papers will be presented on gas and other engines, organization and single-phase system for street railways. The allied association, the Manufacturers' Association, will have the largest and best exhibition of appliances ever shown at any convention. As this will be the first exhibition held under its auspices, it is expected to be a great success. The hall has over 60,000 sq. ft. of space. The passenger associations have granted the various associations rates of fare and one-third on the certificate plan. Delegates should be sure and get certificates from the ticket agent when they purchase their tickets, and leave them with the clerk when they register. Return tickets will then be ready before the meeting is over.

The headquarters will be at the Bellevue-Stratford Hotel, the rates of which are as follows—European plan: Single rooms, without bath, $2.50 per day and up; single rooms, with bath, $3 per day and up; if two persons occupy a single room, the rate will be $1 more; double rooms, without bath, two persons, $3.50 per day and up; double rooms, with bath, two persons, $4.50 per day and up. Rooms should be reserved well in advance.

To reach the convention hall take Walnut Street cars to Thirty-Fourth Street. Stages will be in waiting to convey delegates to the hall without charge. A light lunch will be served at the hall at moderate cost, so all may stay there until the meetings are over. The annual banquet will be held Thursday evening at the Bellevue-Stratford Hotel. Tickets will be sold to all at cost.

McCLINTOCK BLOCK-SIGNAL SYSTEM ON INDIANA NORTHERN

The Indiana Northern Traction Company's line, which extends from Marion to Wabash, has been equipped for about 2½ miles of its length with a block signal which is the invention of Edward McClintock, and is manufactured by the McClintock Manufacturing Company, of St. Paul, Minn. The system requires two light rails laid between the regular track rails and insulated from the ground for signaling purposes. These light rails, together with the track rails, comprise track circuits. A small truck rides on and makes contact with the light signal rails. The signal rails are divided into sections or blocks, insulated from each other. The signals are located on the car instead of along the road. Communication by telephone or telegraph can also be carried on between moving cars or between cars and a station. Motor generators on the cars furnish current for operating the signals. A system of relays is provided, which in connection with the signal rail circuits indicates the presence of any train within the same block and its direction. The cost of equipment of a road with this system is stated to be $1,000 to $1,500 per mile.

The New York Central Railroad has placed an order with the American Car & Foundry Company for 175 cars to be used on its lines out of New York.

FINANCIAL INTELLIGENCE

Wall Street, Aug. 9, 1905.

The Money Market

There was no material change in the money market this week. The tone was easy throughout, and rates for all maturities ruled practically the same as those prevailing at the close a week ago. Money on call was again under pressure, bankers generally being inclined to employ their money in this department rather than to tie up their funds for fixed periods. Rates ranged from 1½ to 2 per cent, with most of the transactions reported at the high figure. The time money market was more active, a better demand being reported from stock commission houses and from mercantile sources. Sixty and ninety-day contracts were made at 2¾ and 3 per cent, respectively, and four months' funds were obtainable in quantity at 3½ per cent. The demand was chiefly for five months or longer, which would carry the borrower well into the new year. Some loans for six months were reported at 3¾ per cent, but it is understood that these transactions were of a special nature. January money was in excellent demand at 3¾ per cent, but the banks and other lenders were not inclined to make the slightest concession in rates. The general market quotation was 4 per cent, and practically all the transactions were made upon this basis. Commercial paper was more active at slightly higher rates. Specialists reported a moderate increase in the offerings of good names, and the absorption was fair, the largest buyers being the nearby out-of-town institutions. Local banks were practically out of the market and were not inclined to deal with other than their own customers. Rates were quoted at 4 per cent for prime double names, and 4 to 4¼ per cent for choice single names. Sterling exchange ruled weak at 4.8640 for prime demand bills. The feature of the bank statement published last Saturday was an increase in loans of $1,316,300 to $1,146,163,700, making a new high record for the loan item. There was a decrease in cash of $3,797,100, while the surplus reserve decreased $3,142,450. The European markets were practically unchanged. The discount rate at London was quoted at 1 13-16, and at Paris and Berlin the rates were unchanged at 1 5-16 and 2⅛ per cent, respectively.

At the close indications pointed to a firmer market in the near future. The movement of currency to the South has begun, and it is expected that the usual autumn outflow to the West for crop-moving purposes will begin within the next week or ten days. In addition, the bank reserves are now considerably smaller than in the corresponding period of previous years. The bank statement of last week showed the surplus reserve to be $12,163,525. This compares with a reserve of $56,308,850 in the corresponding week of 1904, $21,587,075 in 1903, $13,738,125 in 1902, $23,165,350 in 1901 and $29,144,875 in 1900.

The Stock Market

There was a decided improvement in the stock market this week. Trading, although largely professional, was upon a much larger scale, and apart from temporary reactions caused by sales to realize profits, the general tone of the market was decidedly strong. London was not a factor at any time during the week, and while commission house business continued light, there was evidence at the close of a growing interest in the speculation on the part of the outside public. The influences of the week were the continued ease in the monetary situation, the activity in the iron and steel industry, the strong position of copper metal, favorable reports of railway earnings for the month of July and for the fiscal year, and the encouraging reports concerning the growing crops. In the early dealings the market displayed a reactionary tendency on selling by traders, but the declines were limited to fractions. A feature of the week was the ready absorption of all stocks offered. In the later dealings, the upward movement was resumed, but at the close of last week there was another effort to depress prices by the speculative element, the selling being based upon a further shrinkage in the bank reserves of over $3,000,000. There was no unfavorable development over Sunday, and at the beginning of the present week prices developed considerable strength, and in many instances established new high records. A noteworthy feature was the fact that all the advances in the standard issues were made upon comparatively light trading. Delaware, Lackawanna & Western made another sensational gain to 450, the highest price at which the stock has ever sold, while American Smelter and Jersey Central also established record prices. In many other instances the highest prices in the present movement were reached. Northern Pacific sold at the highest price recorded since May 9, 1901. Other conspicuously strong features were Canadian Pacific, Reading, Delaware & Hudson, Northwestern, Great Northern, Illinois Central, Erie common and preferred, Union Pacific and Baltimore & Ohio. The feature of the late trading was the heavy absorption of the Steel issues, especially the preferred stock, which sold at 105 ex the dividend. The bond market was fairly active and strong, in sympathy with the strength in the stock market. The closing was strong at the highest prices of the week.

The local traction issues were extremely quiet and failed to respond to the improvements made elsewhere in the market. The price fluctuations, however, were within a range of a point.

Philadelphia

Considerable activity developed in the local traction issues this week, and prices with few exceptions made substantial gains over those prevailing at the close of last week. Interest shifted to Philadelphia common, which was marked up sharply on unusually heavy transactions. The opening transaction was made at an advance of 1⅝ to 46½, and after reacting to 44⅞ on profit-taking sales, it rose to 47 and closed within ¼ of the highest. In all, about 23,000 shares were traded in. Numerous rumors accompanied the advance, but none of them could be verified. The preferred stock was practically neglected, only a few odd lots changing hands at 49. The usual semi-annual dividend of 2½ per cent has been declared upon the preferred stock, payable on Sept. 1. United Gas & Improvement was also conspicuously strong, the price advancing from 95⅞ to 100⅞ on the exchange of about 14,000 shares. Philadelphia Rapid Transit displayed more animation and a buying accredited to New York interests, the price advancing steadily from 27½ to 28⅞, a net advance of 1½ points. More than 7500 shares were dealt in. Philadelphia Traction was firm, practically all of the transactions taking place at 100. Union Traction displayed strength, the price fluctuating between 60½ and 61, the final transaction being made at a small fraction below the highest. Upwards of 800 shares were traded in. Other transactions included Consolidated Traction of New Jersey at 81¾, Union Passenger Railway at 237, United Traction of Pittsburg preferred at 50, American Railways at 51¾ to 52, Fairmount Park & Transportation at 16½ to 16¾, and United Railways of San Francisco preferred at 88 and 89.

Chicago

Little interest was manifest in the local traction stocks. Trading was extremely dull and prices showed practically no change. Metropolitan Elevated common was the most active issue dealt in, upwards of 300 shares changing hands at from 24 to 24⅞. An odd lot of the preferred brought 97½. Chicago & Oak Park common sold at 5½ for 100 shares, and 211 shares of the preferred stock brought 18½ and 19. A small lot of Northwestern Elevated sold at 21½. South Side held decidedly firm at 95, at which price 65 shares changed hands.

Other Traction Securities

The market for traction issues at Baltimore was fairly active and strong. Interest centered largely in the United Railway issues, all of which were fairly animated and firm. The free stock sold at 14 to 14½ for about 1000 shares, while trust certificates representing 675 shares brought 14½. The 4 per cent bonds were firm, $30,000 selling at 93¾ and 94. A like amount of the incomes brought 61 to 60½, and $10,000 trust receipts brought 59½. Virginia Electric Railway & Development 5s were active, $31,000 selling at 100. Other sales were: 100 Norfolk Railway & Light stock at 13, $3000 Augusta Railway & Electric 5s at 104½, and $1000 Baltimore Traction Consolidated 5s at 101½. The Boston market continued quiet and featureless. Boston Elevated was traded in ex the dividend at 154½ and 154. Boston & Worcester held firm at 75. The earnings of the company are said to be very large, the gross returns for the month of July being in excess of $60,000, an increase of $5000, or 9 per cent over the earnings in the corresponding period of 1904. Massachusetts Electric common was quiet and steady, with sales at 17½ to 17¼, but the preferred was weak, odd lots changing hands at from 61¾ down to 60. Boston & Suburban preferred brought 68¼, and West End common and preferred sold at 97½ and 113, respec-

tively. In the New York Curb market Interborough Rapid Transit developed considerable activity, but the dealings were accompanied by violent price fluctuations. From 216 at the opening the price ran off to 215, but later advanced on heavy purchases to 222¼. At the close heavy profit taking developed, which carried the price off 4½ points. In all, about 17,000 shares changed hands. Washington Railway preferred was a strong feature, the price advancing from 92½ to 94 and closing within ½ of the highest. About 3000 shares changed hands. The bonds sold at 89 and 88. New Orleans Railways common sold at 31½ to 30¼ for 600 shares, and about 400 of the preferred changed hands at 72½ to 72. The 4½ per cent bonds brought 89 for $10,000.

Security Quotations

The following table shows the present bid quotations for the leading traction stocks, and the active bonds, as compared with last week:

	Aug. 2	Aug. 9
American Railways	51¼	52½
Boston Elevated	154½	*153
Brooklyn Rapid Transit	68⅜	69⅝
Chicago City	185	—
Chicago Union Traction (common)	9	9¼
Chicago Union Traction (preferred)	38	35⅝
Cleveland Electric	78	78
Consolidated Traction of New Jersey	82	82
Consolidated Traction of New Jersey 5s	108½	108½
Detroit United	92½	92½
Interborough Rapid Transit	215	218
International Traction (common)	—	26½
Internation Traction (preferred) 4s	—	63
Manhattan Railway	166	166⅝
Massachusetts Electric Cos. (common)	17½	17½
Massachusetts Electric Cos. (preferred)	61	60
Metropolitan Elevated, Chicago (common)	23	24
Metropolitan Elevated, Chicago (preferred)	64	63
Metropolitan Street	127⅛	127⅝
Metropolitan Securities	81⅝	83⅜
New Orleans Railways (common), W. I.	30¼	30⅜
New Orleans Railways (preferred), W. I.	72	72¾
New Orleans Railways 4½s	89	88¾
North American	99½	100⅝
North Jersey Street Railway	25	25
Philadelphia Company (common)	45¾	46¼
Philadelphia Rapid Transit	27½	29⅛
Philadelphia Traction	100	100
Public Service Corporation 5 per cent notes	—	—
Public Service Corporation certificates	68½	68½
South Side Elevated (Chicago)	95	95
Third Avenue	127	127
Twin City, Minneapolis (common)	113½	117
Union Traction (Philadelphia)	60½	60½
West End (common)	97	97
West End (preferred)	113	a113½

a Asked. W. I., when issued. * Ex. div.

Iron and Steel

The "Iron Age" says that the most interesting fact in connection with the pig iron market is that the United States Steel Corporation may re-enter the market as a buyer for next month, if the demand for the lighter steel products develops as expected, and as indicated thus far. As an indication of the pressure for iron, it may be noted that with the blowing in during the past few days of one furnace at South Chicago and one at Joliet, the Illinois Steel Company has every stack in the Chicago district in operation. The pressure in the rail trade continues and the mills are full of work. The monthly pig iron statistics show that production in July, a month of thirty-one days, was 1,741,935 gross tons, as compared with 1,793,289 in June.

SURVEY OF THE ALTON, JACKSONVILLE & PEORIA RAILWAY

Surveyors for the Alton, Jacksonville & Peoria Railway last week began in Alton the permanent survey for the new electric interurban line from Alton to Jacksonville. The route will run through several important cities, including Jerseyville, Carrollton, White Hall and Roodhouse. The line from Alton to Jacksonville will be built first, after which that from Jacksonville to Peoria will be constructed. The engineers started at the foot of Piasa Street. The line as surveyed will run up Piasa Street to Fifth, on Fifth to Belle and on Belle to the city limits, and through North Alton to Godfrey. From Godfrey to Jerseyville the surveyors will locate an air line, and the new electric line will be shorter than either of the steam roads between Alton and Jerseyville. The road between Alton and Jacksonville as surveyed will be about 64 miles long, and will run through one of the most prosperous and populous sections of Illinois. The engineering work is under the direction of F. E. Fisher, president of the Fisher Construction Company, of Joliet, Ill. Mr. Fisher is president of the Joliet, Plainfield & Aurora Railroad, which has just been opened to the public. The locating survey will be completed in thirty or forty days. A. O. Auten, of Chicago, is president of the company; Robert Curdie, of Alton, vice-president, and A. W. Cross, president of the National Bank, of Jerseyville, treasurer.

KANSAS CITY RAILWAY & LIGHT REPORT

The financial report of the Kansas City Railway & Light Company (controlled by Armour-Blair interests) for the year ended May 31 shows gross earnings amounting to $4,449,000, as compared with $3,878,350 in the preceding year. The net was $2,213,800, as compared with $1,788,100, and the net income $728,599, compared with $540,853. From the earnings $55,000 was deducted to pay off that amount of the so-called Corrigan bonds. The income figures for the year to May 31, 1905, are as follows:

Gross earnings	$4,449,134
Operating expenses	2,235,260
Net earnings	$2,213,873
Other income	16,589
Gross income (less operation)	$2,230,462
Deductions from income	1,501,863
Net income	$728,599

The balance sheet as of May 31 is as follows:

ASSETS		
Stocks and other securities		$28,314,684
Metropolitan Street Railway advances		1,816,915
Central Electric Railway advances		11,375
Kansas City Electric advances		133,474
Accounts receivable		93,217
Cash		232,642
Treasury stock:		
Preferred	$283,200	
Common	977,920—	1,261,120
Metropolitan Street Railway stocks:		
Preferred	$2,695,000	
Common	1,886,500—	4,581,500
Total		$36,444,928

LIABILITIES	
Common stock	$12,500,000
Preferred stock	12,500,000
First lien bonds	7,325,000
Collateral notes (three years)	3,000,000
Bills and accounts payable	734,222
Dividend (paid June 1)	119,026
Surplus	266,680
Total	$36 444,928

A summary of what has been done during the year by the company, submitted by Charles N. Black, the general manager, to President Corrigan, presents briefly the present condition of the physical property. In this summary Mr. Black refers to the means pursued to insure increased power, the plans for bridges and viaducts, the additions made to the rolling stock, etc. The output of the new central power station at Second and Grand Avenues will be increased by the installation of a 5000-kw steam turbine on Dec. 1. In addition to this, the Central Avenue power house of the Lighting Company has been rearranged so as to permit the use of oil for fuel. Sub-stations have been built at Fifteenth and Walnut Streets and at Twelfth and Cleveland Streets. In addition to the forty cars of the Intramural Railway at St. Louis, which the company bought last fall, it has added six 14-bench cars to the rolling stock. The hope is expressed that an early arrangement will be made with the city for the conversion to electricity of the Twelfth Street line, the only one now operated by cable.

UNITED RAILWAYS TAKES OVER ST. LOUIS, ST. CHARLES & WESTERN

The United Railways Company took over the St. Louis, St. Charles & Western Railway, Aug. 1, when the formal transfer was made through the Mercantile Trust Company to John I. Beggs, president of the United Railways Company. The latter company has virtually had possession of the line since Festus J. Wade bought it at a trustees' sale last week, as noted in the Street Railway Journal of Aug. 5. The property was sold under a mortgage foreclosure by the old Colonial Trust Company, as trustees for holders of a $500,000 bond issue, made three years ago. The $495,000 in cash which Mr. Wade paid for the road was put up by the United Railways, it was stated. Mr. Wade had no interest in the deal except as agent. Mr. Beggs says that he will establish a through service on the St. Charles line by running the cars down-town if the company is permitted to exclude from the cars passengers for points inside the city limits. That is, fast service will be given on the interurban line to the center of St. Louis, if the public will educate itself not to use the cars for service inside the city limits. The tracks of the new line will be connected with the United Railways at Wellston, where a double loop will be built for the joint use of the Easton, Olive and St. Charles lines. A new waiting station will also be built at Wellston, and the premises turned into a pretty park. The cars will be painted the new lemon color, the standard adopted by the United Company. The regular fare on the St. Charles line will remain the same as now, but the special rates will be raised, as the company cannot afford to carry passengers for 1 cent a mile in the country. Louis Hesrich, general superintendent of the road, will continue to operate it for the present.

ANNUAL MEETING OF THE CENTRAL PENNSYLVANIA COMPANY

At the annual meeting of the stockholders of the Central Pennsylvania Traction Company, of Harrisburg, plans for betterments to the company's service were adopted, and these directors were elected for three years: Edward Bailey, Harris Cohen, S. F. Dunkle, H. A. Kelker and B. F. Meyers. At a subsequent meeting the present officers of the company were all re-elected. President Musser's report showed that the company's business has increased considerably, the total number of passengers carried during the past year having been 13,379,111, as compared with 12,606,637 the year previous. The total number of miles traveled was 2,021,976, a gain of 100,015 over the year previous. Gross receipts were $539,567, and operating expenses $273,769, leaving net earnings of $265,798. Taxes, rentals and interest on bonds footed up $201,717, leaving a surplus of $64,080. Of this amount $12,000 has been reserved for the construction of the proposed subway under the Philadelphia & Reading Railway tracks at Paxtang. The company has relaid considerable track throughout the system with 9-in. side-bearing girder rails, and is about to begin the laying of a double track on Reily Street from Second to Sixth, and a single line of track on Maclay Street from Second to Fourth. The double-tracking of the Second Street line to Maclay Street is about completed. During the coming year the company expects to reconstruct its double-track line through Front Street, Steelton, and pay its share of the cost of paving that thoroughfare, the total outlay requiring about $60,000. It is expected to complete the line between Harrisburg and Hummelstown by Nov. 15 of this year. That portion between Paxtang and Rutherford station has been in service for some time. Track construction in Hummelstown has been completed. The company has now 59.55 miles of track in operation. The committee on new power plant has decided upon the style of plant to build, and expects to fix upon a suitable location within the next week. The large new repair shops and storage houses on North Cameron Street are about completed. The company's lease on Paxtang Park has been extended for eighteen years, and 20 acres additional have been secured adjoining the park. Work on the new subway at the park will be started at the close of the present amusement season. During the coming year a stock assessment of at least $5 per share will be levied for betterment purposes. During the year there were issued $105,000 of bonds on the Linglestown & Blue Mountain Electric Railway Company to reimburse the Central Pennsylvania Company for the money expended in building the line from Progress to Linglestown. The company has also been advancing to the Harrisburg & Hummelstown Electric Railway Company the money needed for the construction of the line between these two points. This will be returned to the company either by a bond issue on the new line or a stock assessment on the Central Company to purchase all the stock of the Harrisburg & Hummelstown Company.

TO STUDY QUESTION OF MUNICIPAL OWNERSHIP

At the request of its departments of industrial economics and trade agreements, the Executive Council of the Civic Federation has appointed a commission to investigate national and municipal ownership and operation of public utilities. In a statement just issued in reference to the appointment of the commission and its aims the Executive Council of the Federation says:

"The current discussion and acute agitation of this subject indicate its hold upon the popular mind and the necessity for its analytical and comprehensive examination. Its present debate is often misleading, because of contradictory or unsatisfactory statements of fact. It is intended, therefore, that this investigation shall disclose the actual results of public ownership and operation, as far as they have been undertaken in the United States, and of their more extensive practice in foreign countries. The ascertainment of these facts will afford a solid basis upon which to found discussion and conclusions for the guidance of future policy. The scope of this inquiry will cover the relative advantages of public ownership and operation, as compared with public ownership and private operation. Each system will be examined with regard to its effect upon wages, hours and conditions of labor, collective bargaining, cost and character of service, political conditions, civil service, spoils system, and municipal corruption, financial results and taxation."

The commission will meet early in the fall and arrange its programme and methods of work. It contains the names of leading merchants, bankers, railroad presidents, lawyers and others throughout the country. The list includes among many others: Melville E. Ingalls, president of Big Four Railroad; Isaac N. Seligman, treasurer of Citizens' Union; Oscar S. Straus, Dr. Albert Shaw, editor of "The Review of Reviews;" Franklin MacVeagh, of Chicago; Alexander H. Revell, president of the Chicago Civic Federation; Robert W. De Forest, Edward Rosewater, editor of the St. Louis "Republican;" Austen G. Fox, John G. Agar, Frank A. Vanderlip, W. D. Mahon, president of the Association of Street Railway Employees; John Mitchell, president of the United Mine Workers of America; Samuel Gompers, president of the American Federation of Labor; E. E. Clark, grand chief of the Brotherhood of Railway Conductors; Prof. F. W. Taussig, of Harvard; Prof. Edwin R. A. Seligman, of Columbia; Prof. J. W. Jenks, of Cornell; Prof. Henry W. Farnam, of Yale; Prof. Frank J. Goodnow, of Columbia University; Prof. Leo S. Rowe, of the University of Pennsylvania; Walton Clark, vice-president of the U. G. I. Company of Philadelphia; Samuel Insull, president of the Edison Company of Chicago; Hamilton Holt, editor of the "Independent;" Lawrence F. Abbott, editor of the "Outlook;" Talcott Williams, editor of the Philadelphia "Press;" Frank Parsons, president of the National Public Ownership League of Boston; Charles A. Conant, V. Everit Macy and Marcus M. Marks, of New York.

FLORIDA "JIM CROW" LAW UNCONSTITUTIONAL

The "Jim Crow" law of Florida has been declared unconstitutional by the Supreme Court of that State. The law went into effect July 1, and immediately a boycott was declared which affected all the street railway companies of the State. In Jacksonville, to whose citizens is due the credit of defeating the law in the courts, most peculiar conditions obtained. In that city are two companies. One of them is owned by Stone & Webster, of Boston; the other is owned by local colored capitalists and is the only line of its kind in the United States. In enforcing the law on the latter system, the arrangement was adopted of giving the colored people the forward part of the car, while the rear was reserved for the whites. This caused considerable amusement and gave rise to the variation, "I've got a white man ridin' back of me."

The decision of the Supreme Court in this case is final, for the State took the appeal and the State cannot take the case to the United States Supreme Court.

The grounds set forth in the application for the writ of habeas corpus, when the case came before Judge Call, were seven in number, but Judge Call only declared that one of them was well taken and that was the one reading as follows:

"Because Section 7 of this act not only gives to certain portion of colored people, to wit, colored nurses having the care of white children, and colored servants in charge of sick white people, rights and immunities denied to other colored people, contrary to the fourteenth amendment of the Constitution of the United States of America, but also renders said law special and not general, contrary to Section 20, Article 3 of the Constitution of the State of Florida."

VANDERBILT IN CENTRAL NEW YORK—SUB-STATION AT SYRACUSE FOR NIAGARA POWER

The trip of William K. Vanderbilt, Jr., and Attorney Walter N. Kernan, of the Vanderbilt-Andrews syndicate, over the line of the Syracuse & Suburban Railroad on Aug. 3, led to reports that the syndicate was considering the purchase of the property, which consists of a 14-mile road from Syracuse to Edwards Falls, and with a 3-mile spur to Jamesville. Messrs. Vanderbilt and Kernan denied to a representative of the Street Railway Journal that the trip had any such significance. It was stated that the purpose was that Mr. Vanderbilt might familiarize himself with the situation, as the syndicate already owns the Syracuse Rapid Transit system and is about to electrify the West Shore Railroad, a branch of which runs parallel with the Syracuse & Suburban for some distance. There is a proposition to extend this road to Cazenovia Lake.

At a meeting of the directors of the Syracuse Rapid Transit Railway Company, to be held in New York soon, plans will be decided upon for the large sub-station to be built here in connection with the introduction of Niagara power next year. General Manager E. G. Connette says that the new plant and equipment will cost about $150,000.

PRINCETON AND THE ELECTRIC RAILWAY

Whether or not an electric railway is injurious to a town is no longer a debatable question in Princeton, N. J., where the opposition to the entrance of the trolley was most energetic a few years ago. In 1895, when an electric railway was first talked of between Trenton and Princeton, all kinds of dire things were prophesied, and the opposition was so strong that for five years the line was kept out. The Trenton Street Railway, however, finally came into a remote and inconvenient part of the borough, after a most bitter fight. A year or so later the Trenton, Lawrenceville & Princeton Railroad (New Jersey & Pennsylvania Traction system) came to the borough line, and in 1902 secured a franchise to run up Witherspoon Street within a block of the University campus. The two roads are carrying more than 1,500,000 passengers yearly between Trenton and Princeton. From 1900 to 1905 business failures in Princeton were but a fraction of the number that occurred between 1895 and 1900, or even between 1890 and 1895. From 1890 to 1900 the permanent population increased about 14 per cent, or from 3422 to 3899, while from 1900 to 1905 (according to the State census just completed) the increase was 58 per cent, reaching 6200, or 116 per cent for the decade between 1900 and 1910, assuming that the same rate (and it is increasing) continues; this in spite of the entrance of two electric railways, and without a single manufacturing plant or other inducement to bring new people into the borough. The student population, numbering (counting university, seminary and preparatory schools) nearly 2000, is not included in the figures given.

PORT CHESTER GETS MT. VERNON FRANCHISE—OFFICIAL STATEMENT OF ITS ACHIEVEMENTS

The New York & Port Chester Railroad Company, which plans to build a four-track third-rail electric railway from New York to Port Chester, a distance of 27 miles, succeeded in obtaining from the Common Council of Mount Vernon, at a meeting of the latter on Tuesday evening, the franchise to pass through all streets of that city.

The company has issued a new statement regarding its present financial standing, and reviewing the history of its fight with opposing interests. The statement emphasizes the fact that the New York Railroad & Development Company is financing the Port Chester road, and places at the latter's disposal a capital of $2,000,000 for construction, the buying of real estate, etc. The expending of the money is in the hands of the executive committee of the Port Chester Railroad. The following legal steps which have been taken in compliance with the law by the New York & Port Chester Railroad Company are summarized in the statement, as follows:

(1) Secured the certificate of public convenience and necessity from the Railroad Commission.

(2) Had that certificate twice unanimously sustained by the Court of Appeals.

(3) Secured from the Common Council of Mount Vernon the right to pass through all streets.

(4) Secured from Common Council of New Rochelle right to pass through all streets.

(5) Secured an order from Supreme Court at White Plains to pass through Pelham, Larchmont, Harrison, Mamaroneck, Rye and Port Chester, and to pass over and under every public street and highway in those places.

Consent from the city of New York is lacking, and application for this franchise is now before the Board of Estimate and Apportionment.

Terminal property has been purchased in the Bronx, where connection will be made with the Interborough Rapid Transit Company.

IMPORTANT STEP IN THE PROGRESS OF THE NATIONAL BATTERY COMPANY

The annual meeting of the stockholders of the National Battery Company was held Aug. 4 at the general offices of the company in Buffalo. The old board of directors was continued unchanged, and the following officers of the company were elected: John R. H. Richmond, who was formerly treasurer, was elected president of the company; James Macnaughtan, formerly vice-president, was continued in the same office; Ralph Kimberly, formerly secretary, was appointed to fill the offices of both secretary and treasurer, the latter office being the one formerly occupied by Mr. Richmond. Mr. Richmond and several associates have taken a large block of the increased capital stock, which will be used in the further extension of the business.

R. L. Coleman, formerly president of the company, was elected chairman of the board of directors, and he still retains his large interest in the company. James Macnaughtan, under whose management the company has been brought to its present position of strength and activity, was reappointed general manager of the company.

The company has done an excellent business in the sale of storage batteries during the past year, and extensive plans for further development have been made. The field of activity will be broadened, and it is confidently expected that the results for the coming year will more than justify the company in a continuation of the progressive policy that has been inaugurated. The company has an excellent organization. The sales manager is both an electrical and mechanical engineer, with extended commercial experience, and the factory manager is a thoroughly trained technical man, who has been connected with this company from its inception. Other departments of note are the engineering, construction and publicity departments, all of which are managed by men carefully selected for their ability and training in their particular line of work.

INDIANA TRACTION LINES ALMOST DOUBLE IN VALUE DURING LAST YEAR

A notable increase in the property valuation of Indiana electric railways during the past year is shown by the assessments made against these companies by the Indiana State Tax Board at the close of its first session. The total assessed valuation of the lines for 1905 is $26,387,366, as compared with $13,702,394 for 1904. An examination of the schedule shows that while the aggregate assessment is much greater, there is no marked general increase in the individual assessments per mile, the increase being due to the extensions or increased mileage of the old roads and the building of a number of new roads. A slight general increase is also noted in the assessed valuation of steam roads, the total being $178,000,000, as against $165,863,367 last year. This increase is likewise due to new lines and increased mileage in the State. A general increase in the assessment of the express companies doing business in the State is shown by the valuations placed on these companies. The express business has been greatly augmented by the carrying of parcels by the interurban lines. The largest increase was imposed on the Adams Express Company. Its assessment was raised from $425 to $566 a mile. The assessment of the other express companies remains about the same as rated last year.

BELMONT SYNDICATE BUYS LONG ISLAND REAL ESTATE

The Degnan Contracting Company, acting for the New York & Long Island Railroad Company, the Belmont company now building the tunnel under the East River, from Forty-Second Street, New York, to Long Island City, has taken title to five blocks of land in Long Island City, comprising about 250 lots, 25 ft. x 100 ft., at the average price of $800 per lot, or $200,000 for the whole tract. The new purchase is in the line of the extension of Mr. Belmont's proposed tunnel. On the property just purchased there will be a railroad yard abutting on the south side of Thompson Avenue, over which highway and Hoffman Boulevard the Belmont line is to be extended to Jamaica, where it will connect with the New York & Long Island Traction Company, whose lines extend to Belmont Park, Queens and Hempstead.

CURTIS STEAM TURBINES IN JAPAN

Characteristic of the present progressiveness of Japan is the fact that outside of Europe and the United States this small nation is the largest users of steam turbines in the world. On July 29, 1904, the first shipment of steam turbines arrived in Japan via the steamship "Korea" from San Francisco. They were of 500-kw capacity, of the Curtis type, and were for operating the Shigai Railway in Tokio. Four weeks from their arrival they were in full operation. As significant of the success of these first units, there have been ordered by the Japanese from the General Electric Company, of New York, thirty-seven Curtis steam turbines with electric generators, with a total normal capacity of more than 35,000 hp. Of these, eleven units are now installed and in satisfactory operation.

Two of the 1000-kw turbines mentioned above are intended for the Miike Coal Mines on the Island of Kyushu. The Osaka Electric Light Company, which furnishes electricity to the city of Osaka, which has a population of over 800,000, has six of these turbines. The capital of this company is $2,400,0000, and with its progressive methods it will soon rival some of our modern American illuminating companies.

One of the largest electrical interests in Japan which has ordered some of the machinery referred to above is the Tokio Street Railway Company, which furnishes transportation facilities for the city of Tokio, which has a population of 1,440,000. Its Japanese name is Tokio Shigai Tedsudo. Its franchise runs until 1952, and its capital stock is 15,000,000 yen, divided into 300,000 shares. This company's power station includes five 2000-hp Curtis turbo-generator units.

AFFAIRS IN CHICAGO

Reports in Chicago are to the effect that representatives of the controlling financial interests in the various local street car companies will meet in New York within a couple of days for the purpose of considering the plans for a merger of the various lines upon one city, one company, one system and one fare basis, and also to go over the legal and rehabilitation propositions which the representatives of the various companies of Chicago have had under discussion. John J. Mitchell, of Chicago, who is one of the controlling men in the traction syndicate, has gone to New York, and it is announced that he will there meet the other controlling financial men who are expected to furnish the money necessary for the rehabilitation of the lines.

STREET RAILWAY PATENTS

[This department is conducted by Rosenbaum & Stockbridge, patent attorneys, 140 Nassau Street, New York.]

UNITED STATES PATENTS ISSUED JULY 25, 1905

795,261. Car Truck Bolster; John M. Ames, New Brighton, N. Y. App. filed April 12, 1905. Comprises a box-like structure for a center bearing, said structure extending above the body of the bolster, and longitudinal flanges extending from the upper portion of the box to the end portions of the bolster and affording seats for side bearings.

795,262. Car Truck Bolster; John M. Ames, New Brighton, N. Y. App. filed April 12, 1905. An integral hollow cast bolster, comprising a lower body part and an upper narrower part and having at its center a box-like formation extending to the top of the upper part and affording the center bearing and sleeve for the bing-bolt.

795,282. Car Bolster; Clarence H. Howard, St. Louis, Mo. App. filed May 1, 1905. Comprises two opposite side beams transversely fixed to the longitudinal car sills, a cross-beam intermediate to the side beams and having the body center plate integral therewith, the end portions of the cross-beam extending beneath and adapted to bear against the under side of the middle portions of the side beams and means for separably fixing the cross-beam to the side beams.

795,285. Switch; William S. Jackson, Hoboken, N. J. App. filed Aug. 27, 1904. A longitudinally-swinging contact bar depends from a portion of the trolley wire, and when moved in one direction or the other by the trolley wheel opens suitable circuits to actuate a desired switch or switches.

795,316. Brake Mechanism for Trucks; Burton R. Stare, Kingston, N. Y. App. filed Nov. 16, 1901. Means whereby the braking pressure may be properly proportioned so that the wheels which carry the greater part of the load may receive the greater braking pressure, and consists in combination with the usual brake-shoes and brake beams, of a lever pivotally mounted upon one of the beams, a lever connected to actuate the other beam and also connected to the first lever, and a member connected to the first lever between its center and point of attachment of the second lever, which member is adapted to be actuated from the brake rod.

795,348. Brake Rigging and Operating Device Therefor; George L. Fowler, New York, N. Y. App. filed May 26, 1905. A system of levers by which the braking pressure is compounded.

795,363. Brake Shaft Holding and Releasing Device; John F. O'Connor, Chicago, Ill. App. filed April 6, 1905. A friction wheel of disc on the brake shaft and a stationary friction-shoe with which the friction wheel is held in frictional engagement by the tension of the brake chain.

795,419. Friction Brake; Aldo E. Reynolds, Peoria, Ill. App. filed Dec. 27, 1904. A cup-cone revoluble with the wheel and axle, a cone carried on the axle but independent thereof, the axle turning therein, a brake beam for each pair of wheels, connection between each brake beam and the cone, and a pair of beveled-faced plates carried on the axle adjacent to the cone for shifting the latter along the shaft into engagement with the cup-cone to impart a partial rotary movement to the cone to draw the brake beam against the wheels and means at each end of the car for moving the beveled plates.

795,475. Switch; Harvey J. Barton and Harvey J. Barton, Jr., Philadelphia, Pa. App. filed Dec. 7, 1904. A rotating head having a gravitating detent mounted thereon and pendent therefrom and a stationary ratchet, with either member of which said detent is adapted to engage.

795,501. Car Seat; Francis K. Fassett, St. Louis, Mo. App. filed Jan. 11, 1904. Two levers connected at their upper ends to the back and pivotally mounted at their lower ends one above the other upon the frame, both the levers being prolonged beyond said pivotal points, the prolongations engaging each other to assure synchronous movement.

795,580. Cable Grip; Sebern A. Cooney, New York, N. Y. App. filed March 28, 1905. Comprises a fixed and a movable jaw, an operating toggle connecting the jaws and a single nut acting to adjust the toggle to take up wear in all the bearings.

795,596. Car Seat; Francis K. Fassett, St. Louis, Mo. App. filed July 20, 1903. Details of construction of a "walk-over" car seat.

795,616. Switch and Signal Track Trip; Charles M. Hurst, Rawlins, Wyoming. App. filed Nov. 25, 1904. A pair of bell cranks so arranged at the side of the track that one arm of each bell crank is upwardly inclined, and may be frictionally engaged by the passing car to swing it on its pivot and actuate the switch.

795,683. Wheel for Railway, Tramway and Other Vehicles, etc.; Samuel G. Board, Manchester, England. App. filed May 24, 1904. A wheel comprising in its construction a prepared material of sawdust magnesium oxid and a binding material forced and compressed while still in a soft, plastic, moist condition around the hub and into the space between it and the tire, and maintained therein under a dead hydraulic pressure equal over its entire area until set.

795,690. Wheel; John A. Casey, Jacksonville, Fla. App. filed April 12, 1905. A wheel having a tread provided with intersecting grooves producing projecting engaging portions.

UNITED STATES PATENTS ISSUED AUG. 1, 1905

795,945. Railway Track Structure; Frederic F. Stockwell, Jr., Somerville, and Henry R. Luther, Newton Center, Mass. App. filed Nov. 11, 1903. A process by which the short lengths of rails usually included in frogs, switches, etc., are so connected and united with the central body of the structure as to remain integral therewith in spite of repeated and severe shocks.

796,146. Power Brake; Louis Pfingst, Boston, Mass. App. filed Oct. 24, 1904. A brake lever is located at the base of the usual controller and is actuated to throw a friction clutch which engages the brake-applying means to a power connection from the electric motor.

796,196. Switch Operating Mechanism; Henry Dickinson, Flushing, N. Y. App. filed Dec. 19, 1904. A pair of jaws embracing the track rail and adapted to be thrown in one direction or the other by wedge-shaped shoes carried by the car, said jaws having suitable connections to the switch point whereby the latter may be thrown.

796,203. Sand Distributing Machine; Giuseppe Gioiosa, East Boston, Mass. App. filed Jan. 14, 1905. A heating coil around the sand box and an agitator therein.

796,287. Electrically Controlled Shifting System for Track Switches; Thomas Bovey, Chicago, Ill. App. filed July 11, 1904. The switch is provided with a pair of separate electro-magnets, the circuits of which are alternately completed by the motions of the switch point. For either position of the switch point that magnet is energized which tends to move the point to the opposite position, so that the switch point moved alternately.

796,295. Combined Brake and Take-Up Mechanism for Trolleys; Henry B. Clarke, Chicago, Ill. App. filed July 9, 1904. A sudden jerk on the trolley cord actuates an air valve which con-

trols a band brake around the winding drum, and at the same time a signal is given to the conductor that the trolley has left the wire.

796,296. Trolley Retrieving Device; Henry B. Clarke, Chicago, Ill. App. filed Oct. 31, 1904. A spring-drum for retrieving the trolley is held inactive by means of a band brake around the drum which is controlled by a magnet energized through the trolley circuit. When the trolley leaves the wire, the magnet is de-energized and the spring-drum allowed to operate to pull down the trolley.

796,316. Car Wheel; Perry J. Garrison, Three Rivers, Mich. App. filed May 1, 1905. Comprises an outer disk having a tread and flange thereon, and an inner disk with a circumferential flange of a width equal to the width of the tread and extending in a direction toward the outer disk and abutting directly against the tread to reinforce the same, the two disks being oppositely concave and separated the width of the tread and gradually coming together in a direction toward the center of the wheel where the disks abut against each other and a hub to which the abutting ends or edges of the disks are secured.

796,319. Sand Distributing Machine; Giuseppe Gioiosa, East Boston, Mass. App. filed March 20, 1905. A receptacle for sand having a conical bottom with an aperture therein, a conical agitator comprising in its construction a plurality of radio-conical arms journaled to rotate in the receptacle and mechanism to impart a rocking motion to the agitator.

PERSONAL MENTION

MR. DAVID WEBSTER has resigned as superintendent of the Sedalia Transit Company, of Sedalia, Mo.

MR. W. C. PHILLIPS has been appointed superintendent of the interurban line of the Northern Texas Traction Company between Fort Worth and Dallas.

MR. C. A. WALKER has resigned from the Public Service Corporation of New Jersey to accept the position of master mechanic of the Schuylkill Traction Company, of Girardville, Pa. Mr. Walker is well fitted by previous training for the position to which he has just been appointed.

MR. C. M. CORY has been promoted from chief clerk to the position of treasurer and auditor of the Birmingham Railway, Light & Power Company. Mr. Cory takes the position formerly occupied by Mr. C. O. Simpson, who has resigned from the Birmingham company to become general manager of one of the other Newman properties.

MR. FRANK ROSS, assistant general superintendent of the Sacramento Electric, Gas & Railway Company, of Sacramento, Cal., who has accepted the position of superintendent of the Northern Electric Railroad, which will soon be in operation between Chico and Oroville, Cal., has been succeeded at Sacramento by Mr. F. E. Fitzgerald, of Alameda.

IN THE STATEMENT OF CHANGES in the Toronto Railway Company, published in the Street Railway Journal for June 17, an error was made in referring to the resignation of Mr. W. H. Moore as manager of the York Radial Railway. Mr. Moore has not resigned from the company. Neither has he severed his connection with the Toronto Railway, for which he acts as assistant to President W. MacKenzie.

MR. J. BRODIE SMITH, general manager of the Manchester Traction, Light & Power Company, of Manchester, N. H., has been elected to the position of vice-president of the company to succeed the late Mr. George Byron Chandler. Mr. Smith's first work along electrical lines was as superintendent of the fire alarm telegraph in Manchester, a position which he held for two years. Then followed his appointment to the position of superintendent of the Franklin Electric Company. Next he became superintendent of the Manchester Electric Light Company. In 1896 Tucker, Anthony & Company entered the field in Manchester and Mr. Smith became general manager of the concern's interests.

MR. ELY M. KINNEY, of the construction department of the General Electric Company at Schenectady, was married at Saratoga on Saturday, to Miss Helen B. Cunningham, of Carthage, Mo. The bride was attended by Miss Mary Kellogg and Miss Verna Brinkley, both of Missouri. The best man was Harry K. Crandall, of Athens, Pa. The guests of honor at the wedding were Mr. Warren Tubbs, of Buffalo, and Mr. Albert V. Thompson, of the General Electric Company. The wedding supper was served at the Grand Union Hotel, Saratoga, after which Mr. and Mrs. Kinney took an evening train for New London, Conn., where Mr. Kinney has charge of the installation of an electric railway system.

MR. G. L. GROVER, vice-president and general manager of the Eastern Wisconsin Railway & Light Company, operating the local street railway in Fond du Lac, Wis., the Fond du Lac interurban line, and the Fond du Lac electric and gas plant, has handed in his resignation, to take effect Oct. 1. Mr. Grover has been identified with the Fond du Lac company for nine years, going to that city in 1896 from Milwaukee, where he was superintendent of the Milwaukee & Wauwatosa Electric Company. In 1903, when the Eastern Wisconsin Railway & Light Company was organized, Mr. Grover was elected general manager.

MR. W. J. HAYLOW, who was for a number of years superintendent of transportation of the Atlantic Coast Line, has been appointed general superintendent of the railway department of the Savannah Electric Company, a position just created. Mr. Haylow will have entire charge of all matters connected with the railway business of the company, as distinguished from the lighting department. With the announcement of the appointment of Mr. Haylow, it is also announced that the position of superintendent of transportation, from which Mr. N. B. Rhoads has resigned, will be abolished.

MR. ALLEN B. WELLS has resigned his position in the auditor's office of the Brooklyn Rapid Transit Company to become division superintendent of the Tranvias Limitado de Mexicano Electrico (Mexican Electric Tramways, Ltd.), in the City of Mexico, Mex. Mr. Wells has had an extended experience in the detail of railway operation in Brooklyn, entering the employ of the company ten years ago in the timekeeper's office. Shortly after he became general timekeeper, which position he held with success for eight years. He was then promoted to the chief clerkship in the office of the engineer of way and structures, and six months later to a similar position in the office of the vice-president and general manager, Mr. J. F. Calderwood. For the six months prior to his resignation he was engaged in special work in the office of the comptroller. Mr. Wells is a Southerner by birth and will be eminently adapted to his new duties in Mexico, where he will be associated with Mr. W. W. Wheatly and Mr. James A. Pierce, both of whom were formerly connected with the Brooklyn Rapid Transit Company.

MR. E. C. FOLSOM, who recently resigned as superintendent of transportation of the Fort Wayne & Wabash Valley Traction Company, of Fort Wayne, Ind., began his street railway career in Cleveland fifteen years ago on the Johnson lines. Later he was engaged in construction work on the Nassau Railroad in Brooklyn. For two years after this he was chief inspector at Detroit. About two years ago he became superintendent of the city lines at Logansport, Ind., in charge of the reconstruction and widening of the gage of these lines, which were later consolidated with the interurban lines of the Wabash Valley, now operating under the name of the Fort Wayne & Wabash Valley Traction Company. When the preliminary consolidation took place he was superintendent of the interurban and city lines, and when the deal was effected which resulted in the present company he became superintendent of transportation of the whole road, including the city lines of Fort Wayne, Wabash and Logansport and the intervening interurban lines. Mr. Folsom is interested in a new automatic block signal which has been in successful use on a busy piece of interurban track near Logansport.

MR. ELMER M. WHITE, cashier and auditor of the Hartford Street Railway Company, of Hartford, Conn., and secretary of the Street Railway Accountants' Association of America, has resigned from the Hartford company to accept the position of assistant secretary and assistant treasurer of the Birmingham Railway, Light & Power Company, of Birmingham, Ala. Mr. White will leave Hartford Aug. 16 for the South, and will assume his new duties Aug. 24. Mr. White is very well known in the street railway field, has served on the executive committee of the Accountants' Association, and has been its secretary since the first of the year. He was born at Northbridge, Mass., Sept. 14, 1857. Three years later his parents moved to Hartford, where Mr. White was educated. Leaving the High School in 1872, he engaged in bookkeeping until 1877, when he became a traveling salesman. In 1883 he took up estate accounting, and in 1885 began the service with the street railways of Hartford which has just ended, in the receiving department of the Hartford & Wethersfield Horse Railroad Company, now the Hartford Street Railway. In 1890 Mr. White was appointed cashier of the company. Since then the additional duties of auditor have been added to his position. At the Saratoga convention of the Accountants' Association, Mr. White was appointed a committee of one to make a new collection of blanks and forms used in street railway accounting work. This collection was exhibited at the St. Louis convention, and the care and skill displayed by Mr. White in connection with this work received many favorable commendations from the delegates present.

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REMITTANCES.—Remittances should be made by check, New York draft, or money order, in favor of the Street Railway Journal.

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Back Copies.—After July 1, 1905, no copies will be kept on sale beyond fifteen months prior to date of issue, except in bound volumes.

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office by 10 a. m. Monday preceding the date of publication, except the first issue of the month, for which changes of copy should be received two weeks prior to publication date. New advertisements for any issue will be accepted up to noon of Tuesday for the paper dated the following Saturday.

Of this issue of the Street Railway Journal 8000 *copies are printed. Total circulation for* 1905, *to date,* 269,550, *copies, an average of* 8169 *copies per week.*

Jerking on the First Controller Point

Although we have many times called attention to the laxity which frequently exists in the adjustment of resistances on motor cars so that there will be a jerk on certain points when the car is started, the numerous cars which are still defective in this respect emphasize the need of calling attention to this feature again. It is very often the case that the resistances are so proportioned that there is an uncomfortable jerk at the first point. This jerking is very annoying to passengers, especially in cars with longitudinal seats or when there is a standing load. While care on the part of the motorman or the use of some automatic device for restricting the advancement of the controller handle can prevent jerking due simply to "fast feeding," it cannot prevent jerking caused by improper proportioning of the resistances. This is a matter which requires constant attention on the part of the master mechanic and his men, not only to see that car resistances are properly adjusted when new, but that they are kept so, and kept free from partial short-circuits.

A Hint for the Passenger Agent

Within a very few weeks one of the most delightful seasons of the year for out-of-door life will be upon us, and it behooves every street railway traffic man whose routes cover picturesque country to see what can be done to make 1905 a record year for fall month receipts. There is no reason why Sunday-school picnics, outings of labor organizations and holidays of other social and business gatherings need be confined to the summer months, even though the closed car may be operating in ordinary city service for the comfort of regular passengers. The encouragement of nutting parties, husking bees and other autumn festivities ought not to be a difficult task for the traffic man whose initiative is a little out of the ordinary, and if the steam roads can make money out of the September and October foliage, the electric railways ought to be able, with their cheaper fares, more frequent and cleaner service and ability to deliver passengers at all attractive points en route, to increase their revenues through the renting of special cars and encouragement of traffic on the regular trips.

There is no doubt that the open car is best fitted for the full enjoyment of out-of-town trips by such parties, and in many localities the public fails to realize how late in the season one can ride in perfect comfort if plenty of wraps are carried. Why should not the trolley sleigh ride—if it can be so-called—become popular in the late fall and winter season on progressive roads? Given a good supply of lap robes, and possibly an arrangement of electric heaters to be used as foot warmers, the open car ought to be as comfortable and certainly far less expensive than the "one-horse open sleigh" of old. Skating carnivals are now regularly encouraged by many Northern roads on the parks which attract so many passengers in the summer season. All America is turning to out-of-door recreation to-day as perhaps never before, and it is up to the street railway traffic man to turn as much of this demand as possible into money. It is none too early to plan an advertising campaign for the fall and winter somewhat along the lines suggested above.

Car House Approaches

The track layout of car houses is always an important factor in the operating convenience of a street railway. In most cities very little space available for storage tracks is wasted in the car house itself, but one often finds poor arrangements of tracks in the car house approach. Thus it is sometimes the practice of the operating company to connect the main line with the car house branches through a single track, which

plan ties up the whole layout if anything breaks down at the point of maximum congestion. In other cases the curves are brought so close together that cars cannot safely pass except on the straight track.

It would seem to be good common sense to install at least two tracks between every car house and the main line, so that an outlet can always be had as well as an inlet. It is also needless to say that the main line itself should be as free as possible from the complications of special track work. There is no pleasure for the passengers in the two dozen or more jolts that a double-truck car passes through in traversing the frogs of five or six car-house stubs leading directly from the main line, and there are no benefits derived either by the car equipment or the track itself from such a layout on the score of lessened maintenance. Local conditions often require an undesirable arrangement, but in rural or suburban car houses where there is plenty of room, it ought always to be possible to lay out a simple and effective track approach. Whatever the car house approach, however, it should always be operated so that the main line traffic will not be needlessly delayed. With this point in mind, the switches should always be trailing when possible. If facing switches must be used, it is better to install a gauntletted track, so that only one facing switch is required on the main track, and to keep this switch open for the main line cars; otherwise the main line crew must set the switch over again every time a car enters the car house, losing valuable time. This is a common defect in operation, even on some of the largest systems.

Improving Interurban Connections

The expansion of electric railways from local into through systems during the past few years has brought about many important changes in equipment and service, and on lines operated under the same general management it is now generally well appreciated that the successful handling of through traffic depends to a large extent upon the care with which the schedules are watched at intersection and meeting points. A great deal can often be done, however, to improve these matters on systems which meet or cross, but which are not under the same executive officers.

It often happens that the schedules of such lines are so arranged that the respective cars miss one another by from one to ten minutes, making it necessary for transferring passengers on the last car to wait from twenty-nine to fifty-nine minutes before continuing their journey. In many cases it is not advisable to arrange the schedules so that meetings shall take place, but there is no doubt that such irregular and long waits constitute the most serious obstacle to enjoyable long-distance trolley travel. Perhaps the most exasperating part of the whole question is the all-too-common experience of seeing the car desired pull away from the intersection point just as the car on the other line approaches, thanks to a childish notion on the part of the management that a rival system deserves no recognition, even if it delivers passengers at certain points to the company's own lines. It is not an uncommon sight to see a car leave the end of the route at a steam railroad station a moment or two before a through express pulls in, leaving the passengers to pay five or ten fares to the local hackman, or perchance continue their trips via the steam road. Shortsighted practices of this kind are manifestly very poor policy, and there ought to be no need of calling attention to them in these days of broader conceptions of what makes for efficient and profitable service.

Acceleration in Interurban Service

High acceleration has long been appreciated as an important factor in urban and suburban rapid transit, but its influence in interurban work is not as widely understood. In elevated and subway service in great centers of population, it pays to concentrate enough power in the motors to provide just about all the acceleration that the passengers can comfortably support, on account of the frequent stops and heavy traffic density. At crowded stations it is hard to avoid stops of from twenty-five to thirty seconds even with the most careful organization of train service and platform attendance; cars and trains must be gotten out of the way as quickly as possible, and economy of power under such conditions is not for a moment to be balanced against the pressure of the public demand for swift transit over the lines of the operating company. Hence we find acceleration rates worked close up to 2 m.p.h. or 2.5 m.p.h. per second during the time spent in passing over the resistance notches of the controller, and although in a multiple-unit system a train of five motor cars may easily draw 1200 kw momentarily from the third rail, the magnitude of the traffic justifies the instantaneous peaks at power and sub-stations.

In suburban service, particularly where steam railroad competition exists, the demand for fairly high rates of acceleration is also insistent. Unfortunately the electric railway has found it difficult to outgrow the old-time practice of stopping anywhere and everywhere to pick up passengers, so that even with the potential speed possibilities of four-motor equipments, it is often impossible to make fast time unless the acceleration is forced close to the edge of physical discomfort. As the number of stops per mile decreases, the necessity of such quick starting from rest lessens, until, in the case of the simple interurban road with few stops between termini and a reasonable freedom from sharp curves, the acceleration problem dwindles to a small matter in comparison with the questions of operating methods, train despatching, maintenance of continuous service, emergency precautions and traffic stimulation.

The point is that it is well to ascertain pretty thoroughly in interurban propositions before signing the contracts for rolling stock, power station and sub-station equipment just what can be done in the way of schedules with moderate acceleration capacity in the motors and low gear ratios. The entire first cost of the road from rail-bonds to generators depends intimately upon the current demands of the rolling stock during acceleration, and the operating expenses are also profoundly influenced by the momentary power consumption with the schedules adopted. High acceleration is of minor importance in the long-distance express service of steam railroads, because the time spent in attaining full speed is so small a percentage of the total running time, and to some extent the same reasoning applies to the through interurban line. Even with an acceleration rate of 0.5 m.p.h. per second, the electric motor shows a clean pair of heels to the great majority of steam locomotives in the matter of getting up speed. On roads operating but a few cars, the ratio of average to maximum load is lower than on large systems, so that higher rates of acceleration, and consequently severer instantaneous current drains, can better be sustained by the latter, other things being equal. When an interurban proposition requires a good deal of city running, is complicated by a tortuous alignment, and passes through well-settled territory where the local traffic along the line between the terminal centers is pretty sure to be substantial, it may pay to adopt the heavier equipment necessary to provide high acceleration, but in most cases it is well to remember that

it costs money to be able to pick up speed at the rate of 2 m.p.h. per second in remote country districts. Modest beginnings are worth as much in interurban railway work as in many other spheres of activity, provided a reasonable lease of future possibilities is taken in preparing for the ultimate expansion of business.

Express and Freight

Interurban roads are considerably at variance with each other in methods of handling freight and express. In this we do not refer so much to the physical conduct of the business as we do to the commercial methods involved. There are some half dozen different plans in use at the present time. Probably the majority of the more important interurban systems have what practically amounts to a fast freight service. That is, they handle a class of matter which is frequently sent by express on steam roads, and also bulky freight. All shipments are taken as promptly as if they were express matter, the rates being as low or lower than competing steam railroad freight rates. This is not strictly express at freight rates, as some have said, because it does not involve delivery or collection, which is a large item of expense on short hauls. Whether this service goes under the name of freight or express is immaterial, except that the word express may have a certain advertising value and may convey more accurately to the mind of the public the kind of service that is given.

There is another side to this question, however, which is that those unfamiliar with the service might think that express rates were charged instead of rates approaching steam road freight rates. On a few roads a general express business is carried on, with collections and deliveries like any of the large steam railroad express companies. Of course, the rates for this service must be very much higher than for freight which is not delivered by wagon. The volume of business handled will be considerably less, although the net revenue may be more. A few roads are handling freight, both in small quantities and carload lots, at about the steam railroad freight rates or less, the methods being very similar to those used on steam roads, with the important difference that usually much more prompt shipment can be obtained than on steam roads. The last meeting of the Ohio Interurban Railway Association brought out a discussion on all these different classes of service, and in addition a kind of combined freight and express service was described, which appears to have considerable merit. We refer to the plan of taking small packages for prompt shipment at one rate, and bulky stuff, to be shipped as suits the convenience of the company at any time within a certain number of days from date of consignment, at a much lower rate. This gives the company a certain amount of freight all the time, which can be hauled when the express car would otherwise run light, or which can be left behind when heavy shipments of better paying express matter are received.

It is a question whether both freight and express business cannot be satisfactorily carried on by an interurban road on the same cars. One of the greatest expenses about the maintenance of a through express business is the delivery and collection by wagons. There are comparatively few places on an interurban road where the company can afford to maintain regular wagons for delivery. The only feasible way to maintain an express service under such conditions is to make arrangements with local teaming companies along the route to handle express matter to and from the cars. It could easily be arranged to consider all matter taken for prompt shipment as coming under one class as long as it is on the cars of the company, leaving it to the shipper to specify whether it shall be collected and delivered by wagon or not. In this case it would simply be a matter of adding the teaming charges to the freight charges to make the express rate and give express service. As a matter of fact, shippers over electric freight lines at the present time frequently have permanent arrangements with teamsters for the prompt collection and delivery of matter. This is quite likely to be the case with the largest shippers as well as the receivers of the largest consignments—that is, the wholesale and retail merchants—to maintain their own wagons, as they do not care to pay the extra price for collection and delivery.

A great deal has been said in some quarters about the great possibilities of hauling heavy freight over electric roads. We are inclined to think that the possibility of heavy freight business on electric roads has been considerably overestimated by some, but we are of an equally strong opinion that the possibilities of the light freight business are much underestimated. It is the local freight and local passenger business that interurban roads are especially adapted to carry. They are so much better adapted to this than steam roads that it is certain to be only a question of time when most of the local business will be carried on by electric roads wherever steam and electric roads parallel each other. As we have beforetime remarked, the existence of a frequent light express service tends to create more business of this kind, just as the existence of frequent passenger service creates passenger traffic.

On account of the limitations of sub-stations and power stations, most of the present interurban roads are not suited to hauling heavy freight trains, although short trains made up of standard steam railroad freight cars can easily be handled when occasion demands it. Whenever a road's heavy freight business gets to a point where long freight trains must be hauled, one usually finds the management casting about for some steam locomotives. It is frequently the case that considerable freight can be hauled in carload lots without bunching these cars into long trains, and in such cases work can be far better done electrically than with steam. The minute, however, that freight trains begin to get of a length which overtaxes the capacity of the sub-stations along the line and calls for a large additional investment in power and sub-station apparatus which must remain idle most of the week in order to handle a few long freight trains, it is time to see if the freight business cannot be cut up into smaller train units, or to buy a steam locomotive if the right of way is such as to permit operation with steam. Then, too, there is the question of the interference of freight business with passenger business, which came up at the last Ohio convention and which is a very important point to consider. With passenger service as frequent as it is on most interurban lines, there is not much chance for long or slow freight trains on the line without interfering with the passenger trains. Considerable business in the way of light, fast freight can be done, however, using cars which can make the same schedule between turn-outs as the regular passenger cars. There is little economy in having slow cars for express or light freight. A fast car will often be given permission to make a run between two turn-outs, where a slow one would be held fifteen minutes to avoid any chance of delaying a regular passenger car. Taken altogether, the more frequent the passenger service on a road, the more necessary is it to have freight cars geared to equally high maximum speed.

TRANSPORTATION FACILITIES AT THE PORTLAND FAIR

The site of the Lewis and Clark Centennial Exposition at Portland, Ore., was very happily chosen, being picturesquely situated on the western bank of the Willamette River and directly overlooking a small lake, some forty minutes by street car service from the business center of the city. In preparation for the increased traffic, due to the influx of visitors to the Exposition, the Portland Consolidated Railway Company, which operates all the lines leading to the fair grounds, has gone to considerable care and expense in providing adequate transportation and terminal facilities. This portion of the fair is of equal interest from a street railway standpoint to the exhibits, of which a description was published last week, so that an account of the methods employed follows.

The accompanying map shows the street railway company's terminals immediately adjacent to the fair grounds. A double-track loop was built, passing down Twenty-Seventh Street and turning on Upshur Street past the main entrance to the Exposition. A special feature of this loop is the divergence of the tracks on Upshur Street, which for a distance of 400 ft. or so were spaced with 17-ft. 6-in. centers. This leaves plenty of room between the cars for people to congregate and allows the cars to be boarded on either side. On both tracks of this loop the cars run in the same direction. There is a slight downward grade on Upshur Street from Twenty-Seventh Street, and this grade aids very materially in the handling of cars slowly and carefully through the crowds which gather here on special days.

The following five separate lines of cars running on four double tracks handle all the traffic to the Exposition: The Willamette Heights line runs out Thurman Street to Willamette Heights, passing a short block of 200 ft. south of the Exposition entrance, while the Twenty-Third Street, Sixteenth Street and South Portland lines are diverted to the loop tracks at the junction of Twenty-Seventh and Thurman Streets. The Morrison Street line runs down Twenty-Seventh Street and directly around the loop. All these lines run over or connect with the main arteries of the city. Thus the Twenty-Third Street and Sixteenth Street lines run out Washington Street, and when a little over half a mile from the business center of the city separate and have separate double tracks to the entrance loop. The Willamette Heights cars also run out Washington Street. The Sixteenth Street and South Portland lines run over the Thurman Street tracks for nearly a mile, and the Morrison Street lines serves a street of the same name for a like distance before it is diverted toward the fair grounds. These different lines cross and recross, and are connected by curves and turn-outs at a number of different points so as to allow a variation in the route of the cars in case of accident, blockade or any other reason. For instance, on baseball days, the cars on the Twenty-Third Street line could be run out by the ball grounds instead of turning on the loop several blocks to the south.

The time-tables for the fair traffic were figured out on a basic service of six-minute intervals on four lines, the Twenty-Third Street cars being considered extras. This made the lowest service to the Exposition grounds forty cars to the hour, which was found, however, to be inadequate. It was then decided to double up the service on the four lines and place a six-minute service on the Twenty-Third Street line during the greater portion of the day, giving a carrying capacity to and from the grounds of ninety cars to the hour. On special days, second sets of extras are put on the various lines, bringing the capacity up to 130 cars, while for short periods of time the service has reached 150 cars to the hour.

The cars used on these lines are from 35 ft. to 38 ft. in length, are mounted on double trucks and have, as a rule, a single motor to each truck. The seating capacity ranges from forty to fifty people, though most of the cars will accommodate, when heavily loaded, as many as 150 people. The carrying capacity of the road, as figured for the Exposition, was thus, under extreme conditions of loading, about 1200 per hour on ordinary occasions. On special occasions it would probably exceed 20,000 per hour. On the opening day the attendance was between 39,000 and 40,000, and on July 4, the heaviest day for the street railway service up to the present, the turnstiles at the fair grounds registered 54,000. As is gen-

MAIN ENTRANCE TO EXPOSITION, SHOWING TURN-STILES, TICKET BOOTHS AND COLLONADE

erally the case at expositions, after the display of fireworks in the evening, there was an immense crowd, all intent upon getting home at the same time. The management of the Portland Consolidated Railway Company had made ample preparation for just such a contingency, and the crowds were swept away down town almost as fast as they congregated, so that by 11:45 p. m. the streets were practically clear of people.

VIEW ON LOOP, SHOWING CARS OPPOSITE MAIN ENTRANCE TO FAIR GROUNDS

The power for the operation of the fair traffic is taken from the steam station of the Portland General Electric Company, only ½ mile distant from the Exposition loop, and from the converting and distributing station of the same company, located in the heart of the city. The lines thus have the advantage of being fed from both ends, and up to date, on the days of the heaviest traffic, no trouble has been experienced from the power, which in all cases has been adequate, and has had a steady voltage with hardly any perceptible drop on any portion of the lines.

At all the principal crossing points and at the entrance to the loop, switchmen have been stationed to signal passing cars, prevent interference of teams, etc., and at points where the cars have averaged more than one to the minute this step has been found a decided advantage in the expediting of traffic. The streets over which the majority of the cars run are provided with good pavements, and are, in consequence, largely used for general traffic, yet very little trouble has been experienced by the cars in the way of congestion from teams and vehicles. This fact is largely due to the efficiency of the switchmen mentioned, as well as to the street railway company's foresight in running separate car lines to the Exposition grounds. As the loops at the fair entrance are located on city streets, there has been no attempt made to compel the purchase of tickets before boarding a car. The fares are taken up as with ordinary traffic.

Since the opening of the Exposition the travel on the outside lines of the Portland Consolidated, as well as on those leading to the Exposition grounds, has very materially increased. This is especially the case with the Portland Heights loop line, which climbs to an altitude over 700 ft. above the harbor, and gives the visitor a beautiful view of the city, rivers, adjoining country and the Cascade Range. The latter includes five per-

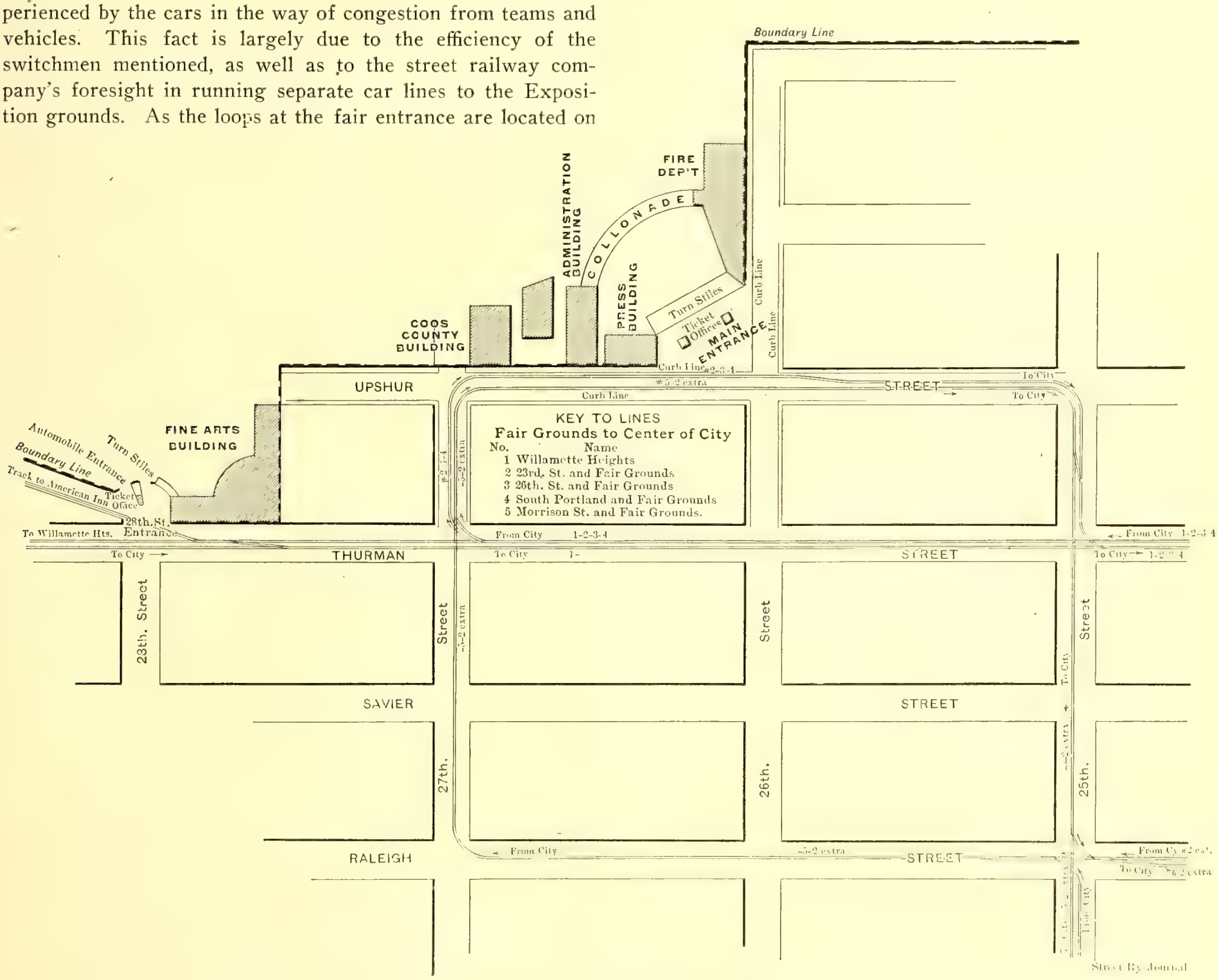


DIAGRAM SHOWING LOOPS AT AND ROUTES TO THE FAIR GROUNDS, PORTLAND

petually snow-capped peaks towering a mile above the summit of the range proper, making the view one of the most beautiful to be had anywhere in the vicinity of the city of Portland.

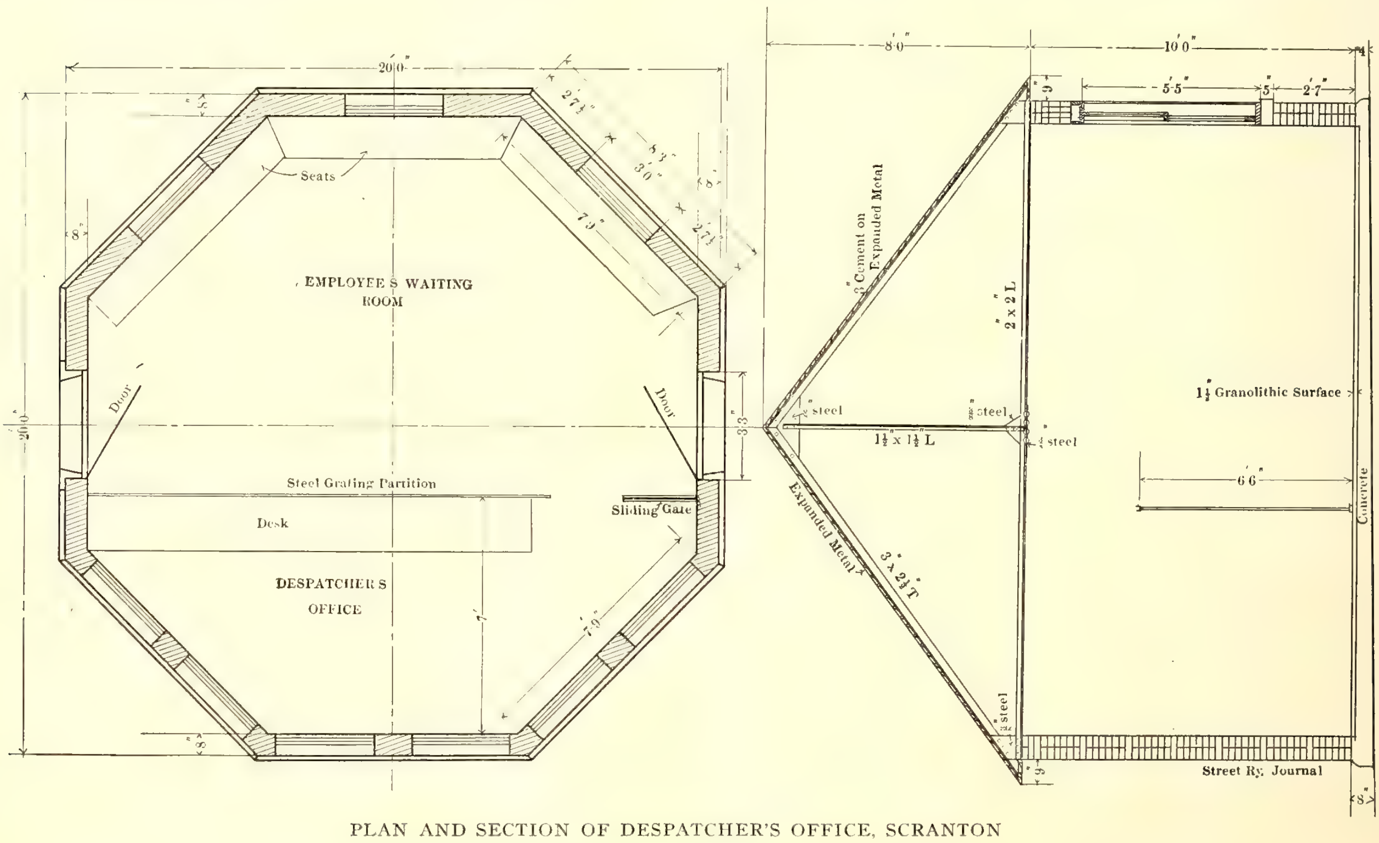
A NEAT CAR-HOUSE DESPATCHER'S OFFICE

A combined office and waiting room of attractive design and intended for the use of the car despatchers, conductors and motormen has recently been constructed by the Scranton Railway Company, of Scranton, Pa., at its large Providence car house. The demand for such a building which would shelter the despatcher and men in cold or stormy weather and still be within easy access and in full sight of all cars leaving the house, had been strongly felt in Scranton, as in many other cities. The location of such an office in any portion of the car house always presents some inconvenience to both despatcher and men. If the despatcher is on the second floor he is at some distance from the men; if his office is on the ground floor his view is often obscured. It was accordingly decided to locate the office in a separate building in front of the car house, where it occupies an open space between the two sections of special work leading to the street, as shown in the accompanying illustration.

Not only is this arrangement of a despatcher's office novel, but in its construction the building presents many interesting features. It is of octagonal shape and is entirely of brick, steel and concrete, making it absolutely fireproof. The walls are of brick, 8 ins. thick, rising to a height of 10 ft. above floor level. The roof consists of a steel framework, built up umbrella shape, of angles and tees, as indicated in the section, and upon this is laid expanded metal for reinforcing the concrete roof, which is 3 ins. thick. This construction consists of truss rod members of 2-in. x 2-in. angles, extending from the eight corners to a central gusset plate, from which a 1½-in. x 1½-in. angle is carried up to the peak of the roof as a stiffener. The roof members or purlins are of 3-in. x 2½-in. T-bars, upon which the expanded metal is carried directly. The floor is of concrete, with a 1½-in. granolithic surface.

The interior thus secured is a circular area approximately 19 ft. in diameter. This is divided near the middle by a steel grating partition 6½ ft. high, providing an office for the despatcher and an outer waiting room for the car crews, extra men, etc., who are in readiness to go out on their runs. The office section is fitted out with desks and other conveniences for the work and telephones for communication with other offices of the system. The building is heated in winter by an equipment of electric heaters distributed around the walls.

DESPATCHER'S OFFICE, SCRANTON



PLAN AND SECTION OF DESPATCHER'S OFFICE, SCRANTON

The Utah Light, Power & Railway Company, of Salt Lake City, has been laying some tracks on paved streets with 80-lb. Shanghai T-rail, with ties surrounded by concrete and thermit-welded joints. The welding has been carried on with great success, according to reports of R. F. Hayward, chief engineer of the company.

THE UNDERGROUND DISTRIBUTION OF POWER FOR URBAN ELECTRIC TRACTION*

BY JAMES HEYWOOD,

Assistant Superintendent of Lines and Cables, Philadelphia Rapid Transit Co.

It is only fifteen years since the installation of the first underground feeders to be used in connection with an overhead trolley wire. The standard size of cable employed at that time was No. 0000 B. & S. gage, and the distances over which power was transmitted were comparatively short. During the next five years great improvements were made in the methods of d. c. distribution by underground cables. As the street railway systems were extended, the problem of delivering power to distant points at reasonable cost and economy of transmission became more serious. With the perfection of a. c. apparatus, the distribution system has become a still more important feature of the entire plant, and the distribution engineer has had to lend all his energies to the problem of obtaining as nearly absolute reliability as is possible.

The investment per kilowatt for the conduits and cables required by a modern city railway system approaches very closely that necessary to erect the generating station.

With d. c. generation and distribution, the first problem to be solved is the location of the station or stations. The center of the load and the facilities needed by a generating station are seldom found at the same point. As the distances to which power must be transmitted become greater, a point is soon reached with the d. c. system where it is more economical to erect another generating station rather than install feeders to supply outlying districts. In increasing this limit, boosters and accumulator stations have been used with great success. The final determining condition is when the investment charges on the cables, plus the cost of the energy lost in transmission, equals the interest on the capital required to construct an additional station.

With the a. c. system the generation of power may be centralized at a point where coal and water are cheapest. Power may then be transmitted at high voltages to rotary converter stations, located near the center of load, and d. c. current distributed to trolley wires or conductor rail, as the case may be. These transmissions are made with a very small percentage of loss due to drop. The comparatively small cost of converter stations has naturally reduced the distance between distributing centers, and consequently decreased the losses between busbar and trolley wire. In densely populated cities the economical arrangement seems to be to place a converter station in the center of an area having a radius of approximately 1 mile.

As the converter stations depend directly for their motive power on the transmission lines from the generating station, a degree of reliability in the cables equal to that of the generating station itself is demanded. We have not yet reached the stage where a cable never burns out. It is therefore essential that each sub-station be provided with at least one cable more than the number actually required to do the work.

CONDUITS

The first condition of reliability in transmission cables is a good conduit. Various materials have been employed in the construction of conduits, among them: paper, glass, wood, cement, terra-cotta and ordinary wrought-iron pipe. The last three are those in most common use to-day. Creosoted wood and cement-lined iron have also been very extensively employed, but we may safely say that most engineers have decided in favor of terra-cotta pipe in some form. Lead cables, when laid in wooden or cement pipes, are subject to corrosion, due to chemical action. Iron pipes often have sharp edges and burs, which are microbes of a most deadly type where a lead-covered cable is concerned. Iron pipes have other objections which will be touched on later.

The chief objections to terra-cotta pipe are the difficulty in procuring good alignment and the care which must be taken to keep the joints tight. A great deal of trouble has been caused by allowing cement to enter the joints of terra-cotta conduits through the bottom of the duct, where it forms a long, low mound under the open joint. After it has hardened in this position its removal is very difficult, particularly if attempted after the conduit is finished and the street paving restored. It is advisable, immediately after finishing a terra-cotta conduit, to draw through it a rigid die of slightly smaller diameter than the duct and as long as a section of duct. A well-laid terra-cotta conduit, surrounded by a wall of concrete, is, however, a most satisfactory construction.

Conduit should be laid in a formation which will present the greatest amount of radiating surface to the surrounding soil, in order to dissipate as much heat as possible. A vertical formation of ducts, such as shown in Fig. 1, is especially desirable, because the cables can be arranged to good advantage in the manholes. For instance, a 20-duct conduit, laid 2 ducts wide and 10 ducts high, will permit 10 cables to be hung on each side of the manhole, and this can be done without any crossings of the cables. It will readily be seen that if the ducts were laid 10 wide and 2 high, considerable bending would have to be done in arranging the cables around the manhole walls.

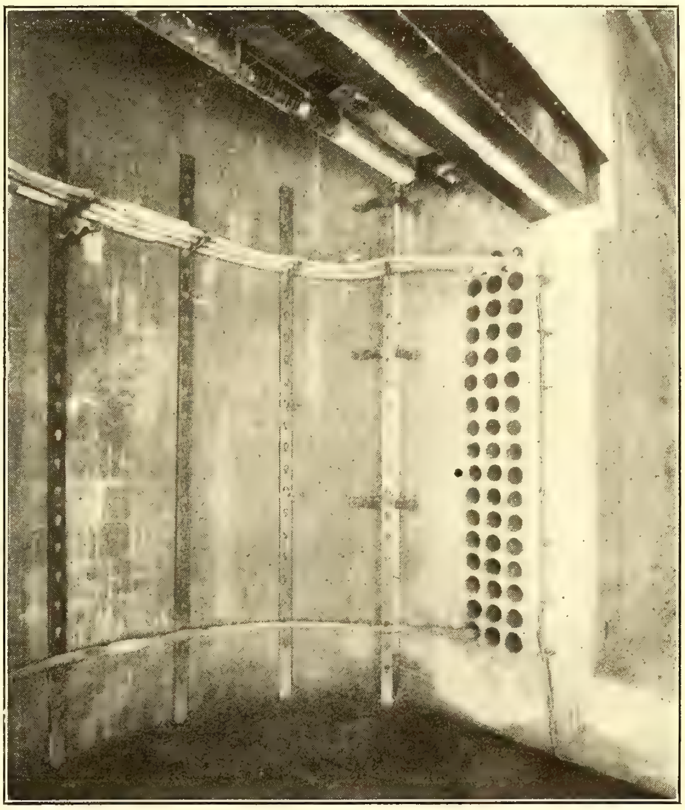


FIG. 1.—INTERIOR OF MANHOLE, SHOWING DESIRABLE ARRANGEMENT OF DUCTS

It is next to impossible, however, to lay ducts through a modern city street and obtain the ideal formation. It is often necessary to change the formation at certain locations, particularly when crossing an intersecting street. There is a great temptation, when a particularly difficult crossing is encountered, to use iron pipes because of the ease with which these pipes may be sandwiched between other underground structures. It is a mistake to employ iron pipe in these cases, if by digging a deeper trench and going under the obstructions its use can be avoided.

The shape of the manholes is an important item in the construction of a conduit. They should be designed so that the

* A paper presented before the Philadelphia branch of the American Institute of Electrical Engineers, April, 1905.

cables will have to be bent as little as possible, although it is essential that the cables be bent to some extent in order to place them in a position where they are least subject to mechanical injury.

An elliptical shape, such as is shown in Fig. 2, seems to be well adapted to fulfil these requirements. Intersections where two conduits cross at right angles and enter the same manholes have always been troublesome. An approximately square hole set diagonally is well adapted to these location. (See Fig. 3.) Cables entering the corners can be formed around the walls and splices can be made without excessive bending.

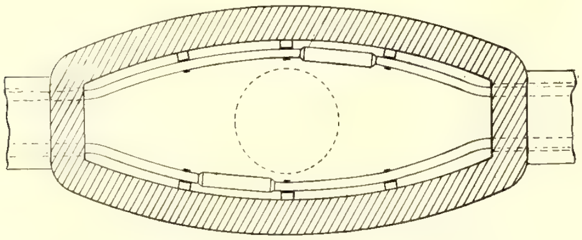


FIG. 2.—PLAN OF ELLIPTICAL MANHOLE

The distance between manholes should be made as great as is practical for drawing in the cables. A good standard of length between manholes is 500 ft. It is often necessary to place manholes at shorter intervals, however, on account of sudden changes in grade. Ducts should be laid at such grades as to drain themselves into the manhole.

HIGH-TENSION CABLES

The insulating material for high-tension cables has been the subject of a great deal of discussion and experiment. In this country, manila paper, thoroughly impregnated with a good insulating compound, is now used almost exclusively. Rubber compound cable has also been employed with considerable success, and has certain advantages over paper, but is from 30 per cent to 40 per cent more expensive, and under certain conditions is subject to more rapid deterioration.

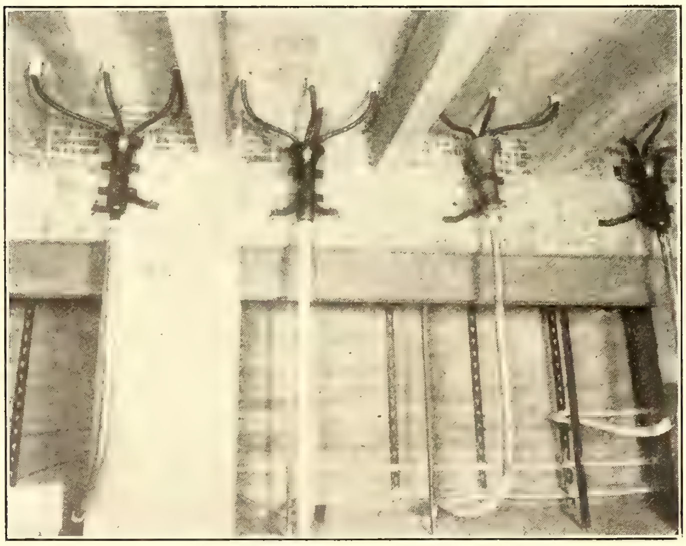


FIG. 4.—METHOD OF ARRANGING TERMINALS

A three-conductor cable, with each conductor insulated from the others, and from ground, is usually used in three-phase railway transmission. Each conductor is a round, stranded cable, covered with spiral wrappings of paper. The cables are then twisted together and covered over with a spirally wrapped paper belt, and the thickness of the belt usually equals the thickness of paper on each individual conductor. As the interstices between the conductors are filled with jute laterals, the entire cable is a true cylinder and strong mechanically.

A cable constructed in this way would probably operate successfully under 15,000 volts. For voltages much above this, an insulating material of greater dielectric strength would have to be used, as the thickness of an insulating wall of saturated paper is limited by its liability to fracture during installation. Other materials, such as impregnated woven fabric, have higher dielectric strength, but are more expensive.

Paper insulation 6 x 6—i. e., 6/32 in. thick on conductors and 6/32 in. on the belt—if carefully handled, will not fracture and can be depended upon to stand a break-down test of 30,000 volts between any one conductor and the other two conductors grounded to the sheath. Foreign cable makers are making extensive use of triangular-shaped conductors, which obviate the necessity of jute fillers. This arrangement allows of slightly greater cross section in the conductors for a given diameter of completed cable.

As the life of a paper cable depends largely upon the integrity of the sheath, too much care cannot be taken in procuring a good lead of the proper thickness. The lead should be of uniform thickness and free from pinholes or other defects of manufacture. For heavy, three-conductor cables a sheath 5/32 in. thick is not too heavy. A cable containing three No. 0000 B. & S. gage conductors with 6 x 6 insulation and 5/32-in. lead will measure about 2⅝ ins. in diameter, and is about the largest size which should be used in 3-in. ducts. Larger ducts would permit the use of larger cables, but they increase the cost of a conduit very materially, especially in streets which are already crowded with underground structures. The size of conductor to be used is, of course, determined by the amount of power to be transmitted. With the distances usually encountered in city work and using voltages above 10,000, cables can be operated up to their full heating capacity without causing prohibitive drops.

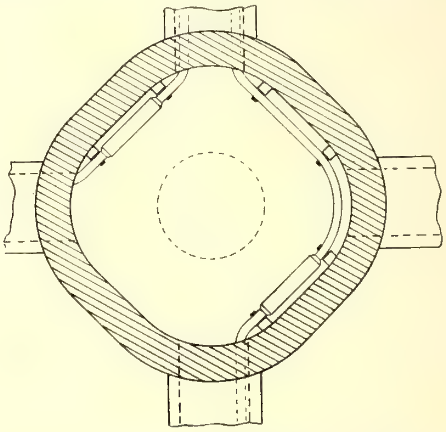


FIG. 3.—PLAN OF APPROXIMATELY SQUARE MANHOLE

TERMINALS

Very satisfactory terminals are made of solid brass or bronze castings, designed to fit over the lead of the cable at one end and flaring out in bell shape at the other. The three conductors are brought through separate holes in a soapstone or wooden disc. (See Fig. 4.) The leads are usually rubber-insulated and covered with a protecting braid of cotton, either weatherproofed or treated with a fire-resisting chemical. Great care should be taken in procuring good rubber compound for these leads. It is a difficult matter to draft specifications which will bind an unscrupulous manufacturer to produce a good rubber compound.

Mechanical tests in which the stretch and "set" qualities of the rubber are noted are very useful, but not entirely reliable in determining the percentage of Para rubber in the compound. An inspection of the mixture at the manufacturer's factory is sometimes made. Valuable data relative to rubber compounds

are given in a paper recently read before the Manchester Section of the British Institute of Electrical Engineers by L. B. Atkinson and C. J. Beaver. The joints in the conductors should be staggered and well down below the disc so as to be thoroughly immersed in the insulating compound with which the bell is filled.

TESTS

High-tension cables should be subjected to a break-down test of twice the working voltage, both in the factory and installation. Numerous break-down tests are not necessary, and are undoubtedly injurious. The writer has known a cable to stand a test of 30,000 volts and break down under 15,000 volts a few hours later. Another cable which was undergoing a ten-minute test of 30,000 volts withstood the pressure for nine minutes and then broke down. There is considerable evidence to show that too much testing strains the insulation.

High-tension cables should be provided with static dischargers to protect them against undue stresses due to abnormal voltages.

INSTALLATION

Some essential points to be considered in a successful installation are: First, a clear duct; second, no sharp bends; third, the isolation of each cable from its neighbor. Assurance can be had of a clear duct by drawing a die through before pulling the cable in. Bends of sufficient radius can be secured by using properly designed manholes.

The third essential has been accomplished in several ways. Stone or brick shelves in the manhole walls have been used, but they do not protect the cables as the latter leave or enter the ducts.

Asbestos webbing wound spirally around the outside of the sheath and held in place by galvanized-iron ribbons has been used with considerable success. If the asbestos is saturated with silicate of soda solution iron ribbons may be dispensed with and at the same time greater fire-resisting qualities secured. Hydraulic cement reinforced by a spiral wrapping of hemp rope and formed around the cable is used by some companies.

FIG. 5.—DRAWING IN CABLES WITH ELECTRIC WINCH

Cables may be pulled into the ducts by hand or power winches. Fig. 5 shows one method of pulling in cables by means of an electric motor. High speeds of from 50 ft. to 75 ft. per minute may be used with safety provided the pull is steady.

D. C. CABLES

As the size of the distributing feeders must be calculated for the maximum load which is likely to be encountered, the load factor of each trolley section is an important item. Long sections have better load factors than short ones, consequently are more economical in the amount of copper required to feed a given length of trolley wire.

Three methods are commonly used in calculating feeders, viz.:

(1) Make all trolley sections of equal length and calculate the feeder to give a predetermined drop under full load.

(2) Make all feeders of equal size and vary the length of sections according to their distance from the sub-station to give a predetermined drop.

(3) A combination of both methods may be followed, using two or three standard sizes of cable—e. g., 750,000 circ. mil, 1,000,000 circ. mil, 1,500,000 circ. mil and 2,000,000 circ. mil—thereby reducing the number of different sized cables which must be carried in stock for repairs.

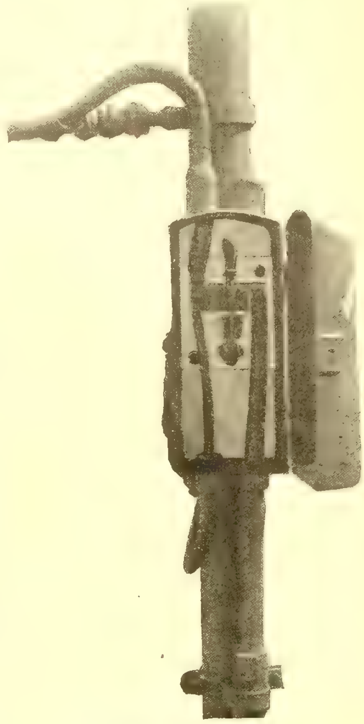


FIG. 6.—TAP SWITCH-BOX

In calculating feeders liberal allowances should be made for abnormal conditions, such as storms and blockades, at which times it is occasionally very desirable to be able to move a large number of cars simultaneously.

Saturated paper cables with a 5/32-in. wall of insulation are giving excellent results for 600-volt d. c. feeders. This thickness of paper gives an electric factor of safety approximating 10, but cannot be materially reduced for mechanical reasons.

Tap cables with twice the carrying capacity of the trolley wire should be installed at frequent intervals, and should be provided with quick-break switches which can readily be opened in case it becomes necessary to "cut out" a cable. A convenient form of tap-switch box is shown in Fig. 6. Rubber-insulated cables are best for taps, as they can be connected to the switch terminals without the use of pot heads and are not subject to mechanical injury in drawing them around bends in the iron pipe which is used in bringing taps up the poles.

Tap cables, and in fact all cables passing through iron pipes, should be covered outside the lead with weatherproof braid. When a burn-out occurs, a large amount of current, seeking a convenient path to ground, flows along the sheath of the cable, and will often burn holes in the lead at the points of contact with iron ducts. A good weatherproof wire will usually prevent this trouble.

RETURN CABLES

It has been said that engineering is the art of spending money. If this be a true definition the engineer has a splendid

opportunity for practicing high art in laying out a return cable system. The current-carrying capacity of rails, where there is a grid system of tracks, has often been underestimated, and numerous small return cables have been installed to parallel the tracks. These cables usually occupy valuable duct space and are of little or no use, as nearly all the return current flows through the rails to the station. Short, heavy return cables well bonded to the tracks at important intersections near the station and well bonded rails beyond these points provide an economical return system.

PREVENTION OF ELECTROLYSIS

However good a return circuit may be, the current will divide according to Ohm's law, and take paths other than those intentionally provided, thereby causing potential differences of varying intensities between the lead cable sheaths and ground. To prevent electrolytic action where moisture is present, it is essential that the lead be kept negative. This is usually accomplished by providing a path from the sheaths to the negative bus-bar, which has a lower current density, and consequently less drop than the return cables.

LOCALIZATION OF FAULTS

Notwithstanding the precautions which may be taken, underground cables will occasionally fail. If the trouble is due to a hole in the sheath it can often be detected before a burnout occurs. A daily insulation test of all feeder cables, including the trolley section, can readily be made with an ordinary voltmeter, and will often detect the presence of this kind of trouble. An ingenious device was patented some years ago by W. D. Gherky, wherein a small paper or cotton-insulated wire was wound spirally around the insulation of a feeder cable immediately inside the sheath and spliced through from end to end. Insulation tests made on this wire would detect a hole in the sheath before moisture could percolate through to the conductor. In practical use, difficulty was found in keeping the test wire from breaking while the cables so equipped were being installed.

Faults of very low resistance in feeder cables can be located by passing an alternating or pulsating current of very low frequency into the cable and through the fault to ground. If a small compass is placed on the cable between the station and the fault, deflections will be noted, while no deflection can be detected beyond the fault. This method was described by H. G. Stott in a paper read before the American Institute of Electrical Engineers in New York.

Feeder cables often burn themselves "clear," and in these cases the fault must be broken down by means of a high voltage, or the "cut and try" method may be resorted to.

High-tension cables often break down between two conductors or from two conductors to ground. In these cases a good conductor is left, and the location of the fault can very rapidly be determined by a loop test. A properly proportioned slide wire and galvanometer with a suitable source of current supply can usually be depended upon to locate the trouble within a fraction of 1 per cent of the total length of the cable.

A complete record showing the location of each manhole through which a cable passes and its distance from the station is of great value when making localization tests.

IMPROVEMENTS UPON THE DETROIT UNITED RAILWAY

Extensive improvements are under way in the electrical department of the Detroit United Railway, Detroit, Mich., involving large additions to the power generating equipment as well as also to the distribution systems, in order to keep pace with the rapid growth of traffic upon its lines of the past year. The policy of the company has been very strongly toward expansion and progress, in addition to maintaining its rolling stock equipment in the best possible and most attractive condition. Liberal and effective advertising has also been resorted to, with extremely favorable results in increased business.

To secure additional power, one of the main power stations of the company has been extended to accommodate an additional generating unit and the necessary boiler capacity. Power is also now delivered to the company by the Detroit Edison Company from a 1000-kw motor generator recently installed in the new steam-turbine power plant of the latter company at Delray. The latter unit delivers power for the lines of the company extending through the western portions of the city to the many growing suburbs along the river front. The new generating unit at the main power plant consists of a large horizontal Allis-Chalmers compound engine, direct connected to a 1500-kw Westinghouse railway generator. The engine has 32-in. and 68-in. cylinders with 60-in. stroke, and operates condensing, using one of the new barometric condensers of Tomlinson design, recently produced by the Allis-Chalmers Company. The new boiler equipment consists of four 350-hp Stirling water-tube boilers, which were installed with Murphy stokers.

The 2500-amp. storage-battery plant of the company is being moved to a point in the suburbs, some 6 miles distant from the main power station, where it will be installed with a distributing and equalizing switchboard governing all of the principal lines running out to the northern end of the city. From this board equalizing feeders will extend out to near the north ends of these north and south lines, so that in times of peak loads the battery may be thrown on to any one or all of these lines as necessity may require. At times of light load, when the battery is not discharging upon the line, all of these lines may be equalized with each other through the circuit breakers and switches upon the board, by means of a common bus upon the board. This board will be constantly under the care of an attendant and will greatly improve the distribution to these distant portions of the city. The distribution system has been greatly reinforced by the addition of some 28 miles of 1,000,000-circ. mil and 500,000-circ. mil copper feeder cable.

YORK COUNTY TRACTION COMPANY TO USE SELF-WINDING ELECTRIC CLOCK

In order to facilitate the operation of cars, the York County Traction Company, of York, Pa., will place a large self-winding electric clock in service on the west wall of the Weiser Building facing Center Square. The clock will have a dial 2 ft. in diameter, with hands and numerals that may be seen across the square. At night the dial will be illuminated. The company has been operating its cars on Eastern standard time received daily from Washington at the Western Union Telegraph office in York. The watches of the operatives are set according to this time. The company, in the moving of its cars, has found it impossible to be guided by either of the city clocks, which usually are at a variance with the time at the Western Union Telegraph office. The new clock will be inspected daily, and set according to standard Eastern time direct from Washington. The clock has been ordered from the Self-Winding Clock Company, of Brooklyn, N. Y.

The first evidence of an effort on the part of steam roads in the vicinity of Evansville, Ind., to curb the inroads of electric railways is manifest by the Louisville & Nashville announcing that it will begin interurban train service between Evansville and Mt. Vernon soon. The electric railway between these cities is not yet completed.

THE QUESTION BOX

Under the heading "General," there are discussions on claim department methods, the best method of collecting and checking interurban fares, memorandum books, sprinkling requirements and ticket destroyers; life insurance and record keeping are treated in the employees' department; feed-water arrangements, piping and coal handling are considered under "Steam Engineering;" and in the line department there are descriptions of several devices.

A.—GENERAL

A 10.—What percentage of your gross receipts are you paying out through the claim department?

Damages run three-fourths of 1 per cent of gross receipts.

DENVER CITY TRAMWAY CO.

A 11.—A company wishes to set aside a certain fund each year to cover all accident claims. Should this fund be based on a definite sum per car-mile, or on a percentage of the total gross receipts? What would be a proper allowance?

We should prefer the gross receipts, as the fraction per car-mile would be so small, although either could undoubtedly be used with very close accuracy. DENVER CITY TRAMWAY CO.

A 13.—In the electric railway business, is an accident liability insurance company—mutual or otherwise—feasible? Why?

We think each individual company can handle its own business to best possible advantage. Our experience has been that we can carry our own insurance for about 10 per cent of what the insurance companies would charge us. DENVER CITY TRAMWAY CO.

A 13a.—How can the claim department best co-operate with the operating department in the prevention of accidents?

A 13b.—Have you ever used the camera to good advantage in adjusting damage claims?

Our claim department prepares quarterly, tabular condensed statements of accidents, similar to the method followed by the Pennsylvania Railroad; these reports are of great value in studying general means for the prevention of accidents as well as the particular steps that may be taken after each individual accident. We use the camera whenever we believe a photograph can be exhibited to advantage. THEODORE STEBBINS, Gen. Mgr. for Receivers, Appleyard System, Columbus, Ohio.

A 37.—What is the best method of collecting and checking fares on interurban roads?

In collecting fares on an interurban road it is customary to give the passenger some form of receipt. This receipt must show the points between which the passenger travels and the amount paid, otherwise it is a practical impossibility to check the work of the conductor, even with two inspectors on a car. With a cash-fare receipt showing the points between which passenger travels and price paid, the work of the conductor can be checked with precision and very little work by methods hardly to be described within the scope of this answer. The cash-fare receipt must also be of a form which can be handled with great rapidity.

THEODORE STEBBINS, Gen. Mgr. for Receivers, Appleyard System, Columbus, Ohio.

A 47.—Have you worked out any special form of hand book or note book by which the manager can keep in convenient shape for quick reference the various data and statistics relative to his property, such as comparative receipts, car mileage, station output, etc.? How do you keep this information? Sample pages or sheets from your book, with description, will be appreciated.

In the matter of keeping data, it has been the writer's experience that no single form of note book or file meets all the requirements. To outline briefly the methods which have been found successful, the really useful arrangements are the alphabetical compartment letter file; the loose leaf book and the plain bound note book. The letter file serves as a receptacle for all data in the way of clippings, such as short extracts from the technical journals, small blue prints, curves, tables already printed and small drawings and photographs. Personally, I have found the geographical separation of subjects the most satisfactory, filing a Boston elevated test under Boston, rather than under multiple unit control; for instance, a reinforced concrete bridge in St. Paul under S, and so on. The loose leaf book seems to be the best arrangement for handy use in one's grip, or in small sizes in the pocket. It is especially adapted to the use of the busy manager who wants to find therein brief facts and figures that are of more or less private nature, and which have not been published. It is a simple matter to paste useful tables, curves, etc., into a loose leaf book, but it is an utter waste of time to copy anything into a note book which can be pasted in or preserved just as well in a file. The following statement gives an idea as to how this information can be tabulated:

Power Stations—Estimated Costs per Kilowatt (Steam Engine Driven).

	Maximum	Minimum
1. Buildings	$15.00	$8.00
2. Foundations	3.50	1.50
3. Boilers and settings	17.00	9.00
4. Steam piping	12.00	4.00
5. Engines	32.00	20.00
6. Generator	21.00	18.00
7. Pumps	1.00	1.00
8. Switchboards	4.00	1.50
9. Feed-water heaters	2.00	1.00
10. Wiring and conduits	6.00	3.00
11. Coal conveyors and coal tanks	6.00	2.00
12. Smokestack and flues	2.00	1.00
13. Fuel economizers	4.50	2.50
14. Stokers	3.00	2.50
15. Ash conveyors	1.50	1.00
16. Incidentals, concrete flooring	2.00	2.00
	$132.50	$78.00

With steam turbines the cost will be about 70 per cent of the maximum costs listed.—W. C. Gotshall.

Lastly, the plain bound note book is useful in making filed notes, or recording tests on the ground, where a continuous story of important happenings is wanted. The card catalogue is of the utmost value for reference work and certain kinds of office data, but its bulk largely destroys its usefulness in the field.

H. S. KNOWLTON, Newton, Mass.

A 48.—Information is requested regarding the sprinkling of streets by street railway companies, and particularly the proportion of street usually sprinkled, and the amount paid by the city and municipalities for this service. Does your company sprinkle streets? If so, on what terms?

The Chicago City Railway Company is required by ordinance to sprinkle its right of way, 16 ft. wide, from May 1 to Nov. 1. All streets are sprinkled four times a day during the season, except on Sundays, when only three sprinklings are required. The first sprinkling must be completed before 8 a. m.; the second sprinkling between 8 and 11 a. m.; the third sprinkling between 12 m. and 3 p. m., and the fourth sprinkling between 3 p. m. and 6 p. m. The right of way in the business district on both electric and cable tracks is sprinkled by contract. The work is usually let to the contractor who sprinkles the balance of the street for the property owners. They do the work with wagon sprinklers. We operate sixteen electric motor-driven sprinklers, each holding 1600 gals., which sprinkle the right of way on all our electric tracks. We have one sprinkler which is trailed behind a grip car, and is used only on the cable lines. We have several streets where we have to use wagon sprinklers, owing to the fact that we have no provision for filling the tank cars without interfering with the regular traffic on the street; in these cases, we use our own wagons. We do not receive any pay from the city of Chicago for this service, but have to pay the city for all the water we use. During the year 1904, it cost the Chicago City Railway Company $43.70 per mile of single track to sprinkle its right of way.

HARVEY D. FLEMING, Supt., Chicago City Railway Co.

B.—EMPLOYEES

B 17a.—What arrangements have you whereby employees can secure life insurance or pensions? Please give details and the results secured.

This company fosters a death benefit association for its employees. The association is run on the assessment plan, and every time it is necessary to make an assessment in the event of a death the company adds $100 to the amount collected from the members, the death benefit being $500 in each case. The company also furnishes the clerical aid necessary for handling the business of the association. E. R. GILBERT, Asst. to Gen. Mgr., Chicago City Ry. Co.

B 27.—What do you consider the best system for keeping records of individual conductors and motormen? Please describe the system you use.

On this road each division superintendent keeps a record of his own men, this record including entries of individual instances of disobedience to rules, of which the superintendent is informed either from his own observation or from the main office. The main office handles the secret service checking system.

E. R. GILBERT, Asst. to Gen. Mgr., Chicago City Ry. Co.

F.—STEAM ENGINEERING

F 21.—Where feed-water is taken from city mains on meter basis, what is a fair charge for the water?

One mill per cu. ft. FRANCIS G. DANIELL.

F 24.—What advantage or economy is obtained by the use of automatic boiler-feeding devices?

Automatic boiler-feeding devices increase the economy of the boiler by giving it a uniform feed of water. High water, which causes wet steam, does not occur, and low water, which may cause the boiler to burn or explode, is avoided. Boiler-feed pumps steady the work on the boilers, increase their life, and reduce the boiler repairs. On the other hand, their employment may tend toward carelessness on the part of the employees, and consequent danger should the apparatus fail in its operation. The boiler, therefore, should always be provided with high and low-water alarms.

E. G. HINDERT, Chief Engr., Cleveland & Southwestern Tract. Co.

F 34.—What are the relative merits and what the relative cost of iron and brass for hot feed-water piping?

Brass piping will not corrode or fill with scale. Iron will do both. The corrosion is usually the most severe at the point where water leaves the pipe, and where the temperature begins to increase. Brass pipe costs about one hundred times as much as iron. We tried iron, and in less than six months it began to give way on account of corrosion.

E. G. HINDERT, Chief Engr., Cleveland & Southwestern Tract. Co.

F 35.—Do you know of any novel or unusual arrangement of valves or piping on boiler feed-lines that have resulted in better regulation or other advantage in feeding water to boilers? If so, please give detailed description, with sketch if possible.

We have a ring system with valve between each boiler, and means whereby in cases of emergency we can feed through the glow-off.

E. G. HINDERT, Chief Engr., The Cleveland & Southwestern Tract. Co.

F 39.—What is the minimum head of hot-water supply above pump suction for reliable pumping service?

We have found it unreliable to have less than 4 ft., with a suction of about 12 ft. in length.

E. G. HINDERT, Chief Engr., Cleveland & Southwestern Tract. Co.

F 49.—What should be done to prevent coal-storage bins from taking fire by spontaneous combustion?

When coal is stored in yards and exposed to the weather, 3-in. or 4-in. vertical tubes, drilled full of ¾-in. holes, should be set vertically every 4 ft. or 5 ft. apart and run through the whole height of the pile. In bunkers the only way is to empty the bunker as quickly as possible. Never use water to extinguish fire in coal pile, as the reaction of gases caused by water would cause spontaneous combustion. Coal should not remain long in a bunker, and when there are a series of bunkers fill them in regular rotation and at regular intervals, in other words, keep the coal moving.

H. A. TIEMANN.

F 50.—An engineer of a small power station requests suggestions on reducing cost of handling coal from cars to boilers. He does not believe size of plant warrants chain bucket conveyors. Can you give him any pointers or "wrinkles" on reducing this cost?

Get the car as close to the boiler room as possible, and shovel the coal off the car directly into the boiler room if the room is large enough. Make a bin that is open at the bottom edge next the boilers convenient for the firemen to get coal out. Cover this bin over the top and up tight to the outside walls, then no dust will arise when coal is being unloaded. This is a very simple, yet good arrangement.

CHAS. H. COX, Gen. Mgr., Lincoln (Neb.) Tract. Co.

Have an elevated trestle built as close to boiler room as possible, and chute coal into boiler room. Always have coal delivered in dump cars.

E. G. HINDERT, Chief Eng., Cleveland & Southwestern Tract. Co.

H.—THE LINE DEPARTMENT

H 4.—What is the best form of cradle or other device for catching broken high-tension lines at highway crossings, or where the lines cross over or under other wires?

Common wire netting, such as is used for fences. The kind that comes in rolls is preferable, as it is light, strong and closely woven and can be reeled off and cut to any desired length. This form of cradle is frequently used in the West, where high-tension lines cross telephone or telegraph lines.

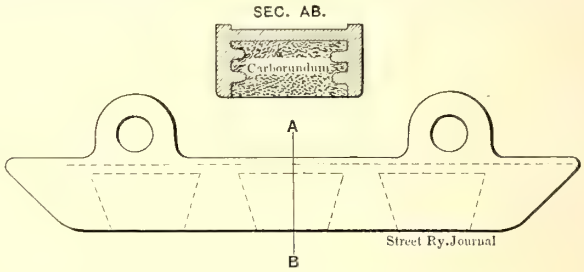
J. B. CRAWFORD, Hartford, Conn.

Would recommend wires parallel under high-tension wires with cross strips of wood having hooks at ends, or ordinary wire "sheep" fence of sufficient width.

H. V. S.

H 16a.—On a road operating with third rail, what is the best method of keeping the third rail clean?

The sketch herewith shows a cast-steel shoe filled with carborundum, designed for removing rust from the third rail. Application has been made for a patent covering this device.



FILLED TROLLEY SHOE

J. E. OSMER, M. M., Northwestern Elevated R. R. Co., Chicago.

H 21a.—What means, machines, devices or special rigged cars are you using for expediting or cheapening the work of the line department? Please send descriptions, with photographs or drawings, and statement of results secured.

We constructed in our own shops, after our own designs, a very handy and efficient construction and repair car, mounted on a Brill 21 E truck. The car is of the box type, having three end and two side windows and two side doors, is painted a different color from other cars, and supplied with a complete set of wrecking and line tools, work bench, heaters, search lights, lanterns, etc. The roof is surmounted by a working platform, built up of wood slats about 2 ins. wide, and spaced 1 in. apart, and entirely insulated from the body of the car. A section of this platform, about 4 ft. x 6 ft., may be raised a distance of 6 ft. above the rest of the car, making a roomy tower capable of rising to some 18 ft. above the track. This tower is rigidly fastened to two double-strength vertical pipes, 3 ins. diameter, which are cross-connected at the bottom, and slide up and down through properly braced iron castings in the roof and over two smaller double-strength pipe, the bottom ends of which are rigidly fastened to the car floor. Attached to the 1-in. pipe, connected across the bottom of the moving vertical pipe, are two pulleys, over which pass ⅜-in. flexible steel tables, which are fastened to the roof of the car at one end, and at the other end to a long pipe roller operated by gears and handle under the workbench. By this means one man can raise two men on the tower if necessary, and by placing the vertical pipes in a line parallel to the length of the car, they give ample support and interfere very little with work in the car. Having both city and interurban lines, this car on lines with 15-minute schedules is able to do most all of the repair work in the day time, and on single-track line with half hour run between turnouts, is very handy for work at night in all kinds of weather.

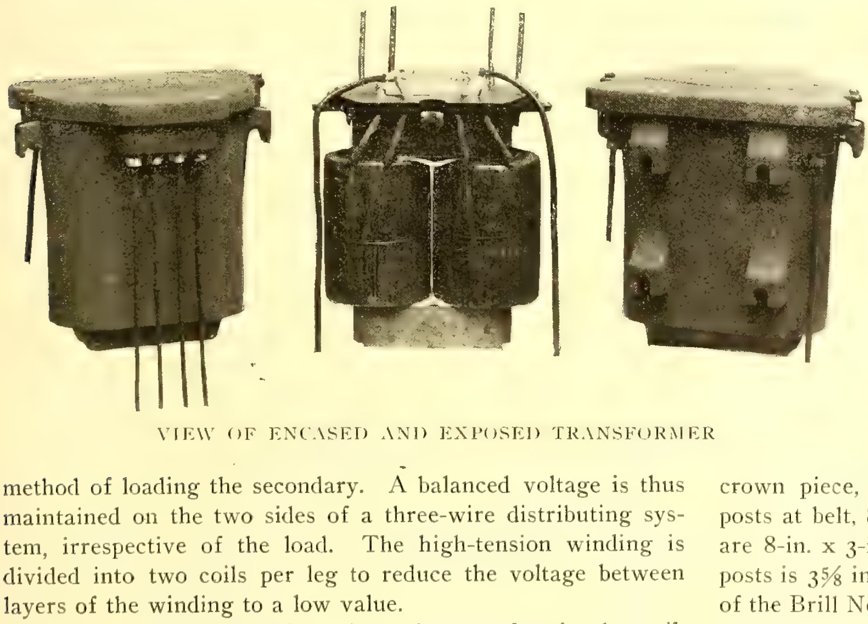
H. V. S.

TYPE C TRANSFORMERS

The Westinghouse Electric & Manufacturing Company has placed upon the market a new line of core type transformers in addition to the large assortment of transformer apparatus regularly made, with which users of electrical appliances are familiar. These transformers will be known as type C, and have operating characteristics closely approximating those of Westinghouse type OD transformers. They are intended for general distribution service on 60-cycle circuits operating nominally at 1050 volts and 2100 volts, although they will operate successfully on voltages up to 1200 and 2400. They are manufactured in sizes from .6 kw to 50 kw, all wound for the same primary voltages, but divided into classes according to the voltages of the secondary. Class 200 may be connected for either 105 volts or 210 volts, and class 400 for 210 volts or 420 volts.

The transformer is enclosed in a cast-iron case with felt gaskets under the lid, so as to make the transformer absolutely weatherproof. For sizes above 20 kw the case is corrugated to increase the radiating surface, but in the smaller sizes a smooth case has surface sufficient to radiate the heat generated. Hanger irons are provided by which any transformer up to and including the 30 kw may be mounted on a pole.

The core of a type C transformer is built up of carefully annealed steel punchings of cruciform shape, and is practically non-ageing. The primary and secondary coils are placed on the long sides of the core, the laminations of which are clamped together at top and bottom by suitable end frames. The low-tension winding is composed of one coil per leg, each coil having two sections so connected that the inner section of one leg is in series with the outer section of the other leg. This arrangement results in a secondary winding of two exactly similar parts, both as to resistance and reactance, and insures equal loading of each primary coil, irrespective of the method of loading the secondary. A balanced voltage is thus maintained on the two sides of a three-wire distributing system, irrespective of the load. The high-tension winding is divided into two coils per leg to reduce the voltage between layers of the winding to a low value.



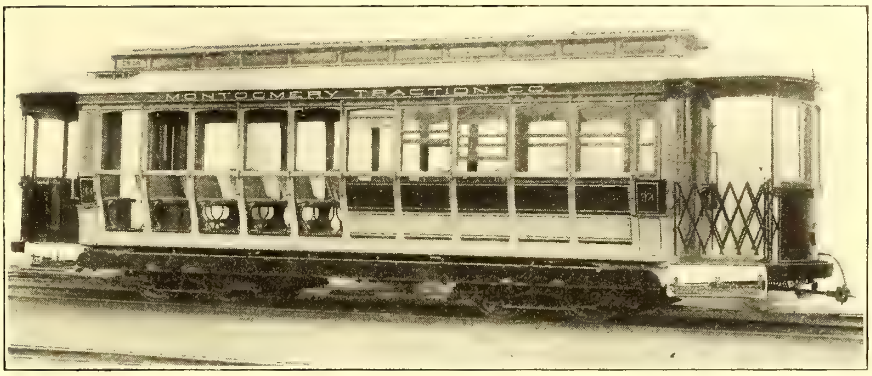
VIEW OF ENCASED AND EXPOSED TRANSFORMER

The core type construction allows the use of a circular coil, which has many advantages. All insulating parts between layers of the winding and between high and low-tension coils are cylindrical in form, eliminating sharp corners which are harmful to insulating material. The windings are so disposed and oil ducts so provided that a free circulation of oil between coils and core is obtained, insuring ready dissipation of the heat and preventing deterioration of the insulation. Very careful attention has been paid to the insulation and liberal allowance made to insure a high factor of safety.

The design throughout has been worked out with the greatest care, and a line of transformers has been produced which can be relied upon for economical operation, durability and continuity of service. Their regulation and efficiency are as perfect as can be secured without detriment to other desirable features. All coils are wound to exact dimensions and all insulation is cut to gage, so that the corresponding parts of all transformers of the same capacity are interchangeable.

CONVERTIBLE CARS FOR MONTGOMERY, ALA.

Four convertible cars with the Narragansett double step have lately been completed for the Montgomery (Ala.) Traction Company, by the J. G. Brill Company. The Narragansett double-step arrangement comprises Z-bar sills with the upper step on the outward extending lower flange of the Z-bar, thereby utilizing the space ordinarily occupied by a timber sill. This arrangement enables double trucks having equal sized wheels to be used by overcoming the great objection to long open cars, namely, too extreme width when double trucks are used. It provides a running board of the same height as the platform step, adding safety as well as comfort and speed to the movement of passengers in and out. These cars are intended for city service, and therefore it is highly important that ingress and egress be facilitated to the utmost extent. The illustration gives a good idea of the appearance of the cars, either open or closed. The new cars are seated for thirty-eight passengers, the seats being of spring cane. Quartered oak in natural color, with decorated ceilings, constitutes the interior finish of the cars. Brill portable vestibules are used, the central sash sliding to one side and the side sashes stationary.



CONVERTIBLE CAR HALF CLOSED

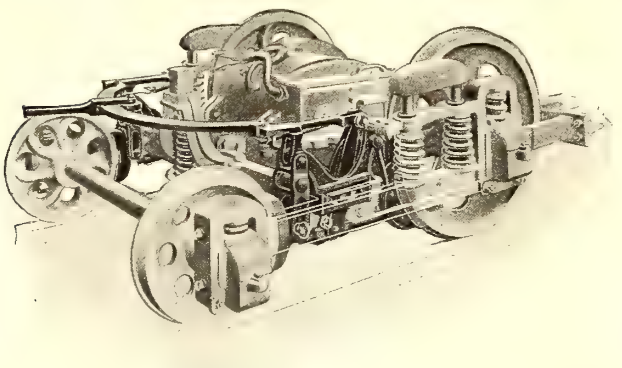
The length over the end panels is 28 ft. 4 ins., and over crown pieces, 38 ft. 4 ins. The other dimensions are: From panel over crown piece, 5 ft.; width over sills, 7 ft. 8 ins., and over posts at belt, 8 ft. 6 ins.; sweep of posts, 5 ins. The side sills are 8-in. x 3-in. x ½-in. Z-bars. The thickness of the corner posts is 3⅝ ins., and of the side posts, 3⅜ ins. The trucks are of the Brill No. 27-G type for fast and heavy city and suburban service. They have a wheel base of 4 ft. and 33-in. wheels.

J. G. White & Company, Ltd., London, England, have been awarded the contract by the London County Council for the reconstruction of the tramways from North Street, Wandsworth, via York Road, Battersea Park Road, etc., to Westminster Bridge. The contract price is £163,874.

A NEW TYPE OF BRAKE

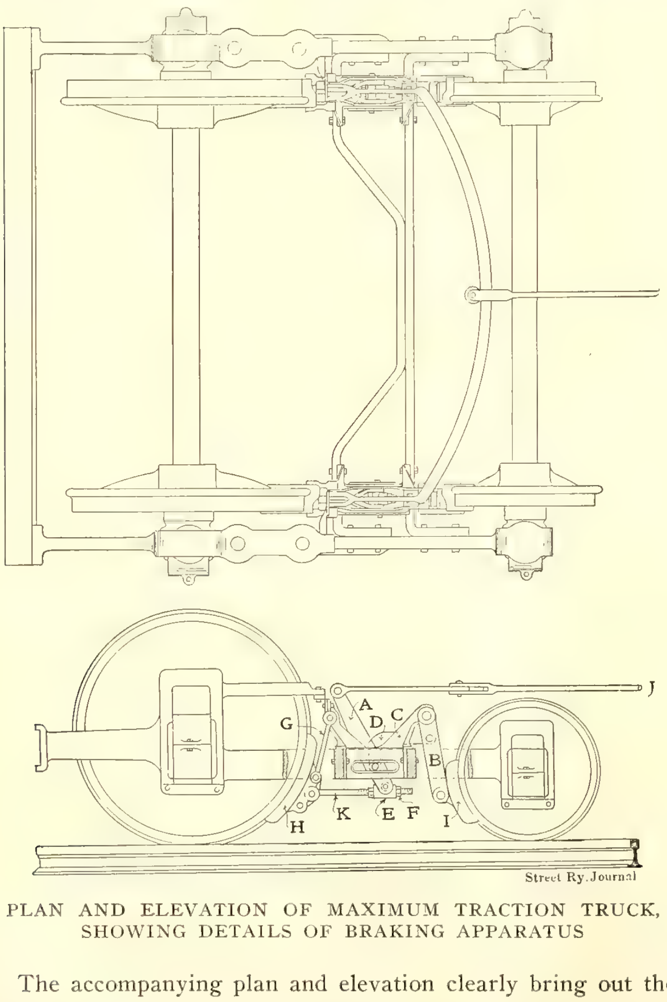
The Columbia Machine Works & Malleable Iron Company, of Brooklyn, has just placed on the market a new quick-acting beamless inside-hung brake. The inventor of the brake is Charles E. Remelius, superintendent of rolling equipment of the Public Service Corporation of New Jersey, who designed it especially for the Brill Eureka maximum-traction truck.

Several novel and important features are claimed for the new apparatus. A car of the Brooklyn Rapid Transit Company



GENERAL VIEW, SHOWING APPLICATION OF BRAKING APPARATUS

was equipped with the new brake and put into service on May 5, 1905, and up to July 17, notwithstanding the constant wear to which the brake rigging was subjected, it was only adjusted three times, and there was no report of slack chain or any defect in the mechanism. The brake-shoes that weighed 30 lbs. each in the beginning only lost 10 lbs. of weight per shoe.



PLAN AND ELEVATION OF MAXIMUM TRACTION TRUCK, SHOWING DETAILS OF BRAKING APPARATUS

The accompanying plan and elevation clearly bring out the compactness and neatness of the scheme. The braking mechanism on each side of the truck is confined to the space within the wheels, while the usual brake-beam is eliminated, it being replaced with a pull-bar situated in a space outside of that devoted to the motor. The pull-beam is operated by a single rod. This arrangement leaves the motor unencumbered, so that there is easy access for repairs. It also expedites the removal of wheels and provides supports for side bearings, all of which have a very important bearing on satisfactory and economical maintenance.

Again referring to the drawing, it is seen that the usual motor support and a second cross-bar riveted to the center of the former makes the seat for the cast-steel frame, *C*, that supports the brake proper. The braking effect is obtained by a combination of levers; *A*, the main lever, being one of the first-class, with the fulcrum at the center, and *B*, the secondary lever, one of the third-class, with the fulcrum at the end. *A* and *B* are connected by means of the link *D*. The load end of the secondary lever *B* is directly connected to the pony brake-shoe and hung from *C*, while the load end of the main lever *A* is connected to the driver brake-shoe *H* through the push-rod *K*, the brake-shoe *H* being hung from frame *C*. When power is applied to the brake-rod *J*, which is connected with the main lever *A*, an analysis of the combination shows there is a close relation between the amount of movement of the brake-rod *J* and that of the brake-shoes. This relation depends on the relative lengths of the lever arms, which may be adjusted or varied. When the arms of lever *A* are as 1 is to 4, and the arms of *B* as 1 is to 3 from actual demonstration with slack shoes, it only requires three-quarters to a full turn of the brake handle to accomplish a full-speed stop. The shoes are equally as quick to release when the power is let off. Another desirable feature of the brake is that a great deal of the shoe must be worn away before it is necessary to make any adjustment of the brake. Still another feature is that the braking power is divided unevenly on the driver and pony wheel—that is, the major portion of the braking effect being accomplished by the driver-shoe *H*. A connecting pull-bar provides for independent equalization of the two brakes on opposite sides of the track, and any slight difference in the proportion of the parts of one side over those of the other may be compensated by the adjustment of the trunnion *E*.

The details of the foregoing brake have been very carefully worked out, each part having economical and substantial sections, with the levers *A* and *B*, link *D* and frame *C* of cast steel. Cars are now being equipped with this brake for the Public Service Corporation of New Jersey and for the Philadelphia Rapid Transit Company.

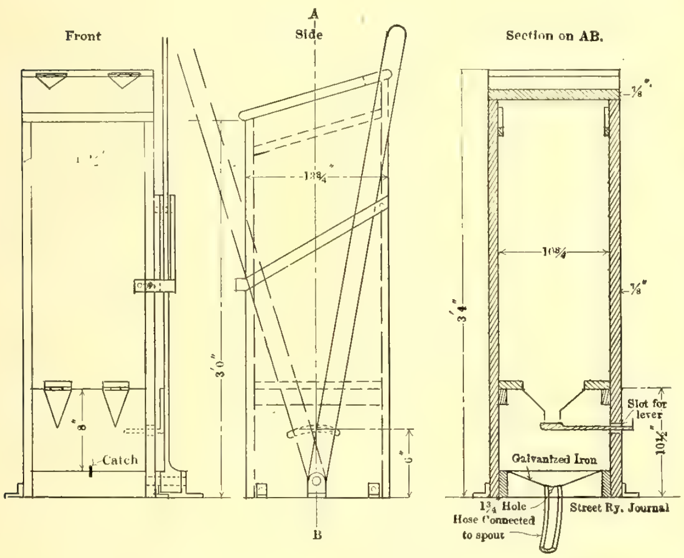
The Columbus, Buckeye Lake & Newark Traction Company and the Columbus, Newark & Zanesville Traction Company have discontinued the limited parlor car service between Columbus and Zanesville, as it was not very profitable.

In an editorial article in the "New York Medical Journal" of July 29, Dr. G. Frank Lydston discusses the ventilation of street cars. He says that if there is anything more unsanitary than the crowding together of all sorts and conditions of people in various states of health and cleanliness, he is not aware of it. The trouble at present, according to the author, is due partly to inadequate ventilating apparatus, but more to the passengers and conductors themselves. A proportion of the former object to imaginary or real drafts, while the conductors do not take the trouble to open the ventilators, or else keep them closed to economize in the heating of the car. The remedy suggested is to provide a double ventilated roof with suitable apertures for ventilation at various points in the lower part of the car. These openings should have no means of closure, thus making both conductors and passengers helpless in the matter of opposing proper ventilation.

A NEW SAND BOX FOR SCRANTON

A new design of sand box has been in use by the Scranton Railway Company, at Scranton, Pa., for some time past with excellent results. The important feature of the sander is the feeding device, which is so arranged that clogging at the valve by accumulations of damp sand is entirely prevented. This difficulty had formerly been experienced to an uncomfortable degree, because Scranton is a very hilly city and a large amount of sand had to be carried in the hoppers. In wet weather moisture would inevitably gain access to the spout hose and gradually work past the valve into the lower funnel portion of the box, with the result that the sand would pack and refuse to feed out onto the rail when needed.

The principle of the new sand box is shown in the accompanying drawing. The box, which is about 1 ft. square and 3 ft. high, has a funnel bottom 10½ ins. above the floor of the car platform on which the box is mounted. Below this bottom is the outlet valve, which is operated by the vertical hand lever for use of the motorman, and below this valve is a second funnel, which is directly connected to the sand hose. When the sand valve is opened the sand flows out to the lower funnel below and thence through the spout to the rail. The provision



ELEVATIONS AND SECTION OF SCRANTON SAND-BOX

of this air space below the valve has been found effectually to prevent access of moisture to the sand.

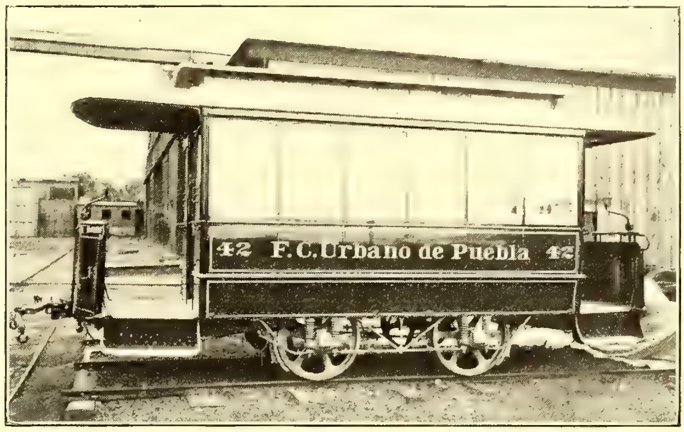
A rapid method of filling sand boxes is employed at the car houses in Scranton. Instead of laboriously carrying sand into the cars while in the car house at night, the cars are sanded as they leave the car house; special men are stationed at the sand bin near the street entrance for this purpose. As the car passes, a man with two pails of sand rapidly passes through a car and fills the box at each end with hardly a moment's delay. Each sand box has a capacity of over 2 cu. ft., which is more than enough for a day's service under most extreme conditions.

The Cœur d'Alene & Spokane Railway has established weekday limited service between Spokane and Cœur d'Alene. By means of the special train now being run, Spokane business men can leave that city at 4:30 p. m., reach Cœur d'Alene fifty-five minutes later, spend the night at the latter place and return to Spokane in time for business the next morning by taking the Spokane limited at 8:28, which gets into Spokane at 9:18. The total distance to Cœur d'Alene from Spokane is 34 miles, or 30¼ miles from the city limits. It requires eighteen minutes to take a train out of Spokane, so that the remaining 30¼ miles are covered in a total of thirty-five minutes.

CAR EQUIPMENT FOR PUEBLA, MEXICO

In these days of electric operation the fact that horses are still used in street railway service is called to mind only when visiting New York or Washington, or inspecting the foreign shipments of some of the large car companies. The horse is still the favorite motive power in Mexico, however, and is one of the few countries for which new horse cars are built. As a reminder of the past, the accompanying illustration of a new closed car recently built by the American Car Company for Puebla, Mexico, is given. Puebla is the second city in size in Mexico, and operates about forty cars for its 16 miles of track.

The car illustrated is 11 ft. 10¾ ins. over the end panels and 6 ft. 6 ins. over posts at belt. The seats are longitudinally



CLOSED CAR FOR ANIMAL TRACTION IN MEXICO

placed and the windows are arranged to drop into pockets in the side walls. Wooden blinds are also provided. The interiors are of cherry and ash, with ceilings of carline finish. The open cars, which formed part of the same order, are 12 ft. ⅛ in. over the end panels and 6 ft. 8 ins. over posts at belt, and have a seating capacity of twenty-five. Like the closed, the cars are finished in cherry and ash, with carline ceilings. Brill gear trucks with 4-ft. 10-in. wheel base and 30-in. wheels are used under both the closed and open types. The American Car Company reports a number of orders for small cars from Mexico, Central and South America.

PROJECTED ELECTRIC RAILWAY FOR LEGHORN, ITALY

There has just been announced the incorporation at Leghorn, Italy, under the auspices of the Banca Commerciale Italiana, of a new tramway company which proposes to build and operate an electric railway between Lucca, Pescia, Bagni di Montecatini and Monsummano, and to establish public automobile service in the towns adjacent to the line. It has the backing of a number of important savings banks and similar institutions, as well as of private capitalists. The capital is placed at $2,400,000, divided into 12,000 shares of 100 lire ($20) each. The headquarters of the line will be at Lucca, and the name of the company is La Societa per la Tramvia Lucca-Pescia-Monsummano. Lucca is 25 miles east of Leghorn; Pescia is 12 miles east of Lucca, and Monsummano is 8 miles east of Pescia.

The Dayton & Troy and Western Ohio lines, operating limited chair car service between Dayton and Lima, have abrogated the excess fare on interline business between points on the two roads, but will still retain the excess on local business on either of the two roads. This is to encourage through travel and to discourage the use of the limiteds by local passengers.

LEGAL DEPARTMENT*

ASSAULTS AND INSULTS BY EMPLOYEES

The law is settled in the State of New York to the effect that when a railway employee commits a wanton or malicious assault upon a passenger the company is liable as matter of law, but that in the case of such an assault upon a trespasser it may be a question for the jury whether or not the servant was acting within the scope of his authority. In the recent decision of the Supreme Court, Appellate Division, First Department, in Barry vs. Union Railway of New York (94 N. Y. Supp., 449), that distinction was administered in a suit brought by a newsboy who boarded a car to sell papers and claimed to have been forcibly ejected and seriously injured by the motorman. It was held that the plaintiff, being a trespasser, the question whether the motorman was acting within the scope of his authority should have been submitted to the jury, and if the finding had been in the negative the company would not have been liable. In Berry vs. Boston Elevated Railway Company, decided by the Supreme Judicial Court of Massachusetts (74 N. E., 933), it was held that where plaintiff, a policeman, was called by one of defendant's conductors to a discarded horse car, used for shelter only, for the ostensible purpose of arresting certain "crooks," as a mere joke on the policeman, and he was injured by reason of a defect in the platform as he boarded the car, the conductor's act was not within the scope of his authority and defendant was not liable, though the act was performed on its premises.

American courts agree quite generally with those of New York with regard to the liability of a railway company for assaults by its employees upon passengers. A recent New York case (Gillespie vs. Brooklyn Heights Railroad Company, 178 N. Y., 347), held a street railway company answerable for insulting language used by a conductor to a passenger. This decision is also in accord with the general current of American authority.

The relation of passenger does not begin until a person has actually touched the car with the intention of entering it. It has been held, nevertheless, as to assaults, that the relation of passenger may continue after one has actually left the car. One of the most recent cases on the subject was Flynn vs. St. Louis Transit Company (May, 1905, 87 S. W., 560). It appeared that defendant's street car conductor committed an unprovoked assault on plaintiff, who was an old man, as he was endeavoring to alight, and pushed or threw him from the car. Plaintiff's umbrella remained on the platform, and when he attempted to get it the conductor kicked him in the groin, whereupon plaintiff hit the conductor with the umbrella, and the latter then followed plaintiff to the street and beat him. It was held that the assault was continuous, and that the relation of carrier and passenger continued to exist during the entire assault.

In Savannah Railroad vs. Bryan (86 Ga., 312), Bryan, a passenger, was kicked off the car by the conductor. Bryan then immediately repaired to the office of the company for the purpose of making complaint to the superintendent. He reached the office in eighteen or twenty minutes. The conductor arrived at or about the same time, and again kicked him and hit him with his fists, and cut him with a knife. It was held that the company was liable for both assaults. In Wise vs. Covington & Cincinnati Street Railway (91 Ky., 537; 16 S. W., 351), it was held: "Where a passenger on a street car leaves the car because he is insulted and abused by the driver, and is pursued and beaten by the driver in the street, it must all be regarded as one continuous wrong, and the railway company is as much liable as if the beating had taken place in its car."

LIABILITY FOR NEGLIGENCE

MICHIGAN—Street Railroads—Killing Cattle—Actions—Evidence—Trial—Misconduct of Counsel—Argument—Direction of Verdict—Instructions—Prejudice.

1. Where a witness subsequently gave the evidence sought to be obtained by a question which was disallowed, the sustaining of the objection was harmless error.

2. Where the court sustained an objection to a question asked of a witness on cross-examination, and stated that the question was improper, and defendant's counsel thereafter made no request to have the matter referred to by the court in its charge, he was not entitled to predicate error thereon.

3. Where, in an action against a street railway company for killing one of plaintiff's cows, the record showed that the car which struck the cow had a conductor, and was carrying upwards of fifty passengers, and there was no effort to obtain the attendance of the conductor or more than one of the passengers, and their absence was not accounted for, defendant's counsel having severely criticised one of plaintiff's witnesses, it was not error for plaintiff's counsel in his argument to refer to the absence of the conductor and the other passengers, and to draw an inference therefrom that their testimony, if produced, would be adverse to defendant.

4. In an action against a street railway company for killing plaintiff's cow, an instruction that plaintiff could only recover if the killing was willful and reckless, and that unless defendant, when it saw the cow on the track, or had good reason to believe it would go on the track, did nothing to prevent running against the cow, the jury could not find for plaintiff, was not prejudicial to defendant.

5. In an action against a street railway company for the killing of plaintiff's cow, evidence held to require the denial of a motion to direct a verdict for defendant.—(Airikaian vs. Houghton County St. Ry. Co., 101 N. W. Rep., 264.)

MICHIGAN—Carriers—Injuries to Passengers—Street Railroads—Sudden Jerks—Evidence.

Where plaintiff, a passenger on an open street car, arose as the car was approaching his destination, and stood with one foot on the platform and the other on the car step, with his hand on the rail, and, as the car stopped with a sudden jerk, he was thrown to the ground and injured, he was not entitled to recover, in the absence of evidence as to the cause of the jerk.—(Conroy vs. Detroit United Ry., 102 N. W. Rep., 641.)

MINNESOTA—Willful Negligence—What Constitutes—Street Railroads.

1. Willful or wanton negligence, whereby liability is incurred irrespective of the contributory negligence of the party injured, is a reckless disregard of the safety of the person or property of another, by failing, after discovering the peril, to exercise ordinary care to prevent the impending injury.

2. The trial court erred in submitting the question of the defendant's willful negligence to the jury in this case.—(Alger, Smith & Co. vs. Duluth-Superior Traction Co., 101 N. W. Rep., 298.)

MISSOURI—Carriers—Injury to Passengers—Street Cars—Premature Start—Negligence—Contributory Negligence—Last Clear Chance—Damages—Loss of Time—Instructions.

1. A street car company is bound to stop a car for a period reasonably sufficient to afford passengers an opportunity to board it, in the exercise of reasonable diligence on their part, with due regard to age and physical infirmity.

2. In an action for injuries to a passenger while attempting to board a street car by the premature starting thereof, evidence as to plaintiff's acts in attempting to board the car, held to require a submission of the question of plaintiff's contributory negligence to the jury.

3. Where a street car was started before plaintiff succeeded in boarding it, whereupon the conductor seized plaintiff by the arm in an endeavor to drag him on the car, which failed, plaintiff's direction to the conductor to release him as the speed of the car increased, and after the conductor had failed to stop the car as plaintiff requested him to do, was insufficient to preclude a recovery for injuries sustained by plaintiff in falling from the car.

4. An instruction, in an action for injuries to a passenger, was not objectionable as eliminating the question of plaintiff's contributory negligence, where the change as a whole was not subject to such objection.

5. Specifications of negligence, in an action for injuries to a passenger while boarding a street car, in that the car was started before plaintiff was afforded a reasonable opportunity to board the same, and that it was not stopped subsequently to avert the peril impending in plaintiff's jeopardous situation, were not inconsistent.

6. Where plaintiff was injured by the premature starting of a street car while attempting to board it, an instruction that if the jury found that, after seeing plaintiff's dangerous position, the conductor could have stopped the car, by signaling to the motorman, in time to have prevented the injury, and failed to exercise ordinary care so to do, which produced it, plaintiff was entitled to recover, etc., was proper.

7. Plaintiff's evidence, in an action for injuries to him while at-

* Conducted by Wilbur Larremore, of the New York Bar, 32 Nassau Street, New York, to whom all correspondence concerning this department should be addressed.

tempting to board a street car, that the conductor did not release his hold on plaintiff's arm until he commanded him to do so, was binding on plaintiff as an admission.

8. A requested instruction that plaintiff had admitted that defendant's conductor had not released his hold on plaintiff's arm until plaintiff commanded him to do so, and that if from the evidence the jury believed that plaintiff's fall from the car and injury were directly due to, or were directly contributed to by, plaintiff's conduct in causing the conductor to release his hold, etc., plaintiff could not recover, regardless of the negligence of defendant's servant, was properly refused as a comment on the evidence, and as emphasizing certain parts of plaintiff's testimony.

9. Where, in an action for injuries to a passenger, it appeared that plaintiff had retired from business, and that during his disability plaintiff's son had collected his rents, etc., without compensation, plaintiff was not entitled to recover for loss of time.—(Shanahan vs. St. Louis Transit Co., 83 S. W. Rep., 283.)

MISSOURI—Street Railways—Negligence—Injuries to Employees —Defective Turntable—Actions for Damages—Causes of Action—Proof—Pleadings — Evidence—Admissibility—Harmless Error—Excessive Verdict—Passion or Prejudice.

1. When two or more proximate causes contribute to produce an injury, each is sufficient within itself to support a cause of action for the recovery of the entire damage resulting, and a plaintiff pleading in his petition all of such claimed acts of negligence is entitled to recover upon proof of any one of them.

2. In an action against a street railway company by an employee for personal injuries, the petition alleged that defendant negligently allowed a turntable to become so out of repair that the grip slot on it and the grip slot in the track would not, when operated in the usual manner, so fit as to make the slot on one side exactly correspond with, and be opposite to, the slot on the other; that the operator in charge of the turntable so negligently set the same that the slot on the turntable was not in line with the slot in the track; and that, by reason of his negligence and the dangerous condition of the turntable, the grip on the car which plaintiff, a gripman, was attempting to take across the table, struck the slot rails of the track, causing the car to stop; and that plaintiff was struck by the grip lever, as the result of the arrested motion of the grip bar, and injured. Held that plaintiff could recover under the cause of action pleaded without proof of negligence on the part of the operator.

3. The evidence examined, and held sufficient to show that the negligence charged with respect to the defective condition of the turntable could have contributed to the injury.

4. The petition alleged that the slot in the turntable, when the latter was turned and set by the operator to allow plaintiff to take his car onto the emergency track, as the track on the other side of the table was called, did not fit the slot in the emergency track, by reason of which the grip struck the slot rails of such track, etc.; the gist of the complaint being the failure of the slot in the table to meet that in the emergency track when the car reached that point. Held that as the car could not have entered on the table if the latter was out of position there, and the accident was charged to have occurred after it entered and crossed, defendant was advised that the issues to be met were involved in the fact of a displacement during the crossing, and hence recovery could be sustained on account of a displacement of the table produced by the motion of the car in crossing.

5. Evidence that prior to the date of the accident the operator was seen holding the table in position with a crowbar, in the presence of defendant's foreman, and also that other but similar means had also been used for the same purpose, was admissible as tending to show the defective condition of the locking apparatus of the table, and notice thereof of defendant.

6. Evidence that one of defendant's employees, prior to the date of the accident, told defendant's foreman that he did not think the table was in good condition for a man to run over, was inadmissible to show the defective condition of the table.

7. The evidence was, however, competent to show notice to defendant of such condition.

8. An objection to the question asked a witness by defendant's counsel, as to what the condition of the slot and of the latch of the locking apparatus was on the day of the accident, was sustained, as calling for the opinion of one not qualified as an expert. Thereupon defendant asked the witness to describe the condition in his own language—the condition of the socket, the latch, the turntable track, and of the emergency track, and the condition of the opposite track "as to being in line," on that day—and there being no objection, the witness answered. Held that, even had competent evidence been called for, defendant was not injured by the ruling as to the first question; the error, if any, being cured in the evidence admitted.

9. Plaintiff's left arm was broken, and the muscles thereof badly bruised, as the result of the accident, and at the trial, some 20 months thereafter, was still so disabled as to be practically useless; his doctor testifying that, in his opinion, the arm would never entirely recover. Held that a verdict for $2,500 was not so excessive as to justify the court in saying that it was the result of passion or prejudice.—(Dutro vs. Metropolitan St. Ry. Co., 86 S. W. Rep., 915.)

MISSOURI—Street Railways—Negligence—Contributory Negligence—Discovered Peril—Trial—Verdict by Nine Jurors—Statute—Constitutionality—Vested Rights.

1. Though an action was begun and the issues joined prior to the adoption of the law authorizing nine of the jury in a civil case to render a verdict, a verdict so rendered was valid, as no one has a vested right in modes of procedure.

2. Plaintiff was driving down a grade of 3 per cent, approaching a street railroad crossing, his horse going at a slow walk, when he saw a street car approaching at about nine miles an hour. There was no brake on plaintiff's wagon, and he drove on the tracks without stopping or attempting to turn out, and a collision ensued. The crossing was level, and when plaintiff first saw the car, it was about 250 feet from the point of contact. Held that he was guilty of contributory negligence.

3. The evidence as to the distance the car was from plaintiff at the time he drove onto the tracks being conflicting, and ranging between 50 and 108 feet, defendant could not be held liable under the doctrine of dicovered peril.—(Roenfeldt vs. St. Louis & S. Ry. Co., 79 S. W. Rep., 706.)

MISSOURI—Street Railroads—Crossings—Injuries to Drivers—Contributory Negligence—Failure to Look—Last Clear Chance.

1. Where plaintiff, prior to driving onto a street across which a street railway was operated, notwithstanding certain small trees and weeds growing on plaintiff's lot, could have seen a car approaching at a high rate of speed, but he failed to look, and drove upon the track after having checked his team to avoid a passer-by, and was injured, he was guilty of such contributory negligence as precluded a recovery.

2. Where, at the time plaintiff drove upon a street car track, defendant's car by which plaintiff was struck was not more than 75 feet away, and was running at such a rate of speed that it could not have been stopped, by the use of the brake and reverse, before striking plaintiff's wagon, plaintiff was not entitled to recover notwithstanding his contributory negligence, on the ground that the motorman had the last clear chance of avoiding collision.—(Fellenz vs. St. Louis & S. Ry. Co., 80 S. W. Rep., 49.)

MISSOURI—Street Railways—Injuries to Pedestrians—Negligence—Contributory Negligence—Question for Jury—Instructions—Concurrent Negligence—Departure from Pleadings—Parties—Real Party in Interest—Assignment of Unliquidated Claim—Effect.

1. Under Rev. St. 1899, Section 540, providing that every action shall be prosecuted in the name of the real party in interest, except in certain cases, but which expressly recites that it shall not be deemed to authorize the assignment of a thing in action not arising out of contract, an unliquidated claim for personal injuries cannot be assigned, and an attempted assignment of a part thereof to an attorney does not render him a party in interest in an action for the injuries.

2. From testimony that, while defendant's car had stopped, and passengers were alighting, plaintiff sought to pass in front of the car, which was started without any signal to her, it could be fairly inferred that the motorman saw, or should have seen, plaintiff's effort to get by the car.

3. A pedestrian in the most crowded portion of a large city, who seeks to pass in front of a stationary car, in plain view of the motorman, is not guilty of contributory negligence, as a matter of law, but the question of due care on his part is for the jury.

4. A motorman at the junction of two of the most prominent thoroughfares in a large city, in frequent and constant use by pedestrians and vehicles of every sort, should exercise a degree of care commensurate with such conditions, and is charged with knowledge that the diligence which might suffice in less populous and traveled parts of the city would fall short of constituting ordinary care in such thronged portions.

5. In an action against a street railway for injuries to a pedestrian attempting to cross in front of a stationary car, where the defense was that the car was moving, and that plaintiff was negligent in stepping immediately in front of it, it was not sufficient for the court to charge that the burden throughout rested on plaintiff to establish that her injuries were caused solely by the negligence of defendant, and without fault on plaintiff's part, but defendant was entitled to a sharply defined and concise instruction that, if plaintiff's injuries resulted from the concurrent and mutual negligence of both herself and defendant, defendant was not responsible therefor.

6. In an action against a street railway for injuries to a pedestrian, where plaintiff's evidence was that the car had stopped two feet from the crossing on which she started to pass over defendant's tracks, and the negligence assigned was the act of the motorman in charge of a motionless car in recklessly starting it, and there was no averment that the casualty resulted from failure to stop a moving car, it was error for the court to qualify a charge to find for defendant if plaintiff stepped in front of the car when she knew it to be moving by adding, "if the motorman could not have stopped the car after he either saw, or could have seen by using ordinary care, that plaintiff was in a position of danger."—(McLeland vs. St. Louis Transit Co., 80 S. W. Rep., 30.)

MISSOURI—Carriers—Injury to Street Car Passenger—Boarding Car at Unusual Place—Duty of Lookout by Carmen—Safety of Handrail—"Res Ipsa Loquitur"—Duty Towards Probable Licensee.

1. Carmen are not under obligation to guard against negligently starting the car so as to throw a person who attempts to board it on the wrong side of a street crossing, where the car has stopped to throw a switch, where they have no actual knowledge of his position, and the only testimony to show that it was usual to receive passengers at that point is that of the injured person, who merely states that he had previously seen persons board the car where he did.

2. The doctrine of "res ipsa loquitur" applies to a handrail on a street car, used by passengers to assist them in boarding and alighting, and which gives way in the hand of a passenger struggling to regain his balance on the car's suddenly starting.

3. A street car company is under obligation, to a person who attempts to board a car at an unusual place without the knowledge of the carmen, to use ordinary care to keep the handrail used by passengers in boarding and alighting in proper repair.—(McCarty vs. St. Louis & S. Ry. Co., 80 S. W. Rep. 7.)

MISSOURI—Street Railway—Passenger Boarding Moving Car—Duty of Motorman—Instructions—Contributory Negligence.

1. An instruction that if plaintiff, at a place where defendant received passengers, signaled the motorman his intention to become a passenger, and the motorman slowed the car down to enable plaintiff to board it, and plaintiff, while it was so slowed down, attempted to board it, it was the duty of the motorman to use a high degree of care to so control the car as to enable plaintiff to safely get on it as a passenger, correctly states the law.

2. The bracketed words in an instruction: "If the jury find * * * that the car was slowed down while passing around the curve * * * for the purpose of making it safe in getting around said curve, and that such slowing down was not done for the purpose of enabling plaintiff to get on the car, [then such slowing down of the car was not an invitation to plaintiff to attempt to get on the same]; and if the motorman did not know, and had no reasonable cause to think, that plaintiff was attempting to get on said car while it was in motion, then it was not negligent or improper in the motorman to accelerate the motion of said car when leaving said curve"—add no strength to the instruction, so that the omission thereof was harmless; the defense to which the instruction was applicable being that the motorman did not see plaintiff or know of his presence.

3. An instruction that the jury are the judges of the credibility of the witnesses, and of the weight to be given their statements, and if the jury believe, from all they have "seen and heard at the trial," that a witness has sworn falsely, they may disregard entirely his testimony, while too broad, will not be held to have misled the jury to suppose they could go outside the evidence and the demeanor of the witnesses.

4. It is not contributory negligence, as a matter of law, for an ordinarily active man, 38 years old, to attempt to board a street car turning out of a curve at a speed of 5 or 6 miles an hour; the place being the usual place where the car stops to let passengers on and off, and he being familiar with the place.

5. Any negligence of plaintiff in attempting to get on a street car while it was in motion will not prevent his recovery; the increase in the speed, after he had got part way on, made by the motorman when he knew or had good reason to believe that plaintiff was attempting to get on, having caused him to lose his balance and fall.—(Fikenberry vs. St. Louis Transit Co., 80 S. W. Rep., 860.)

MISSOURI—Street Railways—Injury to Passenger—Collision of Cars—Evidence—Opinion.

1. The answer of a witness, who, after testifying that he did not see what broke the window of a street car in which he was a passenger, was asked if he could describe the noise that he heard, stated that it sounded to him like a collision of the car; that was his impression of it—is not open to the objection of being opinion evidence.

2. Evidence in an action for injury to a passenger in a street car by the breaking of a window therein, held sufficient to go to the jury on the claim of plaintiff that it was caused by the collision of that and another car while passing at a high speed, with a swaying motion, on a curve.—(Binsbacher vs. St. Louis Transit Co., 82 S. W. Rep., 546.)

MISSOURI—Carriers—Street Railroads—Injuries to Passengers—Premature Start—Time to Alight—Negligence—Prima Facie Case—Actions—Pleading—Evidence—Instructions.

1. Where an action for injuries to a passenger was tried on the theory of negligence, as distinguished from a willful injury, an objection that the issue of negligence was not raised by the petition was waived.

2. Where, in an action for injuries to a passenger on a street car, her evidence showed that she got a transfer from the motorman, and that passengers sometimes boarded the cars to which plaintiff was transferred at the point where she attempted to alight, and the motorman testified that passengers got on and off defendant's cars at such junction, and that before starting his car he looked around to see if anyone was getting on or off, and plaintiff alleged that the motorman negligently and carelessly turned on the electricity as she was attempting to alight, causing the car to suddenly jerk and start forward, throwing her to the pavement, such evidence sufficiently disclosed a duty of the motorman to exercise due care to see that passengers had alighted in safety before he started the car; and the petition was therefore sufficient to support a verdict for plaintiff, though it did not allege that she informed the motorman of her intention to alight.

3. In an action for injuries to a passenger on a street car by the premature starting thereof as she was attempting to alight, plaintiff's evidence held sufficient to make out a prima facie case.

4. Where, in an action for injuries to a passenger by the premature starting of a street car as she was attempting to alight, plaintiff had not communicated to the motorman her intention to get off—the motorman being only bound to watch the rear platform, where passengers generally were accustomed to alight, and see that no one was in the act of getting on or off before he started the car, and having done so—it was error for the court to charge, as a matter of law, that it was the motorman's duty to have seen and observed plaintiff until she reached the street in safety, before starting the car.

5. Where a street car was operated by a motorman without a conductor, and, from his station on the front platform, he got the best observation possible to see that no one was getting on or off the car, and then sounded the gong as notice of his intention to start, he was not guilty of negligence, as a matter of law, in failing to ascertain that plaintiff was in the act of alighting when he started the car.—(Cramer vs. Springfield Traction Co., 87 S W. Rep., 24.)

MISSOURI—Street Railroads—Personal Injuries—Collision with Vehicle—Contributory Negligence—Duty to Look and Listen—Discovered Peril—Evidence—Question for Jury.

1. In an action against a street railroad company for personal injuries caused by collision of defendant's car with plaintiff's vehicle, evidence held to justify submission of the issues of negligence and contributory negligence to the jury.

2. In an action against a street railroad company for injuries caused by collision of a car with plaintiff's wagon as plaintiff was attempting to cross the tracks, there was evidence that plaintiff was negligent in pausing before starting to cross the tracks, and then attempting to cross after the motorman had proceeded under the impression that plaintiff intended to stop. Defendant requested an instruction that it was the duty of plaintiff to have exercised ordinary care, and to look and listen, and that, even though the gong was not sounded, still if plaintiff could, by ordinary care, have stopped in time to avert the collision, they should find for defendant. The court modified the instruction by adding the words: "Provided that you find that he did fail to exercise such care, and that his failure to exercise such care directly contributed to plaintiff's injury, and that the defendant, by the exercise of ordinary care after the plaintiff was, or by the exercise of ordinary care might have been, discovered to be in a position of danger, might have stopped the car by the use of the appliances at hand, and without danger to the persons on the car, and so have avoided injury, and that the defendant failed so to do." Held that the modification rendered the instruction unintelligible.

3. Where plaintiff attempted to cross defendant's street car tracks without looking or listening, but at a time when he could have safely crossed had not his progress been prevented by an excavation, of which he had no knowledge, and which compelled him to stop so that he was struck by a car, his failure to look and listen did not preclude a recovery.

4. Where the negligence of one injured by a collision on a street railroad track directly contributed to the injury, he could not recover if the motorman was merely negligent, but might recover if

the motorman was guilty of reckless or wanton misconduct, and could have stopped the car in time to avoid injury after discovering the danger.—(Frank vs. St. Louis Transit Co., 87 S. W. Rep., 88.)

MISSOURI—Carriers—Injuries to Passenger—Contributory Negligence—Instructions—Harmless Error.

1. In an action against a street railroad for personal injuries received by a passenger from being struck on the arm by the brake handle while riding on the front platform of a car, the measurement of the platform showed that plaintiff had ample room to keep out of the way of the brake handle. He knew the handle was there, that the signal had been given for the car to start, and knew the brake handle would immediately begin to revolve, but placed his arm within its radius. Held that plaintiff was injured through his own negligence by having placed his arm in a place of known danger.

2. In an action against a street railroad for personal injuries received by a passenger by being struck on the arm by the brake handle while riding on the front platform of a car, where the evidence tended to show that the platform was in a crowded condition, and that the motorman could have broken the force of the revolutions of the brake, though it is error to charge that it was not the duty of the motorman to anticipate that plaintiff would put his arm within the radius of the brake handle, it is not cause for reversal, the evidence showing conclusively that plaintiff was guilty of negligence in having placed his arm within the radius of the brake handle, the danger of which was known to him.—(Brewer vs. St. Louis Transit Co., 79 S. W. Rep., 1021.)

MISSOURI—Carriers—Negligence—Personal Injuries—Instructions—Issues—Speed of Car—Opinion Evidence—Res Ipsa Loquitur.

1. On an issue as to the speed of a street car, witnesses who were accustomed to railroad travel, many of whom rode daily on street cars, and some of whom traveled frequently on steam railroads also, were competent to give an opinion.

2. Where plaintiff in an action for personal injuries alleges specific acts of negligence, the evidence and right of recovery must be confined to those acts.

3. In an action against a street railway company for injuries alleged to have been caused by negligence of defendant in allowing a gate on the rear platform of one of its cars to remain insecurely fastened, so that it swung open, allowing plaintiff to fall, the court instructed the jury to consider all the circumstances shown by the evidence. This was followed by a charge that the actual issue was that the gate was not securely fastened, and that there was no issue that the gate was not properly made, or of a safe kind, or the fastenings not of a safe kind. Held not erroneous as allowing a recovery on negligence not pleaded.

4. In an action against a street railway company for injuries alleged to have been caused by negligence in leaving a gate on the rear platform, through which plaintiff fell, in a condition in which it was liable to open, and in which there was no allegation or proof that the gate broke, the use of the words "giving away," with reference to the gate, in the instructions, was not erroneous, as they did not refer to a fracture, but to disconnection from position as a barrier.

5. Where a gate on the rear platform of a street car swung open while the car was in motion, allowing plaintiff to fall through and injuring her, the happening of the accident created a presumption of negligence on the part of the street car company, casting upon it the burden of showing freedom from negligence.—(Aston vs. St. Louis Transit Co., 79 S. W. Rep., 999.)

MISSOURI—Street Railroads—Personal Injuries—Collision with Vehicle—Instructions—Failure to Look and Listen.

1. Where, in an action against a street railroad company for injuries from a collision of a car with plaintiff's vehicle, the complaint alleged that defendant was negligent in running the car at an excessive rate of speed, and in failing to ring the bell, instructions authorizing a recovery if the motorman discovered plaintiff's danger in time to have prevented the collision by ordinary care were outside the pleadings.

2. In an action against a street railroad company for injuries from a collision with plaintiff's vehicle, in which there was evidence that plaintiff failed to look and listen before attempting to cross the track, an instruction that plaintiff could not recover if he did so fail should have been given, and an instruction denying the right to recover if plaintiff's negligence directly contributed to the injury did not sufficiently cover the point.—(Hartman vs. St. Louis Transit Co., 87 S. W. Rep., 86.)

MISSOURI.—Street Railways—Injury to One Attempting to Board Car—Relation of Passenger and Carrier—Contributory Negligence—Proximate Cause—Instructions—Modification.

1. One cannot be held, as matter of law, guilty of contributory negligence in attempting to board a moving street car; there being evidence that its speed was no greater than that of a man going at a fast walk.

2. Where persons are lined up in the attitude of waiting for a car on a platform constructed by a street railway company for convenience of passengers in getting on and off cars, this is notice to a motorman of their desire to board his car; and, he having turned off the power, applied the brake, and checked the car for the apparent purpose of taking on passengers, one of such persons has the right to assume that he is invited to board the car, so that, in his attempt to do so, the relation of passenger and carrier exists between him and the company, though the power had been turned off and the brake applied for some other purpose, not communicated to those waiting for the car.

3. Though possession of a transfer by one injured in attempting to board a street car has no bearing on the question of his right to recover for injuries received in such attempt, yet, such fact being uncontroverted, and no attempt being made to give it any force, its mere recital in an instruction is harmless.

4. Defendant's requested instruction, in an action for injury to plaintiff while attempting to board defendant's street car, that, if plaintiff attempted to board it while it was going at such speed that a person of ordinary care and prudence would not have attempted to do so under the circumstances, then he was guilty of contributory negligence, and could not recover, is properly amended by the insertion after the word "circumstances" of the clause, "and that fact directly contributed to cause plaintiff's injury;" plaintiff's evidence being that he landed safely on the step of the car, and was thrown therefrom by the sudden forward lurch of the car, and, if this is true, such lurch, and not the attempt to board the car while it was in motion, being the proximate cause of his injury.

5. Modification of a requested instruction that the fact that the motorman failed to stop the car for plaintiff to get on does not authorize plaintiff to recover, by insertion of the words "of itself" between the words "not" and "authorize," does not change the meaning of the instruction, and is harmless.

6. It is negligence, as matter of law, for one to attempt to board a street car going at a speed of 8 or 10 miles an hour.—(Spencer vs. St. Louis Transit Co., 86 S. W. Rep., 593.)

MISSOURI—Street Railways—Injury to Passengers in Alighting—Variance—Excluding Evidence—Harmless Error.

1. Refusal to exclude plaintiff's evidence in an action for injury in alighting from a street car because of variance between the allegation of the petition that the ground was lower than the car, and proof that it was a foot higher than the floor of the car platform, is not ground for reversal, the variance being immaterial; the gravamen of the charge being the stopping of the car at an unsafe place to alight, and defendant not having, as required by Rev. St. 1899, Section 655, alleged and proved by affidavit that it was misled by the variance.

2. Though defendant in an action for injury to a passenger in alighting from a street car was entitled to show that the uneven condition of the street was due to its lowering its tracks pursuant to order of the city, exclusion of such evidence was harmless; the court having confined the jury to consideration of defendant's duty to stop its car at a reasonably safe place for plaintiff to get off the car.

3. Though plaintiff, injured in getting off a street car, knew that the company was sinking its tracks at such place, and of the general condition of the ground there, and saw two men slip and fall in getting off the car, yet, she having then said to the conductor that he could not expect her to get off there, and he having taken hold of her arm, got down to the second step, and said, "Jump this way," in doing which she slipped and fell, she cannot be held, as matter of law, to have been guilty of contributory negligence.—(Senf vs. St. Louis & S. Ry. Co., 86 S. W. Rep., 887.)

MISSOURI.—Carriers—Street Cars—Death of Passenger—Wilful Acts of Conductor—Duties—Evidence—Questions for Jury—Instructions.

1. A carrier is bound to exercise the greatest care consistent with the practical operation of its cars toward a passenger, not only while he is on the car, but also until he has alighted in safety.

2. In an action against the carrier for death of a passenger on a street car, under Rev. St. 1899, Section 2864, authorizing recovery where the passenger shall die from an injury resulting from or occasioned by the negligence, unskillfulness, or criminal intent of any servant or employee while running any public conveyance, etc., evidence held sufficient to require submission of defendant's liability to the jury.

3. In an action against a carrier for death of a passenger, an instruction that if deceased, just before alighting from the car, called the conductor vile names, and struck him, and the conductor, in resenting the insult and repelling the assault, struck deceased, and deceased dragged the conductor from the car, and was shot in a fight which ensued on the ground away from the car, from which

shooting deceased died, plaintiff was not entitled to recover, was proper.

4. An instruction that if deceased cursed defendant's street car conductor while deceased was alighting from the car, and at that time the conductor had not struck deceased nor cursed him, such conduct constituted a breach of the peace; and if the conductor, in resenting such insult, engaged in a fight with deceased on the street, in the course of which deceased was shot, plaintiff was not entitled to recover from defendant—was error, as eliminating as immaterial whether the conductor was dragged from the car, as defendant's evidence tended to prove, or voluntarily followed deceased to the sidewalk, and there attempted to preserve the peace, according to plaintiff's evidence.

5. In an action against a carrier for death of a passenger caused by an altercation with the conductor, an instruction that if deceased struck the conductor before the latter had made any assault upon him, and a fight ensued on the street, off the car, during which the conductor shot and killed deceased, defendant was not liable, was erroneous; for if, after striking the conductor, deceased attempted to get off the car, and the conductor held and beat him, and then followed him off the car, and killed him, the carrier would be liable.

6. In an action for death of a passenger from injuries received in an altercation with the conductor there was evidence that, after deceased struck the conductor, the latter began "defending himself" by beating deceased with the butt end of a pistol as he was leaving the car, and followed him, still beating him, to the sidewalk, defendant's evidence showed that the conductor was first assaulted by deceased, and then dragged off the car by him. Held that an instruction that if deceased assaulted the conductor as he was alighting, the conductor was justified in defending himself, and if he did defend himself from such assault, and while so doing there was a fight on the street, off the car, between the deceased and the conductor, in which deceased was shot, plaintiff could not recover, should not have been given.

7. An instruction that if deceased pulled the conductor off a street car the latter was entitled to strike deceased in resistance thereof, and if deceased succeeded in pulling the conductor from the car, and then engaged in a physical conflict with him, the conductor was entitled to resist any assault that deceased made on him, and, even if the conductor did more than was necessary to resist such assault, and in doing so shot deceased, the carrier was not liable for its conductor's conduct, was proper.

8. An instruction that, though the conductor voluntarily followed deceased from the car, and thereafter engaged in a physical conflict with him, and as a result thereof deceased was shot by the conductor, yet such voluntary act of the conductor was no part of his duty as conductor, and defendant was not liable for the consequence thereof, was erroneous.—(O'Brien vs. St. Louis Transit Co., 84 S. W. Rep., 939.)

MISSOURI—Street Railroads—Collision at Crossing—Injury to Passenger—Pleading and Proof—Variance—Expert Evidence—Excessive Damages.

1. In an action by a passenger for injuries in a collision between an electric car and a cable car at a crossing, where the negligence alleged in the petition was the failure of the flagman to give "such signals as would have enabled the gripman and motorman, by the use of ordinary care, to have avoided said collision," and the evidence showed that the flagman gave both the gripman and motorman the signal to proceed at the same time, there was no material variance.

2. Where the defense in an action for personal injuries is that the paralysis complained of by plaintiff is the result of some other cause than the accident, it is error to permit medical experts to testify that they attribute plaintiff's condition to the accident.

3. In an action for personal injuries, evidence considered, and held that a judgment for $5,500 damages is excessive.—(Taylor et al vs. Grand Ave. Ry. Co., 84 S. W. Rep., 873.)

MISSOURI—Carriers—Street Railroads—Injuries to Passengers—Negligent Starting—Sudden Jerks—Care Required—Evidence—Variance.

1. Where, in an action against a street railway company for injuries to a passenger, she alleged that her injuries occurred because the car started with a sudden jerk before she had reached a place of safety thereon, and she testified in her examination in chief that the car was still as she attempted to get aboard it; that, as she was stepping on it, the car gave a jerk, which threw her over and against the back seat, causing her injuries—the fact that she testified on cross-examination that the car had started before it gave the sudden jerk did not establish such a variance between the pleading and proof as precluded plaintiff from recovery.

2. The starting of a street car before a passenger has landed securely on the platform is negligence.

3. A street railway company is required to exercise toward passengers the utmost care and diligence of very cautious persons while such passengers are boarding and alighting from its cars.—(Lehner vs. Metropolitan St. Ry. Co., 85 S. W. Rep., 110.)

MISSOURI—Street Railroads—Injury to Person Attempting to Board Car—Contributory Negligence—Questions for Jury—Pleading—Separate Counts—General Verdict—Defects Cured by Verdict—Objections to Petition—How Made.

1. Whether plaintiff was guilty of contributory negligence in attempting to board an electric street car while it was moving rapidly, or when he ought to have known that its speed had been checked not to take on passengers, but to get past a broken circuit at a crossing, and that it was likely to recover speed immediately, so as to preclude his recovery for injuries received at the time, was a question for the jury.

2. Where, in an action against a street railroad for personal injuries received by plaintiff in attempting to board defendant's car, the two acts of negligence charged in the petition in separate counts could have been as well charged in one, but one cause of action is stated, and a general verdict is good.

3. Where, in an action against a street railroad for personal injuries received by plaintiff in attempting to board defendant's car, the petition alleged that, though the conductor knew, or by reasonable care could have known, plaintiff was being dragged, he negligently failed to signal the motorman to stop, and by reason of that negligence plaintiff was thrown to the ground with great violence, the failure to aver that, if the conductor had signaled the motorman to stop, he could have stopped the car in time to avert the injury, was a defect cured by verdict.

4. An objection on account of such defect should have been taken by motion or demurrer before trial.—(Leu vs. St. Louis Transit Co., 85 S. W. Rep., 137.)

MISSOURI.—Street Railroads—Injuries at Crossing—Negligence—Speed Limit—"Vigilant" Watch Ordinance—Contributory Negligence—Demurrer to Evidence—Admission of Evidence—Instructions—Review—Questions Not Raised Below—Record.

1. A person crossing a street on foot at an intersection of streets has a right to the use of the street equal to that of the street railway company.

2. A person crossing a street railway has a right to presume, unless he has knowledge to the contrary, that cars will not be operated at a speed exceeding that limited by the city ordinance.

3. It is negligence per se to operate a street car over a crossing at a speed exceeding that limited by the city ordinance.

4. A person about to cross a street railway track is charged with the duty of looking and listening for approaching cars before stepping on the track.

5. If the position of a person three feet from a street car track when he looked and listened was such that when looking at the end of the approaching car he was unable to discern that it was approaching at a rate of speed exceeding 15 miles an hour, as limited by the city ordinance, and it was apparent that the car was at a sufficient distance to enable him, with the exercise of due care to cross the track in safety, he would be justified in relying on the car being operated within the speed limit and with due care.

6. By the direct provision of St. Louis General Ordinances, c. 23, art. 6, Section 1760, subd. 4, it is the duty of electric car motormen to "keep a vigilant watch for * * * persons on foot * * * either on the track or moving toward it, and on the first appearance of danger * * * to such person * * * the car should be stopped in the shortest time and space possible.

7. Though a person may have been negligent in attempting to cross a street car track in front of an approaching car, his negligence will not bar recovery for injuries resulting from the negligence of the motorman in not stopping or checking the car.

8. In passing on defendant's demurrer to the evidence, the court should place the most favorable construction possible on plaintiff's theory of the evidence, allowing him, as a presumption, every inference that could be reasonably deducted from the evidence in his behalf.

9. In an action against a street car company for injuries at a street crossing, evidence considered, and held that a demurrer to the evidence by defendant was properly overruled.

10. It is proper to refuse instructions which ignore important evidence in the case.

11. A person about to cross a street car track is not required to "stop and look and listen;" if he looks and listens it is sufficient.

12. In an action against a street car company for injuries to a person attempting to cross the track, evidence held to show that the city ordinance limiting the speed of cars to 15 miles an hour on certain streets applied to the street where the accident in suit occurred.

13. The objection that a city ordiance introduced in evidence, limiting the speed of street cars to 15 miles an hour, does not apply

to the street where the injuries in question occurred, cannot be raised for the first time in review.

14. Where defendant asked and the court gave instruction on the issues raised by a city ordinance introduced in evidence without objections, defendant cannot contend on review that the ordinance did not apply to the issues in the case.

15. A city ordinance limiting the speed of street cars in certain portions of the city may be introduced in evidence in an action against the street railway company, without showing an acceptance by the company of the privileges granted by the ordinance.

16. Instructions which are not incorporated in the abstract on appeal will not be reviewed.—(Deitring vs. St. Louis Transit Co., 85 S. W. Rep., 140.)

MISSOURI.—Railroads—Collision at Crossing—Pleading—Joinder of Causes—Nature of Action—Authority of Agent—Burden of Proof—Harmless Error.

1. In an action by one railroad company against another for one-half of the damages resulting from a collision at a crossing, the complaint alleged as one cause of action an agreement between the companies whereby damages resulting from the sole negligence of one of the parties at this crossing were to be paid by such party, and damages resulting from the concurring negligence of the parties, or from the negligence of a watchman employed by one of them, were to be paid by them equally. Facts were alleged showing that a collision resulted from the negligence of the watchman, and the concurring negligence of the servants of both companies, and that plaintiff had settled all resulting claims, and demanded payment for one-half the amount so expended. As a second cause of action the complaint alleged that after the damages in suit occurred, the parties met, each recognized its liability, and verbally agreed that plaintiff proceed to settle the claims for damages, and defendent would repay plaintiff one-half the amount so expended. Held that both causes were based on contract, and could be joined under Rev. St. 1899, Section 593; the necessity of pleading the negligence not rendering the first cause of action one ex delicto.

2. On etablishing the latter contract, plaintiff could recover, though it appeared that defendant was free from negligence.

3. A railroad company is bound by the contracts made by its general claim agent, where the person with whom he contracted had no knowledge of any limitation in his authority.

4. A judgment will not be reversed for an error in favor of appellant.

5. The burden of showing limitations on authority of an agent is on the principal.—(Southwest Missouri Electric Ry. Co. vs. Missouri Pac. Ry. Co., 85 S. W. Rep., 966.)

MISSOURI.—Street Railroad—Injury to Child—Contributory Negligence — Negligence — Questions for Jury — Proximate Cause—City Ordinance—Speed of Cars—Limitation—Construction—Evidence—Admissibility.

1. The test of a minor's responsibility for conduct charged to have been negligent is whether he exercised the caution usually displayed by ordinary children of the same age and capacity.

2. In an action against a street railroad for injuries to a child, evidence examined, and whether the child was guilty of contributory negligence held a question for the jury.

3. The negligence of a street railroad in failing to stop a car to allow a passenger to alight does not render it liable for an injury to the passenger by another car, by which he was struck after having alighted in safety, where by standing still he could have avoided the injury from the car that struck him.

4. Where a person stepped from a street car, on which he had been riding as a passenger, to a place of safety between the defendant's parallel tracks, where he could have remained unharmed while a car on the other track passed him, but, after having seen it within five or six feet of him, he attempted to cross the track in front of it, and was struck and injured, any negligence in failing to ring the bell of such car or give warning of its approach is not the proximate cause of the injuries.

5. In an action against a street railroad for injuries, evidence examined, and whether defendant was guilty of negligence held a question for the jury.

6. Where there is a city ordinance limiting the rate of speed of street cars, the ordinance rate may not be lawfully persisted in, regardless of situations which render a slower movement indispensable to the safety of the public.

7. In an action against a street railroad for injuries, where the petition averred the motorman's failure to use any care to control the car which caused the injuries, the averment was broad enough, as an allegation of negligence at common law, to let in evidence concerning excessive speed of the car, especially where no objection was made either to the pleading or the evidence.—(Fry vs. St. Louis Transit Co., 85 S. W. Rep., 960.)

MISSOURI.—Street Railroads—Personal Injuries—Collision of Car and Vehicle—Negligence—Contributory Negligence—Questions for Jury—Instructions—Burden of Proof—Presumptions—Appeal—Municipal Corporation—Ordinance—Violation—Evidence—Sufficiency.

1. In an action against a street railroad for injuries, evidence examined, and held that whether the defendant was guilty of negligence, and the plaintiff of contributory negligence, were questions for the jury.

2. Where the petition charged negligence, and averred a number of specific acts characterized as negligence, a charge which authorized a recovery by plaintiff for any act of negligence, without limitation as to the acts charged, was erroneous.

3. In an action against a street railroad for injuries received in a collision between plaintiff's wagon and a car, the petition alleged that plaintiff saw the car in question coming from the north "as" he turned off to cross from the east to the west track on which the car was approaching. Held that "as" meant that he saw it "when," "at some time," or "while" he was driving across the track; and hence a contention that it meant that plaintiff saw the car coming from the north at the moment he turned to drive across the west track, and that he was thereby convicted of contributory negligence by his pleadings, and that his evidence that he looked and did not see the car should be rejected as contradicting his petition, was untenable.

4. In an action against a street railroad for injuries received in a collision of plaintiff's vehicle with a car, the court charged that if the jury believed that, while plaintiff was crossing the tracks of defendant, his vehicle was struck by a car through the defendant's negligence in failing to stop the car on the first appearance of danger to the plaintiff, whereby plaintiff was injured, then they should find for plaintiff, unless he was guilty of negligence which directly contributed to his injury, as explained in other instructions. Held that by the first appearance of danger referred to was meant the first appearance of danger to plaintiff as seen by the motorman, and a criticism that the instruction was ambiguous in this respect was unwarranted.

5. The instruction mentions a definite fact on which the motorman was required to act, and to begin to check the speed of his car when he first saw there was danger of colliding with plaintiff's vehicle; and an objection that it left the matter open for conjecture was untenable.

6. The fact that the motorman neglected his duty would not render the instruction objectionable.

7. There being no evidence to show the time and space within which the car could have been stopped, the instruction was erroneous in requiring the jury to find such facts.

8. In an action against a street railroad for injuries to plaintiff in a collision of his vehicle with a car, where contributory negligence is pleaded as an affirmative defense, the burden is on defendant to prove it.

9. Having pleaded contributory negligence as an affirmative defense, defendant's failure to ask an appropriate instruction defining contributory negligence raises a presumption that it abandoned the defense; and hence the fact that, as qualifying several instructions given, the court made reference to plaintiff's contributory negligence "as defined in other instructions," when no instructions defining those terms was given, was harmless error.

10. In an action against a street railroad for injuries to plaintiff in a collision of his wagon with a car, evidence examined, and held to show that plaintiff was not driving in violation of an ordinance providing that no vehicle shall use a street railroad track when driving in a contrary direction of the cars running on the track, except for the purpose of crossing or avoiding other vehicles.

11. It is not error to refuse a charge which tells the jury that, before the plaintiff can recover in a personal injury action, "it is not only necessary that nine or more of your number shall agree to find in his favor, but it is also necessary that the nine or more of you so agreeing shall all concur in finding the existence of at least one of the specific grounds of negligence submitted for your determination.—(Schroeder vs. St. Louis Transit Co., 85 S. W. Rep., 970.)

MISSOURI.—Carriers—Injuries to Passengers—Damages—Pleading—Evidence—Instructions.

1. Where, in an action for personal injuries, the petition alleged that plaintiff was severely bruised on her body and limbs, causing severe and permanent internal injuries, and also causing injuries to plaintiff's nervous system, the allegation was sufficient to justify admission of evidence that the injury to plaintiff's nervous system was permanent.

2. In an action for personal injuries, an instruction authorizing the jury to consider pain of body or anguish of mind which would reasonably result to plaintiff by reason of her injuries, and be directly caused thereby, was proper.

3. Where it was alleged that plaintiff had received internal injuries, such allegation was sufficient to justify evidence of an in-

jury to plaintiff's left kidney; defendant having made no motion before trial to have the petition made more definite and certain as to such injuries.—(Fuchs vs. St. Louis Transit Co., 86 S. W. Rep., 458.)

MISSOURI. — Carriers — Injuries to Passengers — Negligence—Damages—Special Injuries.

1. A motorman who, on account of the crowded condition of the rear platform of his car, invites an intending passenger to enter by the front platform, is bound to exercise that high degree of care required of a carrier to prevent injury to such passenger while boarding the car.

2. The unexplained slipping of a brake on a street car, so that it revolves and strikes a passenger boarding the car in the face, authorizes an inference of negligence on the part of the employee in charge of such brake.

3. A functional trouble, which manifests itself in a woman about 70 days after a severe blow on the face, and is caused by a nervous shock produced by the blow, is not a necessary result of the blow, but is a matter of special damage, which must be specially pleaded in order to authorize a recovery therefor.—(Thompson vs. St. Louis & Suburban Ry. Co., 86 S. W. Rep., 466.)

MISSOURI. — Witness — Contradiction — Instruction — Trial —Street Railroads—Personal Injuries—Collision—Contributory Negligence—Question for Jury.

1. A charge that the plaintiff vouches for the credibility of his witnesses, and cannot be heard to impeach their testimony or to question the veracity of any of them, given in a case where plaintiff had introduced a witness who testified to a state of facts directly contrary to what had been testified to by the other witnesses, was misleading, without further advice to the jury as to what was meant by impeaching the testimony of a witness, and hence was ground for granting a new trial on return of a verdict for defendant.

2. A party who puts a witness on the stand may prove by other evidence facts inconsistent with the witness's statement, even if the inconsistent evidence tends to show the witness committed perjury.

3. In an action against a street railroad for injuries to the plaintiff while an occupant of a buggy which was being driven by another person when it collided with defendant's car, evidence examined, and whether the plaintiff was charged with contributory negligence by the act of the driver, held a question for the jury.—(Joyce vs. St. Louis Transit Co., 86 S. W. Rep., 469.)

MISSOURI.—Carriers—Injuries to Passengers—Sudden Stop—Negligence—Prima Facie Case—Instructions—Damages—Excessiveness.

1. Where, in an action for injuries to a passenger by the sudden stopping of street cars, following an assault by another passenger on the conductor, plaintiff's evidence did not show that such assault was the operation of a cause of the accident beyond the control of the carrier, it was proper to charge that if plaintiff, while a passenger, was thrown from the car and injured on account of the sudden stopping thereof, she was prima facie entitled to recover.

2. The existence of a fight on a street car between the conductor and a negro passenger, in which the conductor was stabbed, did not constitute such an emergency as justified the motorman in stopping the car so suddenly as to disable its motive power and throw a passenger from the car and injure her.

3. Where plaintiff was injured by being thrown from a street car by the sudden stopping thereof, and there was evidence that passengers sitting in seats were thrown over and upon other seats, a requested instruction that the simple fact that the car when stopped may have "jerked or slowed up some," having a tendency to cause persons not holding to the car to be thrown forward, would not authorize a recovery, even if plaintiff fell therefrom and was injured on account of such stopping of the car, was properly refused.

4. Where, in an action for injuries to a passenger by being thrown from a street car by a sudden stop, there was no evidence that any of the passengers jumped from the cars, or were attempting to alight, prior to defendant's attempt to stop the cars, an instruction that if there was a fight or commotion on the cars at the time, and the passengers became excited and were jumping therefrom while the cars were in motion, and such passengers cried out "Fire!" or "Fight!" or "Stop the cars!" it was the duty of defendant's servants to stop the cars in the shortest time, having due regard to the rights and safety of passengers thereon, was properly refused.

5. Plaintiff, a child 12 years of age, sustained a fracture and dislocation of the elbow by being negligently thrown from a street car by the sudden stopping thereof. The attending physician testified that her arm would entirely recover, except that she might be affected with rheumatism in the elbow in damp weather, and there was other evidence that she did suffer from rheumatism, and had undergone considerable suffering. Held that a verdict for $1500 was not excessive.—(Willis vs. St. Joseph Ry., Light, Heat & Power Co., 86 S. W. Rep., 567.)

NEBRASKA.—Directing Verdict—Contributory Negligence.

1. On a motion to direct a verdict for the defendant the plaintiff is entitled to every inference which the jury would have been warranted in drawing from the evidence adduced.

2. In an action for personal injuries, where contributory negligence is relied upon as a defense, and where, from the facts and circumstances proven, reasonable minds may draw different conclusions concerning the negligence of the plaintiff's intestate, such question should be submitted to the jury.

3. Evidence examined, and held not sufficient to bring the case within the reason of the "humane doctrine" or "last chance."—(McLean vs. Omaha & C. B. Ry. & Bridge Co., 103 N. W. Rep., 285.)

NEW HAMPSHIRE.—Carriers—Personal Injuries—Evidence—Admissibility—Trial—Remarks of Court—Materiality.

1. On cross-examination of one of plaintiff's medical witnesses, defendant's counsel asked him about the relative authority of certain medical writers on nervous diseases, and inquired of him if he would produce in court the work of a certain specialist. Thereupon the court remarked: "I guess we won't go into a comparison of books. If they don't give us any more information than some lawbooks do, we shan't get much from them." Held that as the remark was conditional in form, and, as it was not the statement of a fact, it could have conveyed no information to the jury as to the reliability of medical theories advanced by the witness, and was therefore immaterial and harmless.

2. In an action against a carrier for injuries in a collision, evidence that other passengers had not complained of having been injured in the accident, and that none had made claim against defendant on account of the injuries, was collateral to the main issue, and properly excluded.—(Foss vs. Portsmouth, D. & Y. Ry. Co., 60 Atl. Rep., 747.)

NEW JERSEY.—Carriers—Moving Car—Attempt to Board—Assumption of Risk.

1. Although it cannot be held, as a matter of law, that a person who attempts to board a trolley car while it is in motion is negligent, yet, when the fact that the car is in motion is the sole producing cause of the injury sued for, the risk of its occurrence is one which the person making the attempt must be held to have assumed.

2. A plaintiff is only entitled to recover by establishing the truth of his case as laid in his declaration, and, if he fails to do this, the defendant is entitled to the verdict of the jury.—(Murphy vs. North Jersey St. Ry. Co., 58 Atl. Rep., 1018.)

NEW JERSEY.—Street Railroads—Negligence—Collision—Instructions.

Upon the trial of an action against a traction company to recover damages for the partial destruction of a wagon with which an electric car collided, the trial judge, without objection, instructed the jury as to the duty of the motorman in terms that made the traction company an insurer against collisions under particular circumstances specified. He then refused a request for instructions to the effect that the motorman was not obliged to foresee that the driver of the wagon would leave his place of safety beside the track, and turn across the track, until he did so turn. Held under the evidence in the case, and in view of the instructions actually given, that the refusal of this request was erroneous.—(Hollingsead et al. vs. Camden & Suburban Ry Co., 60 Atl. Rep., 514.)

NEW JERSEY.—Carriers—Injury to Passenger—Street Car in Collision With Wagon—Negligence—Question for Jury—Instruction.

1. In an action against a street railroad for injuries to a passenger in a collision with a wagon, evidence examined, and whether defendant was negligent held a question for the jury.

2. In an action by a passenger to recover for injuries received in a collision with a wagon, where the declaration alleged that defendant negligently operated its car, a request that plaintiff's proof must conform to the allegation of his pleadings was sufficiently complied with by a charge that under the declaration, "which is founded purely on the negligent operation of the car," and not on the construction of the roadbed, the question was, ought the motorman to have apprehended that the rear of the wagon would be likely to slide towards the car by reason of the cross-over or the condition of the pavement at which the accident happened, and that an accident might then occur? and that, if the motorman ought to have apprehended such danger, then it was his duty to act with reference to it, and that if he failed to guard against a danger he ought to have anticipated, and because thereof the accident occurred, then he was negligent, etc.—(Walsh vs. North Jersey St. Ry. Co., 60 Atl. Rep., 335.)

NEW JERSEY.—Street Railroads—Collision With Truck—Contributory Negligence—Directing Verdict.

1. The driver of a truck is not guilty of negligence, as a matter of law, in attempting to cross a street railway track in front of a trolley car 550 feet away, which is approaching him at a very great rate of speed. He has the right to assume that the car is furnished with appliances to reduce speed and to stop, and with a motorman to make use of such appliance, and that the car will not continue to run in violation of the law limiting the speed of vehicles in public streets to that which is compatible with a safe use thereof by other vehicles.

2. In an action for damages resulting from an injury caused by negligence, it is the duty of the trial judge, when requested to nonsuit or direct a verdict, to determine whether any facts have been established by evidence from which negligence may be reasonably inferred. If the real facts have not been established by the evidence, he must submit them to the jury.—(Vrooman vs. North Jersey St. Ry. Co., 59 Atl. Rep., 459.)

NEW JERSEY.—Street Railroads—Ejection of Passengers—Punitive Damages—Exclusion of Evidence—Reversal of Joint Judgment.

1. A street railroad company is not liable in punitive damages to a passenger who was wrongfully and with unnecessary violence ejected from a car by the conductor, where it did not participate in the wrongful acts, either by authorizing or approving of them.

2. In an action by a passenger against a street car company for being wrongfully ejected from a car, where plaintiff's evidence tended to show that the ejection was wanton and malicious, but that the defendant company approved of the acts of its conductor by retaining him in its service, it was error to exclude evidence offered by defendant that such conductor was prosecuted criminally for his assault on plaintiff and was acquitted.—(Peterson vs. Middlesex & Somerset Traction Co. et al., 59 Atl. Rep., 456.)

NEW YORK.—Street Railroads—Injuries to Passenger—Contributory Negligence—Connecting Injury with Accident.

1. A passenger, in alighting from a street car, is only bound to exercise due care under the circumstances, and the fact that he placed himself in a position of danger while exercising such care does not show contributory negligence, as a matter of law.

2. Evidence in an action against a street car company for injuries to a passenger considered, and held sufficient to present a question for the jury as to whether plaintiff's injuries resulted from the accident alleged to have been caused by defendant's negligence.—(Johnson vs. Yonkers R. Co., 91 N. Y. Suppl., 508.)

NEW YORK.—Street Railroads—Injuries to Passengers—Negligence—Contributory Negligence—Question for Jury—Ordinances—Obedience.

1. In an action for injuries to one having left a street car, while going round the end of the car, from which she alighted, to reach a car running on an intersecting street, to which she desired to transfer, by being struck by a car running in the opposite direction to that from which she alighted, evidence held to require the submission of defendant's negligence and plaintiff's contributory negligence to the jury.

2. A city ordinance providing that no driver of a street car in the city shall allow the car to pass any other car standing at any crossing for the discharge or reception of passengers until the standing car shall have started on its course, and cleared at least 20 ft., is applicable to a case where the street car company caused its cars to be stopped to discharge passengers before crossing a street, though it was difficult for the railroad company to obey the ordinance under such circumstances.—(Craven vs. International Ry. Co., 91 N. Y. Suppl., 625.)

NEW YORK.—Defective Streets—Negligence of City—Contributory Negligence.

1. Where a subway was being excavated in a street under legislative authority by a corporation over which the city had no control, the city was not negligent because it did not keep a gang of men at work repairing the street as it was interfered with from day to day by the contractors making the excavation.

2. The driver of an automobile, who was killed by being thrown into an excavation in the street by an accident which resulted from one of the front wheels running into a depression while he was trying to cross a street car track at a high rate of speed in front of a car going in the same direction, was guilty of contributory negligence.—(Morris vs. Interurban St. Ry. Co. et al., 91 N. Y. Suppl., 479.)

NEW YORK.—Street Railroad—Personal Injury—Person Driving Along Track—Contributory Negligence—Question of Fact.

It cannot be said, as a matter of law, that the failure of a person driving on a street on which there is a street car track to leave the track, when not warned of an approaching car, constitutes such contributory negligence as would defeat his action for injuries sustained through the negligence of the motorman in running him down without warning, though the conditions were such that the injured person, by having driven nearer the curb, could have avoided the accident.—(Barringer vs. United Traction Co., 91 N. Y. Suppl., 386.)

NEW YORK.—Street Railroad—Personal Injury—Negligence—Evidence—Sufficiency.

Error of judgment and miscalculation on the part of one walking in dangerous proximity to a street car track as to the distance he could travel before an approaching car, which he saw and watched during the progress of his journey, would reach him, are insufficient to establish his right to recover, much less negligence on the part of the street railroad, even in the absence of signal of the approach of the car.—(Sullivan vs. New York City Ry. Co., 91 N. Y. Suppl., 325.)

NEW YORK.—Carriers—Assault by Servant—Passengers—Termination of Relation.

Where a passenger on a street car was refused change by the conductor, and, after voluntarily dismounting from the car and awaiting the conductor on his return trip, spoke to him in an office of the street railway company to which he had gone, and was there assaulted by him, the company was not liable for the assault, inasmuch as the relation of passenger and carrier had ceased, and the conductor was not at the time in the performance of his duty.—(Reilly vs. New York City Ry. Co., 91 N. Y. Suppl., 319.)

NEW YORK.—Street Railroads—License Fee—Agreement—Amount—Limitations—Contract Under Seal.

1. By an agreement on Jan. 1, 1853, the Third Avenue Street Railway Company contracted with the city of New York for permission to lay a double track in certain streets. The power to use steam was forbidden, and the privilege was granted on the payment "of the annual license fee for each car now allowed by law." Held, that the amount of the license fee was thereby established, and such amount was not affected by the voluntary change by the railroad company of its motor power to a cable system, and from a cable system to electricity.

2. Where an agreement between the city of New York and a street railway company, Jan. 1, 1853, granted the use of the streets for "the annual license fee for each car now allowed by law," the amount thereof was established by Ordinance May 8, 1839, Section 5, relating to stages or accommodation coaches, at $20.

3. A contract under seal is not governed by the six-year statute of limitations.—(City of New York vs. Third Avenue R. Co., 87 N. Y. Suppl., 584.)

NEW YORK.—Negligence — Personal Injuries — Joint Tort Feasors—Liability—Municipal Corporations—Regulations of Street Traffic—Ordinance—Construction.

1. Where a truck was being driven on a street, when it was struck by a street car, and thereby caused injury to a pedestrian, the liability of the street railroad in an action against it by the pedestrian for the injuries was not affected by contributory negligence of the driver of the truck.

2. Under a city ordinance providing that vehicles proceeding in a northerly or southerly direction have the right of way over vehicles proceeding in an easterly or westerly direction, a street car proceeding in a northerly direction had not an absolute right to the exclusive use of the street, as against a vehicle going in a westerly direction; and hence the driver of the vehicle was not required to stop his horses and let the car pass when the distance between them was such that, had the speed of the car been slackened, a collision would not have occurred.—(Demarest vs. Forty-Second St., M. & St. N. Ave. Ry. Co., 93 N. Y. Suppl., 663.)

NEW YORK.—Carriers—Duty to Passengers—Supervision of Movements—Insufficient Accommodations—Crowded Platforms—Negligence—Questions for Jury—Proximate Cause.

1. A common carrier engaged in a great city in the transportation of a large number of passengers between stations, from which it controls their admission to its trains, is bound to exercise care to so direct the movements and disposition of those whom it undertakes to transport as to preserve their safety.

2. Where a carrier of passengers in a city fails to provide either seats or standing room inside its cars, so that the passengers must stand on the platform in order to ride at all, and they are permitted to so ride, whether the carrier is negligent in allowing the platform to become so crowded that a passenger is liable to be pushed off is a question for the jury.

3. A carrier of passengers in a city is not liable for the death of a passenger who falls from a crowded platform, in the absence of evidence that the passenger's fall was caused by the crowded condition of the platform, and where the evidence rather shows that the passenger slipped and fell because of snow brought upon

the platform by other passengers, and there is no evidence of any other negligence on the part of the carrier than the overcrowding of the platform.—(Kohm vs. Interborough Rapid Transit Co., 93 N. Y. Suppl., 671.)

NEW YORK.—Street Railways—Persons Driving Teams—Injuries—Questions for Jury—Degree of Care—Instructions—Cure of Errors.

1. In an action against a street railway company for injuries to one driving a team, where the evidence of plaintiff's witnesses was that, before driving across the track at a street corner, he looked and saw defendant's car in the middle of the block, and, thinking that there was plenty of time to cross, made the attempt, but the car struck the wagon just back of the front wheel, and defendant's evidence was that, as the car was approaching plaintiff, he, without any notice of his intention so to do, turned upon the track immediately in front of the car, and in such close proximity to it that it was impossible to avert a collision, the questions involved were properly submitted to the jury.

2. The obligation resting on a street railway company to prevent injuries to persons using the street is to exercise that degree of care which persons of ordinary prudence, exercising reasonable care, would use under similar circumstances, and a charge imposing on a street railway the duty of using all the care that the motorman could use at the time imposed on it too great a responsibility.

3. In an action against a street railway company for injuries to one driving a team, a charge imposing on defendant the duty of using all the care that the motorman could exercise at the particular time, was not cured by a subsequent charge exonerating defendant if the motorman, "while operating his car with ordinary care," stopped it as soon as he discovered plaintiff, where the court qualified the subsequent charge by giving it "in connection with the charge already made."—(Klimpl vs. Metropolitan St. Ry. Co., 87 N. Y. Suppl., 39.)

NEW YORK.—Carriers—Street Car Passenger—Injury—Instruction—Withdrawing Issue of Negligence—Proximate Cause—Freedom from Contributory Negligence.

1. In an action by a street car passenger for personal injuries it is error to instruct that, if the jury find the accident to have happened in the manner testified to by plaintiff and his witness, "then the plaintiff would be entitled to a verdict," as the issue of negligence is thereby withdrawn from the jury.

2. In an action by a street car passenger for personal injuries it is error to instruct that, if the jury find that the car was started without warning, with a lurch so violent as to cause plaintiff to be thrown, as testified to by him and his witness, and the car could have been started by the exercise of reasonable skill without such lurch, and the seats were all occupied, and the plaintiff was standing and holding on to a strap, and was solely by reason thereof thrown and was injured, then plaintiff would be entitled to a verdict; since the instruction omits the elements both of proximate cause and freedom from contributory negligence.—(Goodkind vs. Metropolitan St. Ry. Co., 87 N. Y. Suppl., 523.)

NEW YORK.—Carriers—Injury to Passenger—Negligence—Question for Jury.

In an action against a street railroad company for injury to a passenger who alighted from a crowded car for the purpose of allowing other passengers to pass out, and was injured by the car giving a sudden jerk as he was attempting to regain his place on the car, evidence examined, and held sufficient to require submission of the question of the defendant's negligence and plaintiff's contributory negligence to the jury.—Michelson vs. Metropolitan St. Ry. Co., 87 N. Y. Suppl., 501.)

NEW YORK.—Street Railroads—Pillars in Street—Duty of Conductor—Negligence.

1. A street car conductor is bound to take notice of the distance between his car and the pillars of an elevated railroad in the street, and of the size of a passenger standing on the running board, in determining whether it is safe to permit the car to pass a pillar before the passenger has had time to enter the car; but it is not necessarily negligence in every case to allow the car to pass the pillar while a passenger is standing on the running board.

2. A street railway company is not bound to anticipate that a passenger standing on the running board of an open car will swing back so as to come in contact with a pillar of an elevated railroad sufficiently distant to permit the passenger, standing in the position first assumed by him, to pass it in safety, though the passenger found such movement convenient in order to swing himself more easily up into the car.—(Canavan vs. Interurban St. Ry. Co., 87 N. Y. Suppl., 491.)

NEW YORK.—Street Railways—Negligence—Personal Injuries—Injuries at Crossing—Contributory Negligence—Rights of Parties—Degree of Care—Failure to Look—Negligence in Law—Requested Instructions—Error.

1. It cannot be said, as a matter of law, that a person is not ordinarily prudent, when, at the intersection of two city streets, upon alighting from a car and waiting until he has a clear view for half a block, on seeing no car, he undertakes to cross a space of 15 ft., relying upon the assumption that any approaching car will be under control, or that some warning will be given of its approach to enable him to escape danger.

2. The same degree of care is imposed upon a street railway company to avoid injury to a pedestrian crossing its track in front of an approaching car as is required of the pedestrian to avoid danger, the rights of the parties being equal.

3. One who looks, and sees no street car approaching for a sufficient distance to warrant an ordinarily cautious person in believing that it is safe to cross, has the right to rely on the assumption that the car company will respect his equal right of passage, and cannot be said to be negligent, as a matter of law, if he does not thereafter look in the direction from which danger happens to come.

4. Where plaintiff ascertained that the way was clear for a sufficient distance to warrant a reasonable person in believing it was safe to cross defendant's street car tracks, it could not be said, as a matter of law, that she was bound to see the car by which she was struck if it was only 10 ft. from her when she stepped on the track.

5. Where, in an action against a street railroad company for personal injuries, the court had charged that, if defendant's theory that plaintiff, while attempting to cross the track, escaped the fender of the car, and deliberately walked into the car, so that whatever injury she received was the result of her own carelessness, was correct, plaintiff could not recover, it was not error to refuse to charge that, "if plaintiff went into the side of the car at the dashboard after the fender had passed her in safety, she was guilty of contributory negligence."—(Beers vs. Metropolitan St. Ry. Co., 93 N. Y. Suppl., 278.)

NEW YORK.—Contributory Negligence—Persons Non Sui Juris—Street Railways—Persons on Streets—Negligence—Evidence—Absence of Fender—Negligence—Safeguards in Common Use—Failure to Supply—Actions—Instructions—Limitation of Evidence.

1. The jury may find that a boy seven and a half years of age is not chargeable with contributory negligence.

2. In an action against a street railway company for the negligent killing of a person on the streets, evidence that no fender was on the particular car which caused the accident is admissible.

3. Negligence may be predicated on the omission of a street railway to provide its cars with such safeguards as a fender, where the jury is satisfied from the evidence that the injury would have been prevented by the use of such a safeguard, and they are usually attached to cars of similar construction operated in similar localities generally throughout the country, and have proved ordinarily efficacious for the protection of persons on the highway.

4. In an action against a street railway for the negligent killing of a person on the highway, where the use of fenders on other car lines in the locality had been proved, without objection, and the judge, in response to the request of defendant's counsel for further instructions, told the jury, in effect, that they were to consider the absence of a fender on the car which caused the accident only in connection with the management of the car at the time when the accident occurred, the jury could not have been misled on the subject of fenders so as to predicate negligence on the street railway's omission to supply them generally.—(Fritsch vs. New York & Queens County Ry. Co., 87 N. Y. Suppl., 942.)

NEW YORK.—Servant's Injuries—Incompetent Fellow Servants—Assumption of Risk—Knowledge of Incompetency—Assumption of Risk—Pleading—Necessity—Incompetent Fellow Servants—Notice—Evidence.

1. A conductor on a street car, who has knowledge of the incompetency, by reason of intemperance, of the motorman on his car, assumes the risk of working with such motorman.

2. In an action for a servant's injuries, defendant may avail himself of the defense of assumption of risk, though he did not plead it, where plaintiff's own evidence shows that the risk was assumed.

3. In an action for a servant's injuries, testimony as to a conversation, subsequent to the accident, with defendant's superintendent, as to his knowledge before the accident of the intemperance of the fellow servant through whose incompetency the accident occurred, was incompetent as original evidence of notice.—(White vs. Lewiston & Y. F. Ry. Co., 87 N. Y. Suppl., 901.)

NEW YORK.—Street Railways—Injury to Passenger Boarding Car—Negligence—Pleading and Proof—Negligence—Evidence — Proximate Cause — Concurrent Negligence — Witnesses—Proof of Bias—Harmless Error—Witnesses—Bias—Party Entitled to Show.

1. A complaint alleging that plaintiff was injured by a fall from

defendant's street car while in the act of boarding it, caused by its being started before he had been given reasonable opportunity to place himself in a position of security, does not require proof that it was started with more than ordinary violence.

2. Testimony that defendant's car had come to a stop to take on passengers, and that plaintiff mounted the footboard, and had placed one foot inside on the main platform, and was in the act of raising the other, so as to enter the car, when the car was started, with the result that he fell into the street, authorizes an inference that the fall was caused by the sudden movement of the car, and a finding of negligence on the part of those in charge of the car.

3. The negligence in starting up a street car while one was boarding it, throwing him on to the ground, where he was run over by a truck, is a proximate cause of the injury, making the street railway company liable, notwithstanding the concurrent negligence of the driver of the truck.

4. A mere change in the order of proof, by allowing evidence of bias of witness before his testimony making it material to his credibility, is harmless.

5. Plaintiff may show bias of a witness first called by him, witness's first material testimony having been elicited by defendant.

6. Though witness was first called by plaintiff, yet, his first material testimony having been elicited by defendant, defendant cannot impeach him as to such testimony.—(Fine vs. Interurban St. Ry. Co., 91 N. Y. Suppl., 43.)

NEW YORK.—Carriers—Misconduct of Employees—Liability—Damages.

1. A street railway company is liable to a passenger for an injury to his feelings because of insulting language used by a conductor.

2. In an action against a railroad to recover for injuries to feelings, caused by insulting language of conductor, the jury may consider the humiliation and injury to the feelings, but not any injury to the character resulting therefrom.

3. Where a passenger on a street car tendered the conductor an amount more than the fare, and asked for a transfer, and, after the conductor had attended to another passenger, demanded her change, whereupon the conductor in an abusive manner refused to return any change, but called the passenger a deadbeat and swindler, a directed verdict for plaintiff for the amount of the change as the extent of the carrier's liability is reversible error.—(Gillespie vs. Brooklyn Heights R. Co., 70 N. E. Rep., 857.)

NEW YORK.—Trial—Misconduct of Counsel—Inflammatory Argument.

In an action for injuries, defendant only litigated the question of damages. Defendant's employees operating one of the colliding cars in which plaintiff was injured had been indicted for criminal negligence, and a change of venue had been granted for prejudice of the inhabitants of the county. Plaintiff's counsel, in argument, stated that the accident occurred through the criminal negligence of defendant, to which an objection was sustained, and later asked the jury to bring in such a verdict as would teach defendant and all similar corporations that their railroads must be run with some regard to the safety of human life and limb. Defendant objected to this, but the objection was overruled, and a verdict returned for plaintiff for $17,952.04. Held, that such argument constituted reversible error.—(Kinne vs. International Ry. Co., 90 N. Y. Suppl., 930.)

NEW YORK.—Carriers—Railroads—Injuries to Passengers—Boarding Car—Evidence—Order of Proof—Redirect Examination.

1. Where plaintiff was injured, while attempting to board a horse car standing in the car house, by the premature starting thereof, and it appeared that plaintiff in boarding the car was preceded by another, plaintiff was entitled to answer whether he had got on cars at that place before, and if he knew what the custom was at that time with regard to passengers boarding cars at that point, to show that defendant was in the habit of receiving passengers at that place, which it denied.

2. Where evidence, sought to be elicited from plaintiff on redirect examination, went to plaintiff's cause of action, and related to a subject to which plaintiff's attention had not been directed either on direct or cross-examination, and as to which plaintiff might have been recalled and examined, it was not subject to exclusion, in the discretion of the court, because not offered on direct examination.—(Gleason vs. Metropolitan St. Ry. Co., 90 N. Y. Suppl., 1025.)

NEW YORK. — Carriers — Injury to Passenger — Proximate Cause.

In an action against a street railroad for injuries to a passenger resulting from the plaintiff stepping into an unguarded excavation some distance from the car, from which he had alighted with safety, where it appeared, according to plaintiff's own testimony, that he had taken two or three steps before falling, neither a fire which from unknown causes had broken out in the car, nor the act of the conductor, on its discovery, in stopping the car and letting the passengers alight, was the proximate cause of the injury.—(Goldberg vs. Interurban St. Ry. Co., 90 N. Y. Suppl., 347.)

NEW YORK.—Street Railways—Injuries to Passengers—Res Ipsa Loquitur—Applicability—Burden of Proof.

Where, in an action for injuries to a passenger on an electric street car, plaintiff showed that a series of explosions, which seemed to come from under the car, caused a panic among the passengers, who, in their endeavor to leave the car quickly, pushed plaintiff off, and defendant's evidence tended to show that the explosions did not occur through its negligence, it was error to refuse to charge that the burden of proving negligence was on plaintiff, notwithstanding the explanations of the explosions given by defendant, though it be assumed that at the close of plaintiff's case the doctrine of res ipsa loquitur applied.—(Lynch vs. Metropolitan St. Ry. Co., 90 N. Y. Suppl., 378.)

NEW YORK.—Carriers—Negligence—Action—Evidence—Sufficiency.

Where an open street car, which was on fire, came to such a sudden stop as to hurl a passenger to the pavement, in an action for the injuries it was error to direct a non-suit on evidence showing such facts, since, if the motorman stopped the car, his conduct was plainly negligent, and if the fire caused the sudden stoppage the burden was on defendant to explain the cause of the accident.—(Glassberg vs. Interurban St. Ry. Co., 92 N. Y. Suppl., 731.)

NEW YORK.—Negligence—Personal Injuries—Question for Jury—Carrier—Personal Injuries—Negligence—Burden of Proof.

1. In an action against an ice company for injuries to plaintiff while a passenger on a street car by a collision of the defendant's wagon with the car, whether the defendant was guilty of negligence held a question for the jury.

2. In an action against a street railroad for injuries to plaintiff while a passenger on one of defendant's cars by a collision with a wagon, the burden of proving negligence on the part of the defendant rested on plaintiff throughout the trial, and was not changed by proof of plaintiff's injuries by the collision, which, with the aid of legal presumptions, made out plaintiff's prima facie case against the defendant.—(Maher vs. Metropolitan St. Ry. Co. et al., 92 N. Y. Suppl., 825.)

NEW YORK.—Street Railroads—Construction Work—Use of Streets—Liability to Pedestrians—Judgments—Dismissal—Failure of Proof.

1. An elevated railway is not liable for injuries to a pedestrian caused by his stepping on a nail in a plank placed on the sidewalk by the railroad in the course of the construction of steps, unless it permitted the plank to remain upon the sidewalk beyond a reasonable time.

2. A judgment of dismissal on the merits, entered after a non-suit for failure of proof, is, in so far as it directs the dismissal upon the merits, erroneous.—(Hedenberg vs. Manhattan Ry. Co., 91 N. Y. Suppl., 68.)

NORTH CAROLINA.—Carriers—Street Railroads—Injuries to Passengers—Premature Start—Negligence—Duty of Conductor—Damages.

1. Plaintiff alighted from a street car, on which he had paid his fare, and received a transfer to a connecting line. As he attempted to board the connecting car at the usual place for the transfer of passengers, he was thrown to the street and injured by the sudden start of the car when he had one foot on the step and the other on the ground. Held, that plaintiff was a passenger at the time he was injured.

2. Where plaintiff was injured by the sudden starting of a street car before he had succeeded in boarding it at a regular stopping place, and it appeared that at the time the conductor was not at his post of duty controlling the movements of the car, an instruction that such facts, if believed, were sufficient to establish the street car company's negligence was not error.

3. It is the duty of a street car conductor to be at his station on the platform where passengers are in the habit of boarding the car, and to give them such assistance as is necessary, and see that the motorman is not signaled to start until reasonable time has been given passengers assembled, who manifested an intention to get on the car, to do so.

4. In an action for injuries to a passenger by the premature starting of a street car, an instruction authorizing a recovery of damages for actual nursing, medical expenses and "loss of time, or loss from inability to perform ordinary labor or capacity to earn money," was proper.—(Clark vs. Durham Traction Co., 50 S. E. Rep., 518.)

PENNSYLVANIA.—Street Railroads—Collision with Traveler —Non-Suit—Rulings on Evidence.

1. Plaintiff's evidence, in an action to recover for injuries at a street railway crossing, showed that he looked for a car when at the building line of the street, and saw one about 480 ft. away, approaching; that he drove to the track, and looked for the second time, when his horse was on the track, and saw a car about half that distance away, and drove on at a slow walk; and that the car struck his front wheel almost instantly. Held, that an order of non-suit was properly granted.

2. An offer of evidence is properly excluded where it contains both relevant and irrelevant matter.—(Mease vs. United Traction Co., 57 Atl. Rep., 820.)

PENNSYLVANIA.—Street Railroads—Injury to Passenger.

Where plaintiff was riding in an open summer car having a running board along its side, and wished to get off at a certain street, and when the car stopped before it came to the point where she wished to alight, she stepped down on the landing board, and attempted to step off backwards, and found the distance too great for her to touch the ground comfortably with her foot, and, whether from confusion or inability to control herself, she fell and was hurt, it was error to submit the case to the jury.—(Scanlon vs. Philadelphia Rapid Transit Co., 57 Atl. Rep., 521.)

PENNSYLVANIA.—Street Railroads—Injury to Passenger—Evidence.

1. It is the duty of a conductor on a single-track road, before starting the car, to look on both sides of the car to see if passengers are about to enter.

2. In an action against a street railroad company to recover damages for personal injuries while attempting to enter a car, evidence held sufficient to take the case to the jury.—(Redington vs. Harrisburg Traction Co., 60 Atl. Rep., 305.)

RHODE ISLAND.—Street Railroads—Negligence—Obstruction on Track—Removal—Liabilities.

Where the operatives of a street car, on removing from the track an obstruction that had been unlawfully placed there, left it in the street, and, owing to its presence there, plaintiff was injured by riding into it on a bicycle, the railroad company was not liable.—(Howard vs. Union R. Co., 57 Atl. Rep., 867.)

RHODE ISLAND.—Carriers—Injuries to Passengers—Permanency—Allegations—Proof—Carlisle Tables—Damages—Excessiveness.

1. Where a description of injuries sued for did not show that they were necessarily permanent, plaintiff should allege their permanency, in order to recover therefor.

2. In an action for injuries, to entitle plaintiff to recover present damages for apprehended future consequences, the evidence must show such a degree of probability of their occurring as amounts to a reasonable certainty that they will result from the original injury.

3. Where, in an action for injuries not of themselves permanent, nor alleged to be permanent, the evidence did not establish with reasonable certainty that plaintiff would not recover therefrom, the admission of life tables in evidence was erroneous.

4. Plaintiff, while a passenger on defendant's street car, sustained a severe shock or jolt, which caused pain and suffering to the date of the suit. No bones were broken, nor was there a loss of any limb or organ; and her physician testified that under the most favorable conditions her recovery would be a question of probably eighteen to twenty-four months, but that under ordinary circumstances it might last indefinitely. Held, that a verdict for $6,000 was excessive.—(MacGregor vs. Rhode Island Co., 60 Atl. Rep., 761.)

TEXAS.—Carriers—Failure to Stop Car—Instructions—Actual Damages—Exemplary Damages—Separation in Verdict—Evidence.

1. Where, in an action against a street railroad for damages because of the failure to stop a car and admit plaintiff as a passenger, the court instructed on exemplary damages, it might properly have required the jury to separate in their verdict the exemplary and actual damages, and to state the character of the damages if they only found one kind.

2. Where, in an action against a street railroad for damages for failure to stop a car and admit plaintiff as a passenger, plaintiff and one who accompanied him testified that they commenced signaling the car by waving their hands when it was a quarter of a mile distant, and continued it until it passed, and that when it passed, the motorman motioned to them and the conductor signaled them and laughed. The motorman testified that they stood near the track talking, but gave no signal until he was even with them. Held, that an instruction on exemplary damages was warranted.

3. Where, in an action against a railroad for damages because of the failure to stop a car and admit plaintiff as a passenger, it was an issue of fact whether plaintiff was compelled to walk a certain distance, an instruction that the jury might consider that plaintiff had to walk such distance was error.—(Northern Texas Traction Co. vs. Peterman, 80 S. W. Rep., 535.)

TEXAS.—Carriers—Street Railroads—Injuries to Passengers—Negligence—Contributory Negligence—Assumption of Facts —Question for Jury.

1. Plaintiff (a minor) and his friend boarded the running board of a street car on the side opposite to that on which the conductor was collecting fares, intending only to ride a short distance, and then to continue their journey by wagon. Plaintiff had money, and agreed to pay the fare for both. Plaintiff claimed that, after signaling the car to stop, the car slowed up but slightly, and then began to run faster, and he, believing it would not stop, stepped off, and was injured. It also appeared that plaintiff did not pay his fare before he alighted. Held, that it could not be found, as a matter of law, that plaintiff, in good faith, intended to pay his fare, and hence it was error, in the instructions, to assume that plaintiff was a passenger.

2. Where, in an action for injuries to a person in alighting from a moving street car, his testimony that he rang the bell a number of times for the car to stop before he alighted was uncontradicted, and other passengers on the car testified, but failed to state anything with reference to the ringing of the bell, and the motorman was not called to answer whether he heard the bell or not, the court was justified in assuming that the company was guilty of negligence in failing to stop the car in response to the signal.

3. Where a passenger on a street car signaled the car to stop for him to alight, and he testified that, on the car slowing up and then increasing its speed, he concluded it was not going to stop, whereupon he jumped off and was injured, the question of his contributory negligence was for the jury.—(Dallas Rapid Transit Co. vs. Payne, 82 S. W. Rep., 649.)

TEXAS.—Negligence—Personal Injuries—Petition—Sufficiency —Evidence—Admissibility—Damages—Instruction.

1. In an action for injuries, an allegation of the petition that plaintiff was seriously and permanently injured in his head, neck, shoulders, arms, body, and in his back and spine, without averring any reason why the injuries could not be stated, was obnoxious to a special exception as being too general.

2. An allegation of the petition that plaintiff's injuries resulted in greatly and permanently impairing and diminishing his capacity to earn money was also obnoxious to special exception.

3. Plaintiff was not limited in his damages to the particular calling in which he was engaged at the time of the injuries or the wages he was then receiving.

4. Proof of damages as to the particular trade in which plaintiff is skilled is inadmissible, in the absence of allegation setting forth the particular trade in which he is skilled.

5. Under an allegation of the petition that plaintiff's injuries greatly and permanently impaired and diminished his capacity to earn money, to which a special exception was properly taken as too general, evidence that at the time plaintiff received the injuries he was earning $10 a week was inadmissible.

6. Under an allegation of the petition that plaintiff's injuries greatly and permanently impaired his capacity to earn money, to which a special exception was properly taken, and objections to the admission of evidence thereunder were made, a charge that a finding for plaintiff should include damages for loss of earnings was erroneous, the allegations not showing what plaintiff's earning capacity was before he was injured.—(Dallas Consol. Electric St. Ry. Co. vs. Hardy, 86 S. W. Rep., 1053.)

CHARTERS, FRANCHISES, ORDINANCES, ETC.

PENNSYLVANIA.—Street Railroads—Right of Way—Injury to Property—Action for Damages—Evidence.

1. Where a street railway company contracted in writing with a landowner for the use of land through his meadow, and thereafter orally agreed with him to pay for cutting up the meadow in reaching the strip, the landowner could recover compensation, though he had no right to it except under the oral agreement.

2. A landowner, who had granted a right of way to a street railway company, in an action for damages alleged that defendant had so constructed his railway as to do great damage to plaintiff's property, and introduced evidence that the construction of the road had severed a three-cornered lot from his other land, to his great injury. There was evidence from which the jury could determine the value of the lot. Defendant did not ask for any more definite description of the damages. Held, that the evidence was admissible under the pleadings.—(Quigley vs. Montgomery & Chester Electric Ry. Co., 57 Atl. Rep., 512.)

FINANCIAL INTELLIGENCE

Wall Street, Aug. 16, 1905.

The Money Market

The money market this week failed to reflect the beginning of the movement of money to the West for crop-moving purposes, and the comparatively small reserves held by the local institutions. The tone, if anything, was easier, some lenders being disposed to shade the rate for over the year maturities, which has heretofore been held firm at 4 per cent. The ease, however, was due more to the falling off in demand for all classes of accommodations, rather than to any pressure of funds upon the market. Stock commission houses are said to have secured all necessary requirements, while the inquiry from commercial sources appeared to be less urgent. Money on call was in fair demand and ample supply, at rates ranging from 1½ to 2 per cent, with most of the week's business transacted at the latter figure. The time money market was extremely quiet. The demand for funds was light, notwithstanding the continued activity and strength in the securities market. Sixty and ninety-day contracts were obtainable in almost any amount at 2¾ and 3 per cent respectively, while four months' money was offered at 3½ per cent. Over the year maturities were placed at 3¾ per cent against 4 per cent quoted for some time past. Six months' contracts remained firm at 4 per cent. Commercial paper was only moderately active on the basis of 4 per cent for choice double names. Specialists reported a fair supply and a good absorption, the buying being principally out of the institutions. Local banks continued to accommodate their customers, but have done little in the open market. The European markets remained easy at practically unchanged quotations. The bank statement, published a week ago, showed a further loss in cash of $1,933,500, but owing to a decrease of $2,616,775 in the reserve required, the surplus was increased by $683,775. The surplus on Aug. 12 was $12,846,800, as compared with $37,731,475 in the corresponding week of 1904, $21,563,575 in 1903, $7,126,600 in 1902, $18,421,900 in 1901, and $20,587,050 in 1900. During the week the initial transfer of currency to the West was made through the sub-Treasury for moving the crops. The movement this year is somewhat earlier than in previous years, and although the shipments thus far have been small they will assume larger proportions from now on. Reports from the West are to the effect that the interior institutions are in splendid condition to meet these demands, but it is believed in local banking circles that, judging from the size of the crops now indicated, the New York banks will be called upon to provide as much, if not more, money for crop moving than in recent years.

The Stock Market

The stock market continued to display strength during the week, and although there were periods when prices reacted moderately on profit-taking selling, there was no modification of bullish opinion, and the buying was of a character to stimulate confidence and to encourage broader interests in the speculation. For the first time in many weeks public buying has been in evidence, and it is expected that public interest in the market will materially increase during the second half of the month. The real stimulating influence has been the government crop report showing conditions on Aug. 1, which indicated record yields of wheat and corn and large harvests of other grain, and this was regarded as a very practical offset to the indicated smaller crop of cotton. The continued placing of large orders for steel rails, structural material and railway equipment, was taken to reflect the confidence on the part of the transportation interests and a large tonnage for the ensuing year. The strong position of the copper metal market and the favorable reports regarding other trades were counted among the favorable influences, and so far as the stock market is concerned little attention had been paid to the yellow fever situation at New Orleans. In the early part of the current week prices for stocks reacted to a moderate extent on profit taking and professional selling, but at the close there was a resumption of aggressiveness by the leading interests in such stocks as Union Pacific, St. Paul, the Hill group, the coal stocks, the Southwestern stocks and Amalgamated Copper, and a number of these stocks made new high records on this movement. Much attention has been paid to the peace conference at Portsmouth, and while it is expected that some snag is likely to be struck, it is believed that the result will be an agreement that will terminate the war. Even should the conference prove a failure it would not have any more than a temporary adverse influence on the stock market. The bond market has been strong with good buying of all the Japanese issues and a satisfactory demand for other choice securities. The commodity markets have ruled weak until the close, when cotton advanced sharply.

The local traction issues have been only moderately active, but at the end of the week some aggressive buying developed in Metropolitan which carried the price up sharply, and also caused some improvement in Brooklyn Rapid Transit. Rumors of an early dividend of 2 per cent on the latter stock are emphatically denied, and it is stated that the policy of putting earnings back into the property will be continued.

Philadelphia

Trading in the traction stocks continued upon a fairly large scale this week, and although price movements were irregular, the general trend of value was toward a higher level. A feature of the trading was the activity and strength displayed by American Railway, over 1000 shares of which were dealt in at from 53 to 54½, the closing being within a small fraction of the highest. Railways General was another of the low priced issues to display strength, 540 shares changing hands at from 3 to 3¾, an advance for the week of a point. A better inquiry was noted for the investment issues, and prices advanced sharply on very light transactions. Frankford & Southwark Passenger stock sold at 455 and 458 for thirty-four shares, a gain of 8 points, while small amounts of Second and Third Streets Passenger sold at 302. Thirteenth and Fifteenth Passenger sold at 306, and sixty shares of Union Passenger brought 238 and 240. United Companies of New Jersey sold at 269½ for nine shares. The speculative issues were active and irregular. Philadelphia Company common, after selling at the beginning at 46⅞ reacted to 46¼, but later recovered to 46¾. Upwards of 9000 shares were dealt in. The preferred stock sold at 49. Philadelphia Rapid Transit was active and strong, about 6000 shares changing hands at from 29½ down to 28⅜, but subsequently there was a recovery to 28⅞. Philadelphia Traction held firm at 100. Consolidated Traction of New Jersey was fairly active and strong, about 1700 shares selling at from 81 to 82½, the closing transaction taking place at 81⅞. Other transactions included 900 United Railways preferred at 90, 235 United Traction at 61.

Baltimore

Increased activity, accompanied by substantial advances in prices, characterized the trading in the local traction issues this week. The overshadowing feature was the extremely heavy dealings in all of the issues of the United Railway Company. The stock was dealt in to the extent of 1300 shares at prices ranging from 14¾ to 15, while trust receipts, representing more than 1900 shares, sold at 14½ to 15⅛. The 4 per cent bonds were in active demand, over $81,000 changing hands at from 94¼ to 95⅛. The incomes were heavily traded in, $233,000 of the free bonds changing hands at from 60½ to 63, while trust receipts representing $203,000 sold from 59¼ to 62. Charleston Consolidated 5s sold at 98 for 6000, and $5,000 Toledo Traction 5s brought 101. Other transactions were: $1,000 Virginia Electric Railway & Development 5s at 100, $10,000 Macon Railway & Light 5s at 99, Norfolk Railway & Light 5s at 93¼, Augusta Railway 5s at 105 and Baltimore Traction 5s at 101½.

Other Traction Securities

The Boston market was without noteworthy feature. Trading was quiet and prices in most instances ruled practically unchanged from those prevailing at the close of last week. Massachusetts Electric issues were exceptionally strong, the common and preferred advancing 2 points each to 19½ and 62, respectively, on an extremely small volume of business. Boston Elevated fluctuated between 153 and 154, closing at the latter figure. Boston & Suburban preferred brought 68 for small amounts, and odd lots of Boston & Worcester sold at from 28 down to 27. West End common advanced ½ to 97½, while the preferred moved up a point to 114.

The Chicago market was extremely quiet. Metropolitan Elevated sold at 24, and the preferred at from 63 to 64½. Chicago & Oak Park common held firm at 54, and 100 shares of the preferred brought 19. Interborough Rapid Transit was active in the New

York curb market, but the dealings were attended with erratic price movements. From 220½ at the opening the price ran off to 217½, but rallied and closed at 218½. About 10,000 shares were dealt in. Washington Railway common was decidedly strong, the price advancing a point to 40½ on the purchase of 500 shares. The preferred stock was firm also, 400 shares selling at 93 and 93¼. American Light & Traction sold at 99 for 100 shares. The New Orleans Railway issues were quiet and about unchanged. The common stock sold at 30⅜ to 30⅛ for 1300 shares, while an odd lot of the preferred brought 73. The 4½ per cent bonds were strong, with sales of $16,000 at 88¾ and 89¼.

At Cincinnati, of late, there has been pronounced activity in the securities of the Cincinnati, Newport & Covington, due to indications of a dividend declaration on the common stock. This has been selling at around 33 for many months, but recently moved up to 37⅜ and 38; sales this week, 1371 shares. The preferred advanced to 96¼. Cincinnati Street Railway sold at 146; Toledo Railway & Light at 34¾, and Detroit United at 92¾. Cincinnati, Dayton & Toledo 5s sold at 96¼ to 96⅜, and Toledo, Bowling Green & Southern 5s at 95.

Aurora, Elgin & Chicago has been very active in Cleveland of late; last week about 1800 shares changed hands, advancing from 18 to 19½, and the early part of this week the price was forced up to 20, the highest price recorded this year. The bonds advanced from 93½ to 95½ on sales of about $50,000 worth. Reports of increased earnings are responsible for the anxiety to get these securities. Lake Shore Electric common has been quite active at 10 to 10¾. Northern Texas sold at 66½; Cleveland & Southwestern preferred, a dividend payer, at 54, and Cleveland Electric at 79.

Security Quotations

The following table shows the present bid quotations for the leading traction stocks, and the active bonds, as compared with last week:

	Aug. 9	Aug. 16
American Railways	52½	53
Boston Elevated	*153	154½
Brooklyn Rapid Transit	69⅝	70⅛
Chicago City	—	a196
Chicago Union Traction (common)	9¼	8½
Chicago Union Traction (preferred)	35⅝	36
Cleveland Electric	78	78
Consolidated Traction of New Jersey	82	82
Consolidated Traction of New Jersey 5s	108½	108½
Detroit United	92½	92⅝
Interborough Rapid Transit	218	218¼
International Traction (common)	26½	31
International Traction (preferred) 4s	63	68½
Manhattan Railway	166⅝	167
Massachusetts Electric Cos. (common)	17½	18
Massachusetts Electric Cos. (preferred)	60	61
Metropolitan Elevated, Chicago (common)	24	24
Metropolitan Elevated, Chicago (preferred)	63	64
Metropolitan Street	127⅝	129¼
Metropolitan Securities	83⅜	83⅜
New Orleans Railways (common), W. I.	30⅜	30
New Orleans Railways (preferred), W. I.	72¾	71½
New Orleans Railways 4½s	88¾	89½
North American	100⅝	100¾
North Jersey Street Railway	25	—
Philadelphia Company (common)	46¼	46¼
Philadelphia Rapid Transit	29⅛	28¼
Philadelphia Traction	100	100
Public Service Corporation 5 per cent notes	—	—
Public Service Corporation certificates	68½	68½
South Side Elevated (Chicago)	95	95
Third Avenue	127	127¾
Twin City, Minneapolis (common)	117	117¾
Union Traction (Philadelphia)	60½	61¾
West End (common)	97	97
West End (preferred)	a113½	113

a Asked. W. I., when issued. * Ex-div,

Iron and Steel

The "Iron Age" says, that in nearly all the heavy lines the tonnage on the books is enormous, and further work cannot be taken in many instances from sheer inability to meet even distant deliveries. In the structural trade the event of the week has been the award of the contract for the new Manhattan Bridge to the Pennsylvania Steel Company, which calls for 43,937 tons of material. The pressure upon the structural mills is exceedingly heavy, and the payment for prompt delivery, and the importing of occasional lots of foreign shapes seem to foreshadow an upward movement. During the week the car builders have gathered in additional work. Pig iron has been rather quiet, taking the country as a whole. The purchase by the United States Steel Corporation will probably not be made until early in September. In the East there has been a little wavering as to prices, one large producing company offering iron at somewhat lower figures.

THE SYRACUSE, LAKESIDE & BALDWINSVILLE SOLD

The Syracuse, Lakeside & Baldwinsville Railroad was sold at a mortgage foreclosure sale of Aug. 11 to the Beebe syndicate, which owns the Auburn & Syracuse Electric, the Rochester, Syracuse & Eastern, and the Newark & Marion railroads. The price paid was $530,000, and there was spirited bidding by other interests. The sale was at the instance of the United States Mortgage & Trust Company, of New York, trustee of the mortgage for the bondholders, represented by Davis, Stone & Auerbach. The defendants in the foreclosure action were the Syracuse, Lakeside & Baldwinsville Railroad Company, William B. Rockwell, receiver, and others. The mortgage was made March 1, 1899, to secure a bond issue of $500,000, which was the total principal of the debt, bearing interest at 5 per cent. Interest was never paid, making the sum due on the mortgage $658,872.22, plus interest from July 7. The Syracuse, Lakeside & Baldwinsville Railroad is a 14-mile line extending northwest from Syracuse along Onondaga Lake and to the village of Baldwinsville. The new owners will improve the property at once, and extend it to Fulton and Oswego.

ORDER FOR NEW YORK CENTRAL TRANSFORMERS

The General Electric Company announces that it has just received the contract for all the transformers to be used in the eight sub-stations of the New York Central Railroad at its New York terminal. There will be fifty-four 375 kw, and eighteen 550-kw transformers for operating rotary converters, and thirty-three 120-kw transformers for operating booster sets, representing a total of 34,110 kw, or, approximately, 45,000-hp transformer capacity. All these transformers are to be of the GE air-blast type, built for 25-cycle circuits.

These transformers are provided with one-third and two-thirds voltage taps on the low-tension side, to permit the starting of the rotary converters directly from the alternating current end without the use of starting motor or starting compensator. The order for the motor-driven blower sets for all of these transformers has also been awarded to the General Electric Company.

OUTING AT BREWSTERS OF THE OFFICERS OF THE NEW YORK CITY RAILWAY COMPANY

The seventh annual entertainment, tendered to the officers and heads of departments of the New York City Railway Company by President H. H. Vreeland, occurred Aug. 16. This annual invitation to visit the country home of Mr. Vreeland, enjoy a fish dinner, and afterwards attend a reception at his residence, is anticipated during the summer by all who have the fortune to be invited, and is always most enjoyable. For the first time since they were instituted, the weather interfered with the usual programme. The date originally set was Aug. 15, but owing to the unpropitious elements the entertainment was postponed until the following day. Although not fair, the weather conditions were much more favorable on Aug. 16 than on the previous day, and the occasional showers did not detract in any way from the pleasure of those who were able to attend. The clam bake and dinner were given as usual at the Tonetta Club, under a large tent, and proved most appetising. In the afternoon the guests were driven to Mr. Vreeland's residence. Here they were tendered a reception by Mrs. Vreeland, who has the happy faculty of making all her guests feel entirely at home, and who was assisted in receiving by several other ladies. Later in the afternoon and in the evening the time was spent in indoor entertainment at Mr. Vreeland's "play house," which is provided with bowling alleys, billiard tables and other means of recreation, which were very popular. After a supper at Mr. Vreeland's house, the party, which numbered about 125, returned to New York by special train.

SUBWAYS FOR PITTSBURG

A system of underground lines is projected for Pittsburg. According to the information that is available about the project these companies, all controlled by the same interests, are to apply for incorporation at Harrisburg. They are the Pittsburg Subway Company, the East End Tunnel Company and the Bayard Street Railway Company. E. K. Morse, a prominent engineer, with offices in the Farmers' Bank Building, Pittsburg, is the principal promotor as judged from the incorporators. That he represents important financial and engineering interests whose identity is yet to be disclosed is generally admitted.

The charter applications show that there is a connected system for this new underground system. The first, known as the Pittsburg Subway Company project, includes the down-town terminals of the system. This will provide a tunnel, starting from Oliver Avenue and Smithfield Street through Oliver Avenue to Liberty Avenue, to Ferry Street, to Third Avenue, to Smithfield Street, and back to the point of beginning, thus forming a convenient loop for the turning of cars. All of this is to be under ground, and, with the exception of Oliver Avenue, it conflicts with the routes to the Flinn tunnels for his freight transportation lines.

The East End tunnel route, as marked by the application for the charter, commences at Oliver Avenue and Smithfield Street and goes underground at once, almost in a direct line to the intersection of Neville Street and Ben Venue Avenue. This company claims the right to condemn lands for approaches to its tunnels at the terminals.

The final line is a surface street car line, which starts at Center Avenue and Neville Street and runs through Neville Street to Bayard Street, to Bellefield Avenue and Forbes Street and back to the point of beginning. This last will give Bellefield terminals for the line of tunnels and give passengers service throughout the Bellefield district.

The connection between the terminus of the East End tunnel line and the commencing of the surface line of the company is supposed to be provided for in the statement of "approaches and other necessary lands to be used for the general development of the enterprise." It is complete and connected and opens clearly the route proposed for the general system, and it is said will also mark the beginning of a more extensive system that will be carried to the East End as time passes and the project gets well under way.

THE FIRST DRAWING UNDER THE LOTTERY SYSTEM IN MEXICO

The first drawing under the lottery system in connection with the issuance of tickets on the electric lines in Mexico City, Mexico, which was fully described in the Street Railway Journal of July 1, 1905, was held a few days ago. There were many thousands of tickets out, and the greatest interest was manifested in the drawing by the ticket holders. The drawing took place in the presence of Mr. Wheatly, general manager; Sir Charles Euan-Smith, of London, Eng., chairman of the board of directors, and a representative of the Mexican government.

The arrangement of the drawing was well devised. The instruments used were seven enameled steel globes and a large number of wooden balls, about the size of marbles. Each of these balls contained a single number, from 0 to 9, and two hundred and nine of these balls with these numbers were put into each of the globes. When all of the globes were filled, they were locked by the government inspector who kept the keys in his possession during the drawing process. When everything was ready for the drawing to begin, one of the company's employees turned the first globe, which, like all the others, was so constructed as to revolve on an axis, and the numbers were all shaken and well mixed. One of the balls was then taken out through an aperture on the side of the globe opposite that of the lock. The ball taken out first was numbered 0, and it was placed at the top of a large wooden frame, which was so made that there was a place for each of the balls to rest. The second globe was then made to revolve in the same manner as the first one, and a ball numbered 1 was taken from it. This ball was placed upon the right of the first ball, so that the two numbers read 01. The ball from the third globe, which was turned in the same way numbered 9, and the three numbers now read 019. The remaining globes were manipulated like the first three, until balls had been taken from them, the combined numbers, placed on top of the wooden frame, awarded the capital prize. This process was repeated until all the balls were taken from the globes, when there were seven frames filled with 200 numbers in each frame. A complete list of the numbers of the 209 tickets that won prizes will be published soon, and they will also be posted in all the cars of the system.

AN ATTEMPT TO DIVERT BROOKLYN BRIDGE TRAFFIC TO THE FERRIES

A radical change in the transportation system of Brooklyn, made possible through an agreement due to the initiative of the Transportation League and entered into by the Brooklyn Rapid Transit Company and the Union Ferry Company, went into effect on Monday morning, Aug. 14. By providing a sufficiency of cars for South Ferry on the Fulton Street, Putnam Avenue, Gates Avenue, Seventh Avenue, Bergen Street, Fifth Avenue, Greenpoint and Crosstown lines, the Transit Company will carry passengers to and from the ferry terminal with reasonable comfort and despatch. The ferry company will do its share of the work by arranging the boat service on a scale adequate to the demands which it hopes will be made upon it. The whole is a project for the relief of the congestion at the Brooklyn Bridge by diverting traffic to the ferries. During the hours between 6 a. m. and 8 p. m., the lines mentioned will connect with the ferry boats, which will be operated on a ten-minute headway.

INDIANA ROADS ADOPT OHIO MILEAGE

Secretary F. W. Coen, of the Ohio Interurban Railway Association, announces that the Indiana Northern, the Ft. Wayne & Wabash Valley, and the Indianapolis, Columbus & Southern Traction Companies have agreed to adopt the interchangeable coupon books of the Ohio Interurban Railway Association, making seven Indiana roads, embracing about two-thirds of the mileage of the State, which have adopted the Ohio arrangement. The Indiana managers find objection to the fact that the word "Ohio" is so prominent in this form of transportation—and many of the Ohio managers agree with them—that they have cause for complaint. There is little doubt that at the first meetings of the Ohio and Indiana associations this fall, plans will be worked out for consolidating the two organizations. Much of the credit for bringing the Indiana roads into line on this agreement is due to H. A. Nicholl, general manager of the Indiana Union Traction Company, who while manager of the Cleveland & Southwestern Traction Company was one of the prime movers in the promulgation of the plan among Ohio roads.

ELECTRIC RAILWAY TO CONNECT SAN MATEO AND SAN JOSE

A party of surveyors is laying out a right of way through the Stanford University campus for an electric railway which is to join the electric lines of San Mateo and San Jose. This is the first time that a franchise through or near the Stanford estate has been granted for an electric railway, for the reason that Mrs. Stanford, it is reported, personally objected to any such improvements being made upon the roads running through the campus. The board of trustees has evidently taken a different view of the matter, and is allowing the present survey to be made.

According to the work now being done, the new electric railway will approach the Stanford estate from the south and follow the road which runs along the foothills just west of Lake Lagunita and the Palo Alto stock farm. This road divides the original Stanford property at Palo Alto. The new road will give the university community easy access to all the towns south of Mayfield and north of Menlo Park.

A branch line is also to be run directly through the university campus to connect the university with the town of Palo Alto. It is probable that the branch line will leave the main line at the rear entrance of the campus proper, and then follow a northerly route to the faculty club house, from which point it will run parallel to University Avenue. A passenger station will also be built at a convenient place on the branch line.

An electric railway has long been wanted by students and faculty members living in Palo Alto. The fares charged by the 'bus drivers have been exorbitant, and the service poor. With an electric railway the time of travel will be much shortened, and the service more frequent. The fare will also be reduced more than half of what it has been in the past. A survey of the right of way will be made within the next month.

The Bogota City Railway Company, of Bogota, Columbia, now a mule line, contemplates changing its entire system to electricity in the near future, if the proper concession can be secured from the government.

AN IMPORTANT CALIFORNIA PROJECT

The Central California Traction Company has been incorporated for the purpose of building 175 miles of electric railway in San Joaquin, Sacramento, Calaveras and Stanislaus Counties. The enterprise is said to be a Gould project, the proposed electric lines to serve the useful purpose of feeders of the Western Pacific. The company is incorporated with a capital stock of $2,500,000, of which $300,000 has already been subscribed. H. H. Griffiths, of Stockton, who has been prominently identified with Western Pacific affairs during the past few years, appears as the subscriber of $299,000 of stock. The other incorporators and directors are: M. Fleishhacker, H. Fleishhacker, Alden Anderson, H. H. Ferns, F. W. Smith, W. J. Bartnett, J. Dalzell Brown, John Treadwell, Fred M. West and David F. Walker.

The company plans to build ten or twelve miles of electric railway in Stockton immediately. This will be followed by the construction of fifteen miles of track from Stockton to Lodi, and eventually lines reaching to Sacramento, Modesto, Walnut Grove and other points. The estimated mileage of the several lines is as follows: From Stockton to Lodi and Sacramento, and from Stockton to Modesto, including lines in each town, ninety miles; from Lodi to Walnut Grove, Sacramento County, twenty miles; from Stockton to Walnut Grove, thirty-five miles; from Stockton to Calaveras County, thirty miles.

It is explained that the company aims eventually to have a system of interurban electric lines with a total mileage of something like 200 miles of track, with Stockton as the center of the system. Electric power for the operation of the system will be obtained from the power plant of the American River Electric Company, in Placer County, in which some of the incorporators of the new company are interested. The incorporators of the new company say it is merely a coincidence that a majority of their number are identified with the Western Pacific, and that the electric lines they propose to build will be free to serve as feeders for not only the Western Pacific, but the Southern Pacific and Santa Fe as well.

RECENT SALES OF GENERAL ELECTRIC RAILWAY APPARATUS

The General Electric Company has recently received orders for a large amount of electric railway apparatus, of which the following is a partial description:

The New York Central & Hudson River Railroad Company has ordered 125 2-motor GE-69 (200-hp) equipments with Sprague-General Electric Type-M control, to be used in handling the suburban service out of the Grand Central Station, New York City. These equipments, together with the thirty-five electric locomotives of the same type as the "6000" (which has been described in these pages) will handle the entire passenger service of the New York Central in its electrical zone.

Another New York State order is for five 4-motor GE-67 (40-hp) equipments, with K-28 controllers, for the Buffalo Southern Railway Company which is a consolidation of the Buffalo, Gardenville & Ebenezer and the Buffalo, Hamburg & Aurora Railroad Companies.

The Atlantic Coast Electric Company has ordered two 2-motor, GE-67 equipments, with K-10 controller, while the New York & Queens County Railway Company, Long Island City, N. Y., has placed an order for ten of the new 4-motor GE-80 (40-hp) equipments with K-28 controllers. This motor is a recent design and represents the latest railway motor development. Another order for the new motor consists of twenty 2-motor GE-80 equipments, with K-10 controllers from the Omaha & Council Bluffs Street Railway Company, Omaha, Neb.

Other recent railway motor sales are twenty 40-hp, 2-motor equipments, with K-10 controllers for Oakland Transit Consolidated Company, Oakland, Cal.; eight 4-motor, 50-hp equipments with controllers for the Conneaut & Erie Traction Company; three 4-motor, 75-hp equipments with Sprague-General Electric Type-M control for the Columbus, Delaware & Marion Electric Railway Company, which now has ten equipments of this type in operation, and one 4-motor, 65-hp equipment with Sprague GE control for the Philadelphia & Westchester Traction Company, Llanerch, Pa.

Recent sales of railway generating equipment consist of one 5000-kw, three-phase, 35-cycle Curtis steam turbine generator, and one three-phase revolving field 3500-kw, 35-cycle, alternator, for Twin-City Rapid Transit Company, Minneapolis, Minn. Both of these generators are to furnish current at 13,200 volts; one 600-kw railway generator for furnishing power to Williamsport Passenger Railway Company, Williamsport, Pa.; one 500-kw motor generator set, driven from a 13,200-volt, a. c. circuit, and furnishing 600 volts direct current for Dallas, Tex.; three 300-kw, 25-cycle, rotary converters with transformers, switchboards and accessories, one each for Lancaster, Pa., Chicago, Ill., and Landisville, Pa.

EXHIBITORS AT THE PHILADELPHIA CONVENTION

The following is a preliminary list of the manufacturers who have been assigned space at the South Pavilion, Philadelphia Museum, in connection with the convention next September.

Allis-Chalmers Company.
American Brake-Shoe & Foundry Company.
American Carbon & Battery Company.
American Locomotive Sander Company.
American Railway Supply Company.
American Steel & Wire Company.
Atha Company, Benjamin.
Atlas Railway Supply Company.
Baldwin Locomotive Works.
Blake Signal & Manufacturing Company.
Brady Brass Company.
Brill Company, J. G.
Brown, Harold P.
Buda Foundry & Manufacturing Company.
Carnegie Steel Company.
Chicago Pneumatic Tool Company.
Consolidated Car Heating Company.
Continuous Rail Joint Company.
Crouse Hinds Company.
Curtain Supply Company.
Dearborn Drug & Chemical Company.
DeRonde, Frank S.
DeWitt Sand Box Company.
Duff Manufacturing Company.
Edwards Company, O. M.
Electric Railway Equipment Company.
Empire Safety Tread Company.
Galena Signal Oil Company.
Garton-Daniels Company.
General Electric Company.
Globe Ticket Company.
Gold Car Heating Company.
Goldschmidt Thermit Company.
Hale & Kilburn Manufacturing Company.
Harrison Safety Boiler Works.
Johns-Manville Company, H. W.
Kenfield Publishing Company.
Lorain Steel Company.
Lord Electric Company.
Lord Company, George W.
Lumen Bearing Company.
McGraw Publishing Company.
Manning, Maxwell & Moore.
Mayer & Englund Company.
Merritt & Company.
Miller Anchor Company.
National Brake Company.
National Carbon Company.
National Electric Company.
National Lock Washer Company.
Nuttall Company, R. D.
Ohio Brass Company.
Ohmer Fare Register Company.
Oliver Machinery Company.
Pantasote Company.
Peckham Manufacturing Company.
Pennsylvania Steel Company.
Peerless Rubber Manufacturing Company.
Pressed Steel Car Company.
Railway Journal Lubricating Company.
Ridlon Company, Frank.
St. Louis Car Wheel Company.
Schoen Steel Wheel Company.
Security Register Company.
Sherwin-Williams Company.
Simons Company, John.
Smith Heater Company, Peter.
Speer Carbon Company.
Standard Paint Company.
Standard Steel Works.
Sterling-Meaker Company.
STREET RAILWAY JOURNAL.
Street Railway Bulletin.
Taylor Electric Truck Company.
Under Feed Stoker Company, The.
Underwood Typewriter Company.
United States Metallic Packing Company.
Van Dorn Company, W. T.
Weber Railway Joint Manufacturing Company.
Wharton, William, Jr., & Company, Incorporated.
Wheel Truing Brake-Shoe Company.
Westinghouse Companies, The.

CONTRACT FOR MANHATTAN BRIDGE

The contract for building the superstructure of the Manhattan Bridge, the third to span the lower East River between Brooklyn and New York, was awarded Tuesday, Aug. 15, to the Pennsylvania Steel Company, which bid $7,284,000. The awarding of this contract is of special interest because of the part the bridge will play in the traffic problem of the greater city. Located between the Brooklyn Bridge and the new Williamsburg Bridge, it will draw upon both of them for traffic. As the approach in Brooklyn, which will have its terminus at Flatbush Avenue and Fulton Street, has been planned on liberal lines, and as provision has been made for four tracks for street cars, two for elevated railroad cars, and two for subway cars to cross the structure, there is no telling what the effect will be of the new structure on the traffic situation. The terminus of the structure in New York will be at Canal Street and the Bowery.

The Manhattan Bridge contract calls for the manufacture of 43,000 tons of steel, 8000 tons of which will cover the wire cables and fittings. The bridge is to be located at Pike Slip, between Water and Monroe Streets, on the East River, New York City. The anchorage in Brooklyn is between Adams and Pearl and Water and Front Streets. Contracts for the anchorage, which will cost $1,225,000 each, were awarded last February. The steel for the anchorages is to be delivered before February next.

NEW PUBLICATIONS

Moody's Manual of Railroad and Corporation Securities for 1905. Published by Moody Publishing Company, New York; 2580 pages. Price, cloth, $10; leather, $12.

This is the sixth annual edition of this important reference book, and is much more complete than any of its predecessors. The size of the page has been increased 30 per cent, and the size of the volume 35 per cent. The present edition contains over 3,000,000 words and covers the entire field of corporate investments. The book is divided into ten sections, as follows: 1, Full membership laws of the stock exchanges of the United States and Canada; 2, American and foreign government and State securities; 3, steam railroad companies; 4, electric traction companies; 5, gas and electric light companies; 6, water supply companies; 7, telephone, telegraph and cable companies; 8, industrial and miscellaneous corporations; 9, mines and oil corporations; 10, banks and trust companies and other financial institutions. Upon certain of these classes of securities other books are published, but the general investor will find the sections on gas and electric light, water supply, telephone and telegraph, mining, industrial and miscellaneous corporations especially useful. The fact that the manual contains statistics upon all classes of American securities makes it of especial value to the general investor.

The Corporation Laws of Pennsylvania, 1903-1905, being a Supplement of Statutory Law of Corporations, by John H. Whitworth and Clarence B. Millar. Published by T. & J. W. Johnson & Company, Philadelphia; 203 pages. Price, $1.50.

This book is printed in the same style and with corresponding paging to the work of which it is a supplement, but is complete in itself. It presents all of the laws of 1903-1905 relating to corporations, including railroads and street railways, and is provided with a complete index which refers to both the original book and to the supplement. The rules and the fees of the State Department governing corporations in Pennsylvania are also given in full.

Railway Provident Institutions in English-Speaking Countries, by M. Riebenack, controller Pennsylvania Railroad Company, Philadelphia. Published by the author; 388 pages.

In this volume Mr. Riebenack presents an extensive collection of most valuable statistics, a large part of which were presented by him as reports on the subject considered at the last two meetings of the International Railway Congress. Establishments of this kind are of modern origin, but the practice has developed radically, so that more than 100 railroad companies have now institutions in which the provident idea is represented. A great many of the British companies and certain roads in this country, conspicuously the Pennsylvania Railroad, have gone into the subject of accident and other insurance in a very elaborate way, and full particulars are given of the provisions of the different companies in this respect as well as other provident institutions, such as co-operative capital stock purchasing, literary institutions, etc. Altogether the volume is of great interest and value to any companies which are contemplating any institutions of this kind.

STREET RAILWAY PATENTS

[This department is conducted by Rosenbaum & Stockbridge, patent attorneys, 140 Nassau Street, New York.]

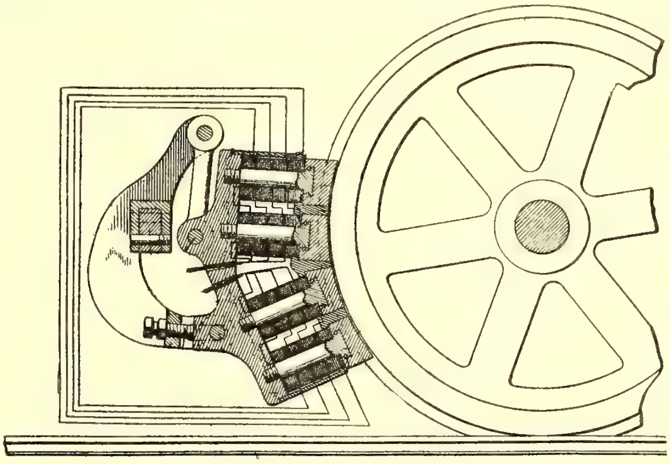
UNITED STATES PATENTS ISSUED AUG. 8, 1905

796,456. Roller Bearing Wheel; Joseph N. Sanchez, Galveston, Texas. App. filed March 1, 1905. The body of the wheel is fixed upon a non-rotatable axle and equipped with a rotatable tread or rim portion mounted to run concentrically upon the body and having anti-friction devices between the body and the tread of the wheel.

796,457. Car Truck Bolster; John Schaffer, Kirkwood, Mo. App. filed Dec. 15, 1904. A car-truck bolster having its body with the side bearings made in two parts, respectively integral, and adapted to meet along the middle of the bolster, the said body being box-shaped in cross-section in the assembled position of the parts, and means for detachably securing the parts to each other.

796,464. Car Brake; Charles J. Specht and Charles R. Krueger, New York, N. Y. App. filed June 24, 1904. An electro-magnetic brake-shoe in which the braking force is determined by the number of magnets energized.

796,509. Car Fender; Elwood C. Hall, New York, N. Y. App. filed Dec. 5, 1904. Details of construction.



PATENT NO. 796,464

796,621. Brake Rigging for Railway Vehicles; Chingalpat N. Achari and Cornelius E. Cardew, Insein, Lower Burma, India. App. filed Sept. 16, 1904. Mechanism whereby the thrust of the brake-blocks is increased or decreased in proportion as the load in or on a vehicle is increased or lessened.

796,657. Brake Apparatus for Vehicles; Edward H. Johnson, London, England. App. filed Dec. 1 ,1903. A resilient spiral band mounted on a rotary axle driven by the car, automatic means whereby the band will frictionally engage the rotary axle, and means whereby the energy resulting from such engagement and from the kinetic energy of the moving car will actuate the brakes.

796,697. Trolley Catcher; Seth J. Buckland, Springfield, Mass. App. filed Jan. 30, 1905. Details of a spring-drum and ratchet arrangement for controlling the trolley cord.

796,749. Electric Car Lighting; James F. McElroy, Albany, N. Y. App. filed Oct. 6, 1902. A dynamo which is directly connected to the wheels of the car, has a mechanical attachment by which it is only connected to the storage batteries when its speed is sufficiently high, and has a mechanical pole changer to accord the dynamo to the direction of movement of the car.

796,817. Trolley Appliance; Frank P. Criner, Fort Wayne, Ind. App. filed Dec. 19, 1904. The harp is always held vertical by two parallel rods which constitute the trolley pole.

796,869. Trolley Wheel; John C. A. Riecke, Baltimore, Md. App. filed Jan. 14, 1905. Upwardly-extending, flaring arms, pivoted to the trolley harp so that they will rock rearwardly to avoid guy-wires, etc.

796,931. Car Brake; William Quinn, Philadelphia, Pa. App. filed Jan. 19, 1905. Consists of wheel and track brakes alternately set from the same source.

796,946. Brake-Shoe; William P. Taylor, Buffalo, N. Y. App. filed Dec. 15, 1904. A brake-shoe comprising a body cast complete in one piece, and a reinforcement within said body composed of a plurality of twisted strands.

796,964. Braking System for Cars; Jesse A. Field, Dunkirk, N. Y. App. filed Jan. 16, 1905. Consists in combination of an axle, a friction clutch on said axle having an annular groove and an even plane peripheral surface on each side of said groove and a movable member consisting of a segmental annulus around said clutch hav-

ing an interior longitudinal rib extending into the annular groove of the clutch for preventing lateral displacement of said segmental annulus, a braking element having operative connection to said segmental annulus and a hand-wheel, or the like, controlling the shifting of the segmental annulus into frictional engagement with the clutch.

796,976. Track Sanding Device; Washington H. Kilbourn, Greenfield, Mass. App. filed Dec. 5, 1904. The sand hopper is pivotally mounted under the car, and means are provided whereby it may be violently swung against a stop to thereby project the same through a lateral opening in the bottom of the hopper and into funnel-shaped pipe for conducting it to the track rails.

PERSONAL MENTION

MR. J. G. WHITE, of J. G. White & Company, sailed for Europe Aug. 15, on the "Koenig Wilhelm II."

MR. C. F. SWIGERT has resigned as vice-president and superintendent of the Portland Consolidated Railway, of Portland, Ore.

MR. DAVID DALY has assumed his position of manager of the Houston Electric Company, of Houston, Tex., succeeding Mr. H. K. Payne, who has become identified with the home office of Stone & Webster, of Boston, who own the Houston system.

MR. H. M. SMITH has resigned as superintendent of transportation of the Rockford & Interurban Railway Company, of Rockford, Ill., to become connected with the Philadelphia & Western Railway, now building out of Philadelphia. Mr. Smith will make a tour of inspection of several lines in the West, and will assume his new duties about Sept. 15.

MR. JAMES STOWEL ANTHONY, of the General Electric Company, was married to Miss Alys P. Scott, daughter of Mr. and Mrs. Alfred Bowne Scott, on Aug. 15. The wedding took place at Geneva, Switzerland, the ceremony being performed by the Rev. Percy Gordon, assisted by the Rev. Mr. Belden. Mr. and Mrs. Anthony will return to this country early in the fall, and will reside in New York.

MR. JOHN MILLAR, formerly master mechanic of the International Railway Company, of Buffalo, has just returned from a three months' tour in Europe. Mr. Millar visited the principal cities in England, Ireland and Scotland as well as a few on the Continent. Although his trip was made largely for pleasure Mr. Millar spent a great deal of time studying street railway conditions and operating methods in the cities visited, and found this experience both interesting and profitable.

PROF. W. WYSSLING, Ph. D., secretary and member of the Council of the Swiss Institution of Electrical Engineers at the Swiss Polytechnicum, at Zurich, and director of the Sihl Electrical Works, has been appointed secretary general of a commission recently appointed by the Swiss Government to study the question of the electrification of the railways in Switzerland. In the study of this subject Prof. Wyssling will make a tour through the United States. He expects to visit a number of the principal cities of the country, as well as to make a personal inspection of the leading interurban electric railways. Prof. Wyssling is coming to this country on the "Grosser Kurfürst," and expects to arrive in New York the early part of next week.

MR. WALTER E. HARRINGTON, whose resignation as vice-president and general manager of the New York & Philadelphia Company was mentioned in the issue of this paper for July 29, has become associated with J. G. White & Company, of New York, as Operating Manager. In this capacity Mr. Harrington will supervise all of the railway, electric light, gas and other properties in which J. G. White & Company are very largely interested all over the world, and will make his headquarters at the New York office of the company. Mr. Harrington has been prominent and successful as a street railway manager, and is known most widely through his connection with the Camden & Suburban Railway Company, of which he was general manager and vice-president for the eight years ending in 1904. In the latter year this property was purchased by the Public Service Corporation, and Mr. Harrington was immediately placed in charge of all of the railway properties south of Trenton belonging to this company. In 1905 he assumed charge of the New York & Philadelphia Company, as vice-president and general manager, but remained with this company only a few months. Mr. Harrington is an active member of the executive committee of the American Street Railway Association, has served on the standing rules committee of the association for several years, is a member of the American Institute of Electrical Engineers, and has acted as consulting engineer for a number of street railway systems. The appointment to his new office dates from Aug. 1.

MR. W. W. WHEATLY, president and general manager of the Federal District Railway and managing director of the Mexican Traction Company, of Mexico City, Mex., an independent company taken over about a year ago by the owners of the Federal District Company, was tendered a banquet by Sir Charles Euan-Smith, the chairman of the board of directors of the company, at the Chapultepec restaurant, Mexico City, on Monday, Aug. 7. There were present as guests some 47 persons, among whom were many leading government officials, representatives of the diplomatic corps and leading business men and bankers, including the son of President Diaz and the president's military chief of staff. In his opening speech Sir Charles complimented Mr. Wheatly most highly on his efficient management of the street railway lines. Then paying a tribute to the administration of President Diaz, he closed by proposing the health of Mr. Wheatly and his assistants in the operation of the property in Mexico. Mr. Wheatly in replying acknowledged his debt of gratitude to Sir Charles, and paid tribute to the employees of the company, without whose most efficient help the success that has been achieved would not have been possible. On the evening of the day of the banquet Sir Charles and Lady Euan-Smith left Mexico for the North. They are bound for London, to which place they expect to sail from New York on Sept 12. En route to the latter city they will visit San Francisco, Portland, Vancouver, St. Paul and other places. Mr. Wheatly himself expects to be in New York during October to remain several weeks, during which time he will contract for considerable sub-station machinery.

MR. GEO. R. FOLDS, whose resignation as assistant to the general manager of the Brooklyn Rapid Transit Company to become general manager of the South Chicago City Railway Company and Hammond, Whiting & East Chicago Electric Railway Company, which operate conjointly in Illinois and Indiana, was noted in the STREET RAILWAY JOURNAL of Aug. 5, has had an extensive experience in electric railway management, where his success has been due to an activity and application to the work which is characteristic only of those who take a great interest in it. Mr. Folds is 35 years of age, having been born in Oshkosh, Wis., on Aug. 23, 1870. Six years later his parents removed to Minneapolis. Here Mr. Folds received his early education. Graduating from the high school in 1889, he entered mercantile business with his father. In the spring of 1893 he became connected with the Minneapolis Street Railway Company, his first work being in the cashiers' department. Later he held the positions successively of transfer clerk, mileage clerk and assistant paymaster, after which he spent a year in a special line of work connected with statements in the claim department. As a result of his investigations of claims and analysis of accidents, the side-running boards upon open cars was abolished upon all cars of the Twin-City Company, and use was made of end-entrance cars with gates for closing upon the platform entrances. During this period of investigations Mr. Folds began a course of study at the night law school of the University of Minnesota, from which he was graduated three years later (1897) and admitted to the bar. At the termination of his special investigations, Mr. Folds entered the claim department at Minneapolis as investigator and adjuster, which position he retained until in Feb., 1899, he was transferred to St. Paul in charge of the claim department of that division, where he also took up trial work. In the fall of 1902 Mr. Folds came to Brooklyn as assistant to the general attorney of the Brooklyn Heights Railway. Soon thereafter, in May, 1903, he became assistant to the general manager, Mr. J. F. Calderwood, in which capacity he served the company with marked success. Mr. Folds has been the means of inaugurating many improvements in operative methods in Brooklyn, most important of which may be named the employment bureau system and school of instruction for car men, described in detail in the STREET RAILWAY JOURNAL for June 17, 1905. Other accomplishments of his include the invention of a new system of transfers involving important advantages, a system of transfer collections from the conductors, the invention of several types of car fenders, and the production of rule books for both surface and elevated lines.

G. R. FOLDS

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REMITTANCES.—Remittances should be made by check, New York draft, or money order, in favor of the Street Railway Journal.

Change of Address.—The old address should be given, as well as the new, and notice should be received a week in advance of the desired change.

Back Copies.—After July 1, 1905, no copies will be kept on sale beyond fifteen months prior to date of issue, except in bound volumes.

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office by 10 a. m. Monday preceding the date of publication, except the first issue of the month, for which changes of copy should be received two weeks prior to publication date. New advertisements for any issue will be accepted up to noon of Tuesday for the paper dated the following Saturday.

Of this issue of the Street Railway Journal 8000 *copies are printed. Total circulation for* 1905, *to date,* 277,550 *copies, an average of* 8163 *copies per week.*

The Ohio Coupon Book

The early bird catches the worm, and the Ohio Interurban Railway Association seems to have secured the honor of adopting the interurban interchangeable coupon book which will soon be the standard of the majority of interurban roads selling such books in the Central States. The Ohio book has been adopted by enough Indiana roads, as noted in our issue of Aug. 19, so that this, taken together with the fact that several Illinois roads have adopted practically the same form, makes it almost certain that this form of book is to be the standard. Probably when the roads in a number of States adopt the book, the name Ohio will be less prominent, but prices and form will doubtless remain much the same. Most of our readers interested in such matters are familiar with this interchangeable ticket book, but for the benefit of those who may not have followed the history of the matter, we may explain that the Ohio interchangeable coupon book is a book containing $12 worth of 5-cent coupons and selling for $10. These 5-cent coupons are good for 5 cents worth of transportation on any of the interurban roads signing the contract under which it is issued. It is a much more elastic arrangement than a mileage book could be, because of the different rates of fare prevalent on different roads. The Ohio Association canvassed the whole situation very thoroughly before it came to its conclusions in adopting this book. While it has its drawbaks, it seemed to come much nearer to suiting all the companies than anything else proposed. The Indiana Electric Railway Association devoted considerable attention to the same matter during the first six months of this year without arriving at any conclusions, but the signing of the Ohio contract by a number of Indiana companies seems to have settled the matter in favor of the Ohio form.

Steel Cars for Street Railways

The present tendency seems to be so strongly in favor of steel cars for underground and elevated roads that it seems almost certain that steel cars will make up an important proportion of the number of cars ordered for such service in the next few years, although it is not by any means to be expected that the wooden car will be entirely displaced in such service. For some time to come such a revolution in car building cannot be brought about in a day, and after all, the steel car building industry is in its infancy. Unless, however, several years' use should disclose some drawbacks to steel cars for elevated and underground service, their position in that service is practically assured. As to what place the steel car will take in surface street railway transportation is a matter for interesting speculation. The principal advantages of the steel car are, of course, its fireproof qualities and supposedly greater durability and strength than the wooden car. It is not feasible to make cars absolutely fireproof, even though most of the material going into them is fireproof. Much has been done the past two years in improving car house conditions and equipping with sprinklers, but the fact will always remain that as long as a large number of wooden cars are collected together in a car house the fire risk on cars will be considerable. It may be possible so to reduce the amount of combustible material in a car by adopting steel construction as almost to eliminate this risk, in which case it would be about as superfluous to carry fire insurance on cars as it is now to carry such insurance on absolutely fireproof power houses in isolated locations.

Handling Mail on Open Cars

Among the numerous trying details which enter into the operation of the modern street railway, the handling of mail on open cars is an exceptionally puzzling matter. At first thought it would appear simple enough to carry the bags either

on the floor between the front seat and the dasher or behind the last seat, but every street railway man who has tried either plan knows the difficulty of avoiding inconvenience to the passengers or the motorman by placing the bags within the car itself. Sometimes the Gordian knot is cut by carrying the bags upon the fender in front of the car, but this course can scarcely be recommended, considering the possibilities in the way of blocking the fender space and injuring the bags in case they fall beneath the car. On a closed car the front vestibule usually solves the problem without difficulty, for passengers need not be admitted to the motorman's compartment, but the open car is seldom built for anything but passenger work, and the trouble is consequently functional.

The interurban line which operates a combination smoker and baggage car need have little trouble with its mail handling, and the large system which can afford special mail cars is likewise well off in the matter. As for the ordinary open car, it should be a simple thing to design a stiff wire basket with a self-closing cover and padlock if necessary, which could be hung from the rear dasher without interfering with the trolley retriever or the tail lights. In case two or more cars should be run together, the mail basket could be transferred to the last car without the least trouble. The question is certainly worth thinking about in view of the damages in case of accident which might be collected by an injured party, through the obstruction of the fender, or by the Government in case of injury to the mails.

Practical Operation of Steam Turbines

The steam turbine as a prime mover in a power house is so new and its shortcomings are so religiously watched over by the turbine manufacturing companies that there is unfortunately at present a dearth of information on the practical points to be observed in the operation of large steam turbines in every-day work. When any device is new it is always the case that manufacturers, knowing that there will be numerous opportunities for improvement on the first designs, make strenuous efforts to see that but little leaks out regarding the practical drawbacks. This is probably wise, because it is human nature to criticise the shortcomings of new apparatus and to accept as a matter of course equally great shortcomings in standard apparatus. After a new invention has been able, first, to convince the world of possible customers as to its advantages, and second, to convince the manufacturing companies that users must be educated in its operation, more rapid progress is made.

To apply some of this generalizing to the steam turbine business, the steam turbine seems to be just now between the first and second stages of development mentioned. It has now secured a recognized place as a prime mover, and from now on, instead of hearing that these steam turbine units operate practically without attention, we will begin to learn something which is of much greater practical importance, namely, just what kind of attention they do need. For example, in the matter of starting up steam turbines, it seems to be pretty well established that they can be started much more quickly than corresponding sizes of reciprocating engines. The danger of knocking off cylinder heads because of condensation of water cannot exist in the turbine, and this is certainly a decided advantage over the reciprocating engine. There are, however, certain things to be guarded against in the turbine which need not be looked out for in the engine. Turbines are necessarily built with a very small clearance between stationary and moving blades. We have then the condition of a long shaft carrying moving blades and a long casing carrying stationary parts, with small clearances between the two. If either part contracts or expands more than the other, the clearance is reduced and rubbing may occur. The casing of the turbine in starting may not reach steam temperature as soon as the shaft. While it is easy to start a turbine quickly under light load, it is a very different thing to put full load upon it as soon as it is up to speed. The practice on one of the types of turbine in common use seems to have been to fix the governor so that the turbine can take only part load at first, gradually increasing the number of ports which can be opened by the governor as the turbine warms up. We have yet to hear of any large turbines with which it is possible to start up quickly and immediately take full load without rubbing. Since the first turbines were built it has been found unnecessary to have as small a clearance as was at first thought essential to economy, but the chances are that the danger of rubbing by careless starting will never be entirely done away with, and the sooner there is a free exchange of experiences on this point, the better.

Engine Efficiencies

Now and then, just as one is getting settled into a state of purring complacency over the virtues of our standard apparatus, there comes, generally from abroad, some disconcerting bit of news to convince one that the world is still moving. This time it is a set of engine tests that show very plainly the trend of modern improvements. Doubtless some of our readers are cognizant of them, but they are of a kind that demands solemn consideration. The substance of the tests as reported was as follows: A compound condensing mill engine of about 500 hp was tested with highly superheated steam. It was a marine type vertical machine with four valves per cylinder, and an independent superheater carried the temperature of the working steam up to between 720 degs. F. and 750 degs. F. The result was the most extraordinary yet reached anywhere, being per ihp-hour 9.2 lbs. at nearly full load and 8.6 lbs. at one-third load, the reduced load economy being regularly better than at full load. This remarkable feature, so pronounced that it must be dealt with as apart from any experimental errors, would apparently indicate merely that with great superheating the engine does best with rather extreme expansions, as indeed might be anticipated. Poor economy of engine at light loads has been so drummed into the ears of engineers that they seldom realize that a machine can be designed and rated so as to reverse this condition, just as in case of an electric motor. There is nothing inherently in the way of maximum efficiency at partial loads in either case.

Now let us see what this performance really means. Suppose this engine had been direct connected to a railway generator. Anywhere between one-third load and full load the indicated horse-power would have been given on an average of less than 9 lbs. of steam and the brake hp-hour on less than 10 lbs. At the ordinary generator efficiencies found in practice over this range of load, one would get the ehp-hour on, say, 10.7 lbs. of steam and the kw-hour on a little over 14 lbs., and this on a generating unit rating somewhere about 300 kw, while getting practically uniform economy over a wide range of load. It is enough to make one stop and think it over. It implies the possibility of getting an ehp-hour on 1 lb. of first-class steam coal and saving nearly, or quite, a pound of coal per kw-hour over anything reached in present practice. If this had been the first report of its kind, we should hesitate to take it so seriously, but several nearly as good have appeared before in England and Germany. The truth of the

matter is that our foreign brethren have been going in for high superheating, while people here have been denouncing it as "theoretical" or "impracticable," or some of the other things one calls a step which one dare not take. Now, as we remarked some time since, it is not yet clear how expensive the process of superheating really is, and evidently the coal economy cannot be quite so good as the steam economy, but since superheating is already advised and practiced in the use of steam turbines, the comparative situation has to be taken as it is. It means that the engines generally in use are being worked at a considerable disadvantage from a general hesitation to make good use of superheating.

Suppose one were dealing with a unit of 1000-kw output, giving, say, 15,000 kw-hours per day at the efficiency here considered. As above the present best practice, there would be a saving of something like 6 tons or 7 tons of coal per day, worth some $20 or $25. Now the real question for consideration is whether it is not advisable to try consistently for these higher economies, even at some added expense. We sometimes hear contemptuous insinuations that such figures as we have quoted are made under "test conditions" instead of "practical" ones. The actual meaning of this phrase is that the boilers are properly cleaned and fired and the engine kept in its finest running condition, instead of both being left to run themselves in care of men who can be hired at a figure pleasing to the executive committee. Test conditions are simply thoroughly good conditions which can be maintained perfectly well at a comparatively small extra expense if one is far-sighted enough to do so. Economy must be judged by the final results, not by individual items, and if a plant can cut down its fuel bill by $10,000 per year by spending $5,000 elsewhere in the running expense that is the policy to be followed. Superheating for engines is bound to come to an extent hitherto unheard of, and it is high time to stop mourning over hypothetical difficulties and to go ahead. It is the only step that can put the steam engine on anywhere nearly the same plane of efficiency as the gas engine, which is pushing so rapidly to the front. Efficiency is, after all, merely a question of working range of temperature, and whether it is reached by superheating or by other means, the end is the same. It is time for enterprising engine builders to busy themselves and to put upon the market engines fully up to the best machines tested abroad in thermal efficiency, as they certainly are now in mechanics.

The Weakest Link

The element of human fallibility in railway accidents is very forcibly brought to mind by the London papers which have just come to hand, giving an account of the terrible electric railway accident near Liverpool in which twenty people lost their lives. To recall the facts briefly, an electric express train, running about 40 m.p.h., from Liverpool to Southport, struck a train of empty cars which was standing on a siding, telescoped the two forward cars of the express and killed or injured nearly everybody in them. Fire broke out and added its horrors to those of the collision. At the inquest the facts as to the cause fortunately came out. The line was fully equipped with interlocking block signals, and the train had passed the distance signals in proper course, when the signalman, finding that the home signals would not clear, assumed that something was out of order and gave a hand signal to come on, thus turning the express into the fatal siding. Here was a case in which, apparently, every mechanical precaution that ingenuity could devise had been provided, and everything was in working order, yet all this foresight was made of no avail by the heedlessness of the operator. He had perhaps become, as men do, too much a part of his automatic machine, and when it behaved in a manner unexpected at that particular time, did the wrong thing. The driver of the express, too, took the hand signal at its face value and came on through the automatic danger signals at full speed.

Block signals, of course, sometimes fail, and it would be interesting to know whether in this case failure had been common enough to create any distrust on the part of the men. Presumably not, and in any event it would seem to be the most elementary precaution to enforce extreme care in running by an automatic danger signal, even when proceeding by direction of the signalman. Had the driver of the express kept his train under full control until he found a block signal set for clear ahead of him, the accident would have been averted or reduced to an insignificant shaking up. A good block signal system automatically going to danger in case of failure of the apparatus is the best safeguard against accident which has yet been devised, but neither it nor anything else can make up for lack of care or of prudence on the part of the human agents of control. More than all else, caution and good judgment are necessary on the part of signalmen and train drivers, and particularly in the matter of keeping the train in full control with respect to the signals. Danger signals are useless to a train which is running at a speed which cannot be checked until long after the signal has been passed. Every train bears before it a dangerous space equal in length to the braking distance at that particular speed. Unless danger signals are visible over a greater distance than this they are of relatively little use. In case of failure of the signals a danger warning may come down automatically, but it never should be disregarded to the extent of running by at speed, even in daylight, as in this latest catastrophe.

As we have many times intimated, the majority of accidents upon electric railways come from disregard of this elementary idea of the dangerous space. As a rule, modern electric cars are well provided with brakes, and are driven by well-trained and intelligent men. Many accidents are of a character quite unavoidable, as when a carriage suddenly turns upon the track in a clear road, or when, as last year, cars suddenly strike a grade made slippery by fallen leaves sodden with rain. But on the other hand, there are a good many cases in which single-track roads are worked at speeds which leave well-marked danger spots at curves and grades at which, if cars chance to meet, an accident is practically certain. At certain crossings, too, of roads and railways the conditions are such as to be a constant source of danger unless the cars are under full control. And a car under such circumstances is not under full control unless it can certainly be stopped at the appearance of danger before it reaches the crossing. Automobiles in reckless hands just now constitute a particular source of peril, which make a blind crossing a place to be feared, and impose an extra and undeserved burden of caution. But however or wherever danger arises, it cannot be wholly averted by any automatic means. It must depend in the last resort upon the skill and resourcefulness of the operators. The most that can be done with mechanical precautions is to adapt them to the requirements of the case in such wise as to simplify the work of the operators as much as possible. In so doing, it must not be forgotten that the signals and switching system may cease to be adequate when the original headway is halved and the speed is increased.

THE ST. GALL-SPEICHER-TROGEN ELECTRIC RAILWAY

BY HENRI SOMACH

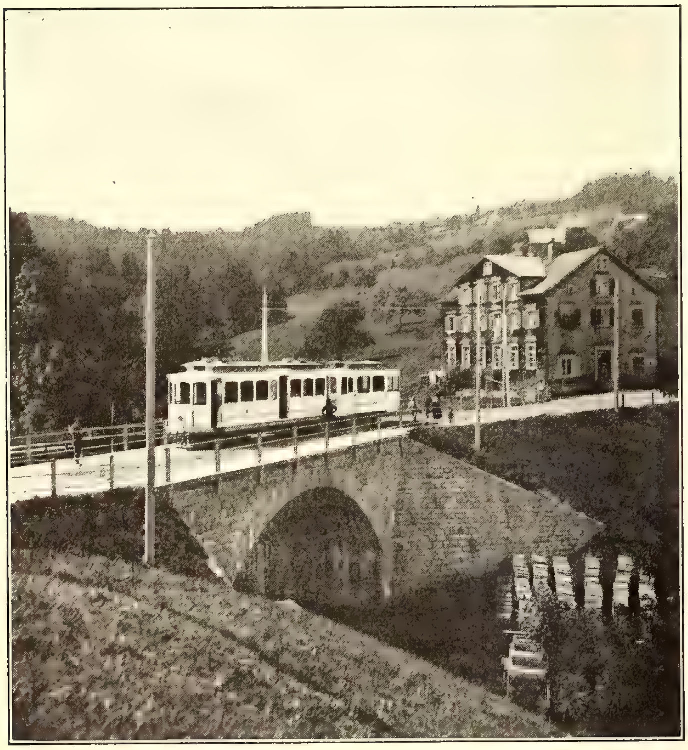
Switzerland possesses a number of important towns and smaller communities which are situated on plateaus with an altitude of 3000 ft. or so, and which are consequently cut off from all direct connection with the steam railroad system of the country. To provide access to these places by a railroad line of standard track and motive power would be too costly on account of the circuitous route which would have to be followed. On the other hand, a narrow-gage electric railway can often be built on existing highways without changing their grades, and forms a very satisfactory solution for this problem. This is especially the case in Switzerland, because all or the greater part of the electric power required for the road can nearly always be purchased cheaply from the numerous existing water-power plants which abound in the mountainous regions of the country. The service can be secured in an economical manner by means of motor cars of greater or less length, with sometimes the addition of a light trail car. In this way the dead weight of the locomotives is eliminated, the weight of the entire train is reduced and at least three-fourths of the weight required is available for traction. Under these conditions it is possible to mount grades as high as 8 per cent. The road which is the subject of this article is a typical example of a railway of this kind, and was put in operation July 10, 1903.

THE ST. GALL TERMINUS OF THE ST. GALL-SPEICHER-TROGEN ELECTRIC RAILWAY

It connects the city of St. Gall, having a population of 33,000 inhabitants, with Speicher, of 3000, and Trogen, of 2500 inhabitants. The altitude of St. Gall is 673 m; of Speicher, 926 m, and of Trogen, 919 m. The highest point on the line is at Vögelisegg, which has an altitude of 960 m. The entire length of the line is 10 km, of which one section, about 800 m in length, extending from the railroad station at St. Gall to the city limits, is used in common with the local system in that city. The minimum curve radius is 14 m.

PROFILE

As shown in the accompanying profile, the lowest point on the line has an altitude of 670.6 m, and the highest point 960 m, leaving a difference of 289.4 m in a distance of 5.5 km. This corresponds to an average in continual grade of 5.26 per cent. The actual maximum grade for a short distance is 7.5 per cent.



MOTOR CAR AND TRAILER CROSSING BRIDGE BETWEEN SPEICHER AND TROGEN

JUNCTION POINT OF THE 800 AND 500-VOLT TROLLEYS, SHOWING EXTRA OVERHEAD WIRE

TRACK

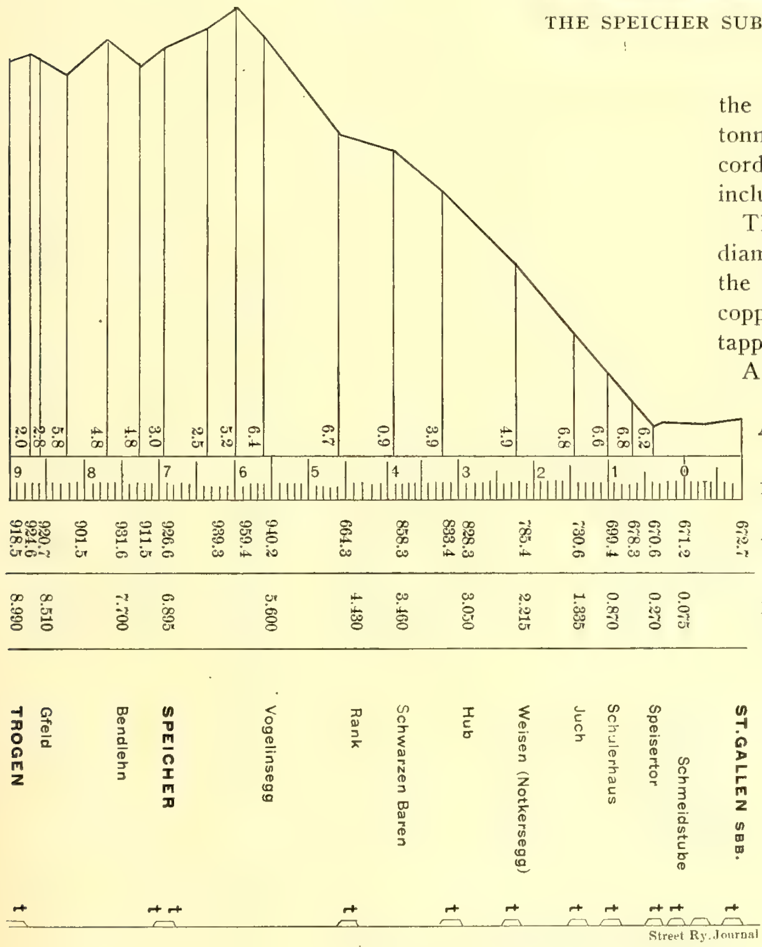
The line is single track with one meter gage, is laid on the public highway and is composed of grooved rails weighing 42.8 kg per meter, which are laid in lengths of 12 m. The weight per running meter of track is 98.35 kg. The substructure is

composed of broken stone 30 cm in depth and an upper bed of gravel 25 cm thick. It seems to the writer that it would have been better in the open country at least to have employed T-rails rather than those adopted. The T-rail has come into general use in Switzerland for light railways built on the side of highways, and grooved rails, as a rule, are employed only in towns and villages. The use of T-rails is especially desirable on lines reaching altitudes where the snow is abundant during the winter. If grooved rails are used, the groove becomes obstructed by snow, and the amount of power required to operate the cars is increased enormously.

THE SYSTEM OF DISTRIBUTION

On the division used in common with the local street railway in St. Gall the energy is supplied at 500 volts. Outside of the city, however, 800 volts are used on the trolley wire. This voltage is that which is generally used on the interurban electric railways in Switzerland. This difference in voltage requires no change in the motor equipment in passing from one section to the other, as the only effect is an increase in speed of the motors. It was necessary, however, to install some sort of automatic regulating device for the lamps. For this purpose an electromagnet is used with an armature which automatically inserts a resistance in series with the lamps when the car passes from 500 volts to 800 volts, and which cuts this resistance out when the car passes from 800 volts to 500 volts.

THE SPEICHER SUB-STATION OF THE ST. GALL-SPEICHER-TROGEN ELECTRIC RAILWAY



PROFILE OF ROAD

OPERATION

The company operates normally eleven trains each way between St. Gall and Trogen in summer, and ten trains each way in winter. Each train is composed of one double-truck motor car and one single-truck trail car, which can be used for either passengers or light freight. The company also has several single-truck freight cars. The weight of the train empty is 24.2 tonnes in the first case and 22.8 tonnes in the second case. The motor car alone weighs empty 18.7 tonnes. When loaded, the weights of the trains are respectively 29.5 tonnes and 33.3 tonnes. The speed varies from 12 km to 25 km per hour, according to grades, and the time of the trip is forty-two minutes, including intermediate stops.

The trolley line consists of two copper wires of 8 mm in diameter. Within the city steel poles are used, while outside the city impregnated wood poles have been installed. Bare copper feeders of 70 sq. mm section are employed, and are tapped into the trolley wire every 300 m.

A particularly interesting point in connection with the overhead system is the arrangement at the point where the voltage changes. At this point the company has installed in series two-section insulators of the same type as those employed for dividing the line into sections at other points. The cars pass over the insulated section, which is about 1 m in length, by momentum, although there is a grade here of 2.6 per cent. In case a train should become stalled at this point, a section of the 800-volt wire is carried parallel to the trolley wire as a precaution. To make use of it, it would be only necessary to transfer the trolley pole from the main wire to the reserve wire, but experience has shown that it is unnecessary, and that the cars drift over this point without trouble.

ROLLING STOCK

The standard motor cars of the company provide seats for thirty-six passengers, and are divided into smoking and non-smoking compartments. These compartments are separated by a small section of 4 sq. m for the transportation of baggage and mail.

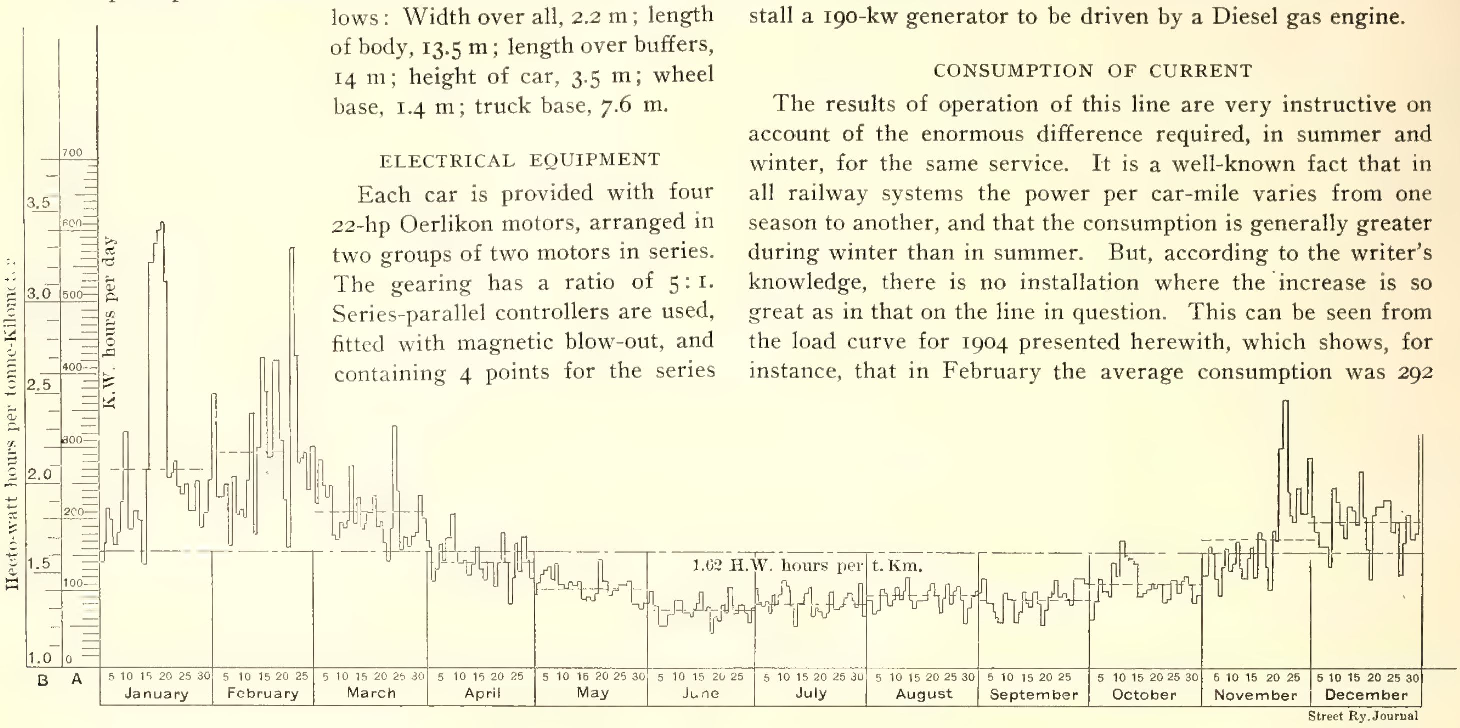
The cars are equipped with hand brakes and with Böker compressed air brakes. Air brakes are also fitted on the trail cars and can be operated from the motor car. In case of breakage of the coupling, the brakes are set automatically. The maximum effort in braking is from 75 per cent to 80 per cent

of the weight of the car. Axle-driven air compressors are used. The sand boxes are also operated by air, and are provided with electric heaters so that in damp weather the sand can be kept dry.

The principal dimensions of the passenger cars are as follows: Width over all, 2.2 m; length of body, 13.5 m; length over buffers, 14 m; height of car, 3.5 m; wheel base, 1.4 m; truck base, 7.6 m.

ELECTRICAL EQUIPMENT

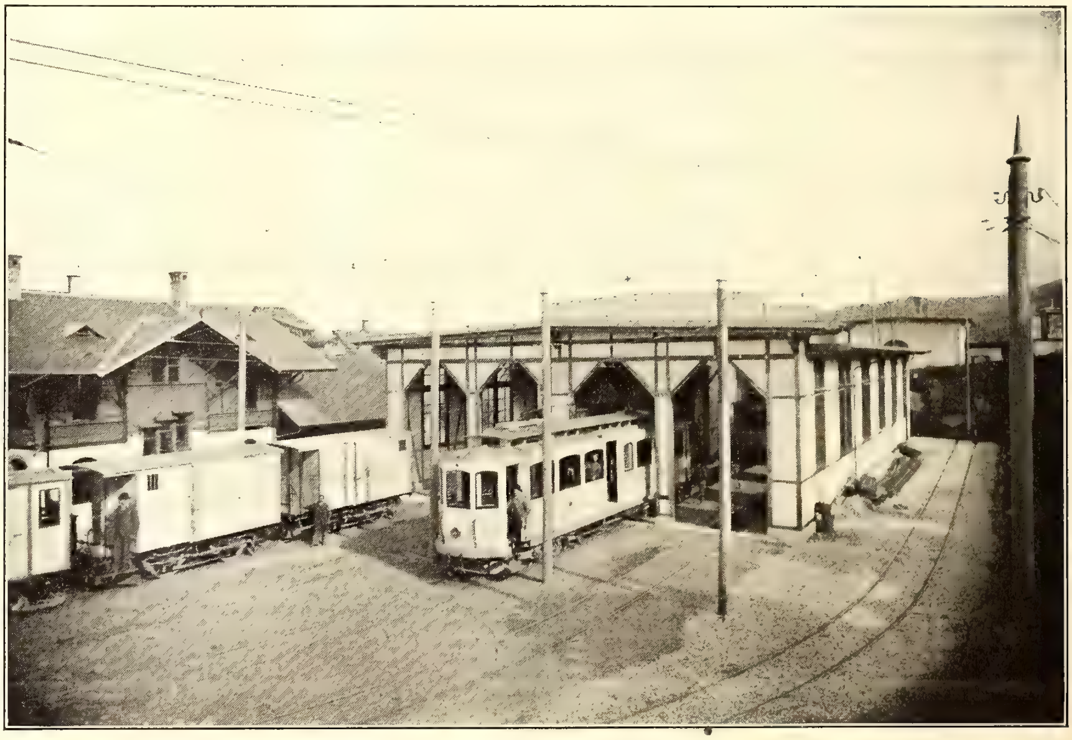
Each car is provided with four 22-hp Oerlikon motors, arranged in two groups of two motors in series. The gearing has a ratio of 5 : 1. Series-parallel controllers are used, fitted with magnetic blow-out, and containing 4 points for the series connection, 3 points for the parallel connection and 6 points for electric braking. The cars are also equipped with eighteen electric heaters and two trolleys. The freight cars are designed for a carrying capacity of 7 tonnes, and are equipped with two motors of 40 hp each.



LOAD CURVE FOR 1904, SHOWING THE DIFFERENCE IN POWER REQUIREMENTS AT DIFFERENT SEASONS OF THE YEAR

SUB-STATION

Electric energy is furnished from the Kubelwerk water-power plant in the form of three-phase current at 10,000 volts and 50 cycles. The railway sub-station is installed at Speicher, where the current is transformed to direct current at 800 volts. The apparatus includes three transformers of 150 kw each, from 10,000 volts to 2000 volts. Two of these transformers are used for railway service, and the other is for the lighting system of Speicher and Trogen. The direct current is supplied by two motor-generator groups, each consisting of a 150-hp induction motor direct coupled to a 105-kw, 800-volt, d. c. generator. These generators work in parallel with a storage battery composed of 400 cells with a capacity of 198 amp.-hours at the one-hour discharge rate. For charging these batteries the cells are arranged in two series of 200 cells each, and these two halves are connected in parallel. For discharge, the halves of the battery are connected in series.



SPEICHER CAR HOUSE OF THE ST. GALL-SPEICHER-TROGEN ELECTRIC RAILWAY, SHOWING ALSO TYPE OF FREIGHT AND PASSENGER CARS

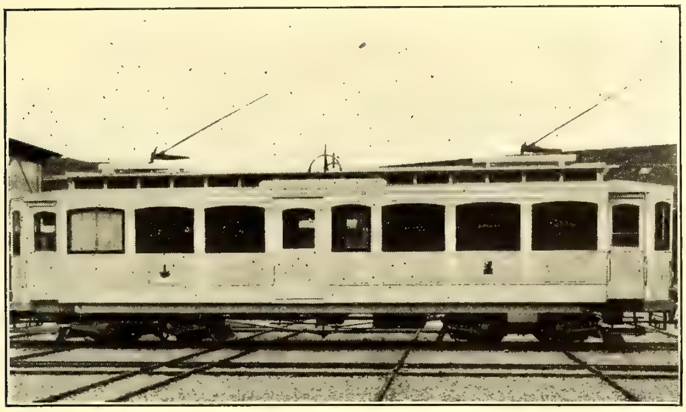
The power station does not present any especially novel features.

In view of the fact that more power is required for the operation of the line, especially during the winter, than can be furnished from this power station, the company proposes to install a 190-kw generator to be driven by a Diesel gas engine.

CONSUMPTION OF CURRENT

The results of operation of this line are very instructive on account of the enormous difference required, in summer and winter, for the same service. It is a well-known fact that in all railway systems the power per car-mile varies from one season to another, and that the consumption is generally greater during winter than in summer. But, according to the writer's knowledge, there is no installation where the increase is so great as in that on the line in question. This can be seen from the load curve for 1904 presented herewith, which shows, for instance, that in February the average consumption was 292 kw-hours per day, whereas in June it was only 70. The output per tonne-kilometer during 1904 averaged 162 watt-hours. During the summer months the output was less than this average, while during the winter months it was greater. The increase in consumption is largely due to the increase in rolling resistance in winter on account of the snow, and also to the operation of snow-plows. The results show how important it is in installations of this kind to design the power stations large enough.

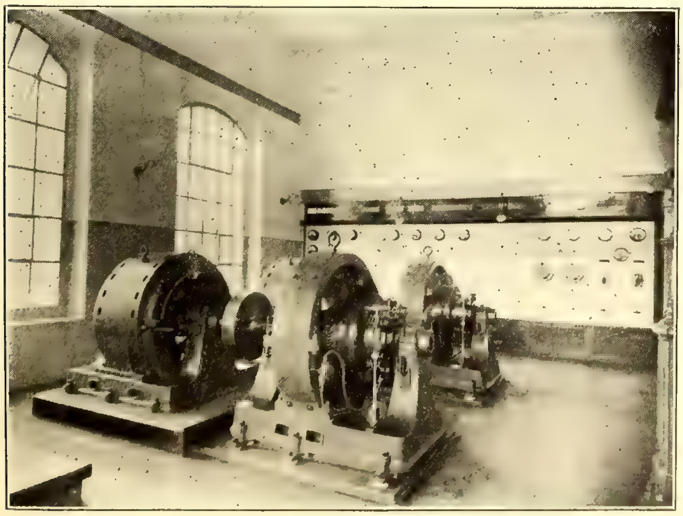
All the electrical material of this line was furnished by the Oerlikon Machine Works. The cost of the complete line was Fcs. 1,420,000. The financial results of operation are very favorable, although the line traverses an agricultural region with a scant population.



STANDARD DOUBLE-TRUCK MOTOR CAR USED ON THE ST. GALL-SPEICHER-TROGEN ELECTRIC RAILWAY

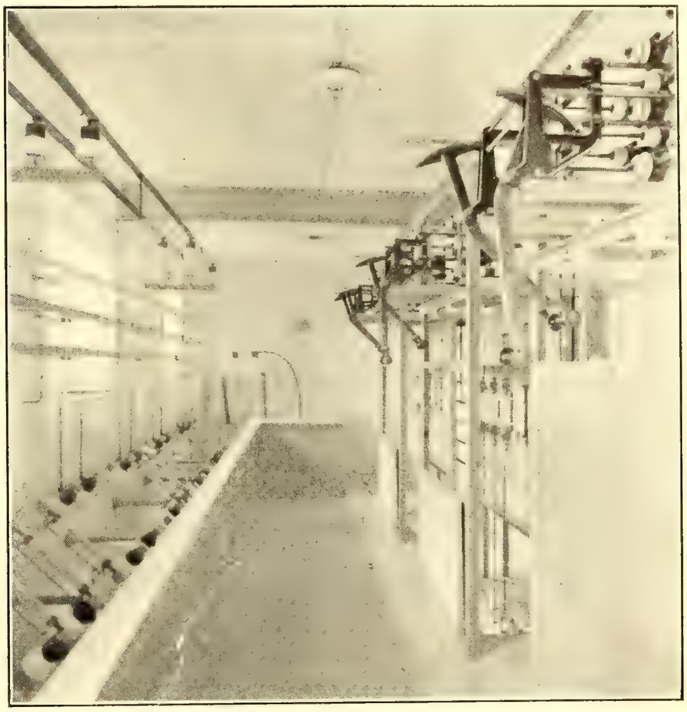
HOLDING COMPANY FOR INTERNATIONAL TRACTION

The organization was effected in New York on Tuesday of the Tractional Company, incorporated a few days ago under the laws of New Jersey. The capital stock of the company is $100,000, and interested in it are the owners of the International Traction Company, of Buffalo, for which it will act as the holding company. Although the authorized stock of the Tractional Company is $100,000, only $76,000 is to be issued at present. The holders of 76,000 shares of common stock of the International Traction Company, constituting a control of the common stock, have exchanged their stock for Tractional stock on the basis of 100 shares of International for one share of Tractional. A large amount of the preferred stock of the International is also held by the new company. According to the statement made by the bankers, three men control the Tractional Company, G. Louis Boissevain, of Kean, Van Cortlandt & Company; Henry J. Pierce, of Buffalo, and Nelson Robinson. These three men, together with Grant B. Schley and T. DeWitt Cuyler, who is a prominent Philadelphia capitalist and a director of the Pennsylvania Railroad, are the directors of the new company. Mr. Pierce, who is president of the International Traction Company, was elected president of the new company. He is president of the Buffalo Chamber of Commerce, president of the Netherlands Tramways Corporation and a director in several other street railway companies. Nelson Robinson was elected vice-president of the new company, and Arthur Robinson, secretary and treasurer.



INTERIOR OF THE SPEICHER SUB-STATION OF THE ST. GALL-SPEICHER-TROGEN ELECTRIC RAILWAY

A statement current about the company that is not official is to the effect that its purpose extends considerably beyond the taking over of the International Company. The fact that Kean, Van Cortlandt & Company are interested in both the Detroit and the Buffalo companies, for instance, gives rise to the statement that eventually the Detroit United will be taken over. From one source comes the very bold conclusion that the Buffalo, Detroit and Toledo systems will all eventually be included in the scheme, and that these three cities will all be connected by a network of lines.



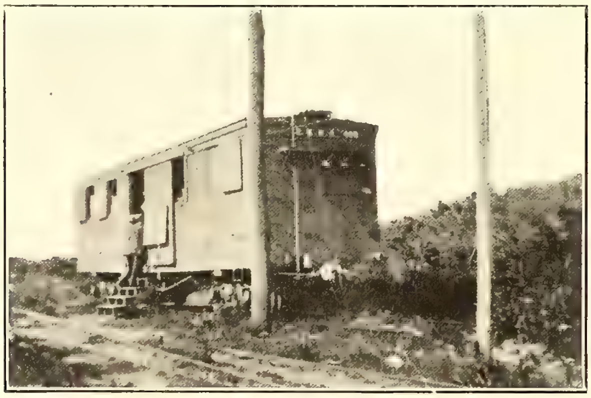
REAR VIEW OF SUB-STATION SWITCHBOARD

When the Toronto Railway Company asked the city of Toronto for the right to admit its radial lines, the city indicated its willingness to consent provided the Toronto Railway Company would forego its exclusive franchise and admit other radial roads upon terms to be decided by arbitration. The Toronto Railway Company has given valuable consideration to the city for an exclusive street car franchise until 1921. The company, notwithstanding this, offered to carry the cars of all radial lines, irrespective of their owners, upon terms to be decided by arbitration if the companies do not agree, from the city limits to the center of the city and return them, provided the city in 1921 would continue this practice. The question in dispute between the city and the company is not the one of "Upon what terms shall the present suburban lines radiating from Toronto be admitted," but the broad one of "Shall there be provision made for the entrance of all suburban roads?" The city desires the company to adopt a broad general policy during the tenure of its franchise, but frankly confesses that it is not willing to continue this policy should it assume the urban franchise in 1921.

THE NEW HAMPSHIRE TRACTION COMPANY'S PORTABLE SUB-STATION

An interesting portable sub-station, somewhat similar to those which have previously been described in this paper in connection with other roads, is in operation this summer at Seabrook Beach, N. H., on the lines of the New Hampshire Traction Company. The outfit is housed in an ordinary freight car, which stands on a short stub track at Salisbury Junction, where the lines of the New Hampshire Traction Company meet the trackage of the Haverhill, Amesbury & Merrimac Street Railway Company. Salisbury Junction is about 2.5 miles from Hampton Beach, and at this point cars moving northward from Black Rock and Salisbury Beach, and cars moving seaward toward Hampton Beach from Amesbury and the other cities and towns of the Merrimac Valley, come together for passenger transfer. Three different tracks meet at this place, which is consequently a strategic point in the distribution scheme of the New Hampshire Company's system.

The car is of the box type, weighs 29,200 lbs., and has a capacity of 60,000 lbs. It was built by the Laconia Car Company, and contains a 250-kw rotary converter and other equipment, which is supplied with current generated at the New Hampshire Traction Company's main power plant in Portsmouth. In the summer season the heavy traffic occurring along the famous beach resorts of Northern Massachusetts and New Hampshire requires additional power facilities in this district, and in the winter there is little or no need of such provision. For this reason the company installed a portable sub-station, which in the fall and winter is available for use at other points, notably in connection with the Rochester Fair.



PORTABLE SUB-STATION OF THE NEW HAMPSHIRE TRACTION COMPANY

A three-phase 13,200-volt circuit is brought to the car on overhead poles and dead ended on three high-tension porcelain insulators mounted on top of the car. The last pole of the line is equipped with double cross-arms to insure greater mechanical stability, and the pole is strongly guyed. Three taps are taken from the line between the last pole and the dead ends, and the wires carried to triple-petticoated porcelain insulators mounted on iron pins set in a horizontal iron strap secured in a recess in the end of the car. The bare transmission wires connect at the insulators with rubber-covered cables, which pass upward through porcelain bushings into the car. In one corner of the car, inside, are mounted banks of General Electric carbon pencil lightning arresters. From the arresters the three cables pass to the oil switches, which are set up on the opposite side of the car in the corresponding corner, and from the oil switches the circuit is carried to the stationary transformers and reactive coil, which occupy the center of the car on the side nearest the high-tension line. The reactive coil forms the nucleus of this arrangement, one transformer being set up on each side and one in front of the former. Opposite the center doors of the car is a motor-driven blower which cools the transformers and the reactive coil by forcing air to them through a 3-ft. x 2-ft. wooden duct; the latter branches at the reactive coil to the three transformers. The transformers are of the General Electric Company's air-blast type, each being rated at 100 kw. They reduce the 13,200-volt current to one of 356 volts for use on the a. c. side of the rotary. The blower is of the Buffalo Forge type, direct driven by a 6-pole, 1-hp, 350-volt, three-phase motor at 500 r. p. m.

The inside of the car is about 32 ft. long x 9 ft. wide, and practically the entire northern third is occupied by the 250-kw rotary, which has four poles and makes 750 r. p. m. when running on 25-cycle current. The rotary is set upon four iron plates by means of set screws, which may be used for raising or lowering it in order to give the proper alignment. The set screws pass through the bed-plate, and the supporting plates beneath are each about 6 ins. square and 3/4 in. thick. Extra stiffening was provided in the channel beams beneath the car to take care of the rotary's weight. The low-tension rubber-covered cables running from the transformers to the rotary are carried through the upper part of the car in porcelain insulator clamps secured to the roof. As there is but one rotary in the sub-station, no synchronizing apparatus is required, but a Thomson alternating ammeter of 25 amps. capacity is installed on one of the car walls. The motor-driven blower is supplied with a blue Vermont marble starting panel mounted close by the outfit, and carrying a double-throw triple-pole switch for throwing about half voltage upon the motor in starting. The a. c. side of the rotary is controlled from a marble starting panel mounted on the floor in front of one of the transformers. This panel contains a triple-pole double-throw switch and the handle of the oil switch which connects the incoming high-tension line with the transformer primaries.

Against the west wall of the car are mounted the direct-current switches and instruments feeding the New Hampshire Traction Company's lines. There is no standard direct-current switchboard in the car, but the apparatus constitutes a combination generator and feeder group, consisting of a 1500-amp. Thomson indicating ammeter, a 750 Weston voltmeter, a Thomson recording wattmeter, a lightning arrester, a type M circuit breaker and a single-pole quick-break knife switch. Some of this equipment is mounted on wooden frame work, and the balance on small separate marble panels. A barrier of sheet asbestos about 18 ins. x 30 ins. is attached to the car roof about 4 ins. above the circuit breaker to prevent arcs blown up the chamber of the latter from causing fires. Power is also supplied to the line of the Haverhill, Amesbury & Merrimac Street Railway between Salisbury Junction and Black Rock through a frame switchboard on the opposite wall of the car. This carries a Thomson recording wattmeter and a single-pole feeder switch. The field rheostat of the rotary converter is mounted on angle irons set upon the floor near the center door on the east side of the car, and the car is lighted from the trolley by a series of five 16-cp lamps set in the roof. There is no section insulator in the trolley between Salisbury Junction and the New Hampshire Traction Company's permanent sub-station at the Amesbury car house, so that the portable sub-station at Salisbury Junction is not without light as long as the Amesbury rotaries are in operation, even though its own rotary is shut down. A lantern is, of course, available when all power is off the line.

Two men constitute the operating force at Salisbury Junction. The sub-station is in operation from 6:15 a. m. to 10:30 p. m. Mondays, Tuesdays, Thursdays and Fridays; from 6:15 a. m. to 11:30 p. m. Wednesdays and Saturdays, and from 7:15 a. m. to 10:30 p. m. Sundays. The day man works from 8 a. m. to 6 p. m., and the night man from 6 p. m. to 8 a. m. The latter is able to put in a night's rest, however, after the machine is shut down and the sub-station cleaned for another day's run. Readings of the wattmeters and the load are taken and recorded

hourly, and the sub-station is provided with a private telephone which connects it with the rest of the operating and power system. Acknowledgments are due to General Manager Franklin Woodman, of the New Hampshire Traction Company, for courtesies extended in the preparation of this description. J. T. Day is chief electrician of the company.

OPERATING RESULTS OF THE VALTELLINA RAILWAY—PECULIARITIES OF THE THREE-PHASE TRACTION

BY EUGEN CSERHATI

The "Valtellina line" has been opened for regular service since July 10, 1904, and on July 1 of this year was taken over by the Italian Government. As this line had previously been in operation for twenty-one months, the experience of two and one-half years allows a fairly reliable statement of the different items of operating expense, the working efficiency and other important features of three-phase railway operation. In the following will be given a brief summary of the results secured.

OPERATING COST

The expenses for labor and material in the Morbegno power plant from July 1, 1903, to June 31, 1904, amounted to Lire 21,553. During this period 3,420,502 kw-hours were generated.

The direct expenses for generating a kw-hour therefore amount to 0.63 centesimi, or about 0.118 cent.

The expenses for labor and material incurred for maintenance and inspection of working conductors, poles and transformer stations amounted to Lire 329 per kilometer of permanent line—that is, about $104 per mile.

The expenses for maintenance and repair of rolling stock, including electrical equipment and mechanical parts per locomotive or motor-car kilometer, amount to 4.36 centesimi—that is, about 1.38 cents per locomotive-mile or car-mile.

The total expenses for traction service, including lubricating and cleaning material, as well as labor, amounted on the average per year for the period with but partly electrically-driven freight trains to Lire 1.97 per 1000 ton-km, and for the period with trains conveyed exclusively electrically to Lire 1.71 per 1000 ton-km—that is, 0.62 cent and 0.54 cent per 1000 ton-miles, respectively.

The corresponding expenses on a steam line in Austria, selected for comparison on account of representing conditions similar to the Valtellina as regards curves and grades, although with a 30 per cent denser traffic, amounted to Lire 4.20 per 1000 ton-km. Hence the saving effected in operating expenses correspond in the first case to 3.98 per cent interest on the capital expenditure, and in the second case to 5.53 per cent, besides which the lighting of all stations and motor cars, as well as heating of the latter, is assured.

CURRENT CONSUMPTION TESTS

During the two years' operation of the Valtellina Railway thorough tests have been made as to current consumption and recuperation on levels and on grades, as well as the energy consumed at starting the trains. These tests have been undertaken by the engineers of the Rete Adriatica, Messrs. Novi and Donati, under the co-operation and superintendence of Mr. Celeri, engineer to the Italian General Inspection Service. The results of the same were published for the first time at the Congress of Italian Electricians, held at Bologna in 1904. The results stated below are taken from these reports.

As stated above, 3,402,502 kw-hours were generated at the Morbegno power plant during the year ending June 30, 1904. The number of ton-kilometers, weight of locomotives and the electrical equipment of the motor cars for the same period amounted to 76,845,265. Therefore the energy consumption per ton-kilometer amounted to 44.3 watt-hours, measured at the distributing board of the power station—that is, 71.3 watt-hours per ton-mile.

In these figures are included:

1. The energy required for traction by the trains.
2. All the losses between the switchboard of the power station and the wheel periphery of the rolling stock.
3. The current consumption for lighting all stations with 1254 incandescent lamps of 16 cp.
4. The current consumption for lighting and heating the motor cars and locomotives.
5. The consumption of energy for driving the machine tools at the Lecco repair shop.
6. The energy required for shunting and switching.
7. The energy consumed during various tests made for the purpose of inspecting the electrical apparatus and equipment.

The figure mentioned above, showing the energy consumption of 44.3 watt-hours per ton-km, was determined by the engineers of the Rete Adriatica, mentioned above, in thorough accordance with, but independently from, Ganz & Company for any period of the service. The net consumption per ton-kilometer was established by means of a motor car specially equipped for the purpose, being fitted out with ammeter and recording wattmeters for both overhead phases. The average of twenty tests showed a consumption of 31 watt-hours per ton-kilometer measured in the car. This figure quite agrees with the test results obtained by the staff of Ganz & Company.

These tests were extended with a view to establishing the net consumption in the power station, the train used for the purpose having run during the night after the termination of the regular service. The current consumption per ton-kilometer amounted to 34.9 watt-hours, and therefore the working efficiency of the system was 88.8 per cent.

In order duly to appreciate the importance of the figures quoted, it must be borne in mind that the profile of the Valtellina is a very unfavorable one, the average grade of the whole line as taken for both directions amounting to 2.5 per cent—that is, a train running through all sections in both directions, from one end to the other, and returning to the starting point, must be lifted about 527.5 m, which height corresponds to the mentioned average grade, the length of the run being $2 \times 106.5 = 213$ km.

The section between Lecco and Colico, on which the energy consumption tests were carried out, shows an average grade of 2.1 per cent, hence the 31 watt-hours must be regarded as the specific consumption per ton-kilometer at a speed of 60 km at a continual grade of 2.1, including starting.

For acceleration from rest to a speed of 60 km (37½ miles) per hour, 95 watt-hours are required per ton-weight, while the losses arising in the motor and rheostat amount to 6 watt-hours per ton-kilometer. Assuming an efficiency of 85 per cent for the motors, the motor losses amount to 4.6 watt-hours, so that there remain but 1.4 watt-hours for rheostat losses—that is, 4½ per cent of the total specific consumption.

A 120-ton train consumes 13 watt-hours per ton-kilometer at a speed of 60 km while continuously running on level track. A motor car running singly requires 48 watt-hours per ton-kilometer, including starting energy. The large difference as compared with the 31 watt-hours for a 120-ton train is due to air resistance, which is reduced in a much smaller ratio than the train weight.

It will be seen that in the light of economical considerations it does not appear to be advisable to replace heavy trains by numerous light trains or cars. Moreover, much importance should not attach to rheostat losses arising at starting, as often happens, as these losses are very small compared to the whole energy consumption.

RECUPERATION OF ENERGY

It is well known that a. c. induction motors have the pecu-

liarity of restoring energy to the line when running on down grades of a certain percentage, which varies according to traction resistance, while the speed is maintained practically constant. The practical value of this peculiarity has very often been doubted. However, the respective tests not only proved the possibility of recuperation, but settled at the same time the quantity of energy which could be gained. On a section with a down grade of 2 per cent, with a 120-ton train and a speed of about 30 km per hour, 28.2 watt-hours—that is, about 80 per cent of the energy—have been recovered which otherwise would have been lost in braking. The exceedingly favorable result in regard to energy consumption of the Valtellina is due chiefly to this circumstance.

The question as to how to utilize the energy thus gained has likewise often been discussed. The simplest solution would evidently be to equip with electric traction not only the steep grades of mountain lines, but also the adjoining level sections, in order to assure the utilization of the returned current of descending trains. Advantage may be taken not only of the energy regained when trains run on down grades, but also when being stopped on level sections, provided that the motors are designed for cascade working. In this case the speed will be reduced to a fraction of synchronous speed when switching over to cascade connection, and the energy which has been required for train acceleration from rest to full speed is partly given back by the deceleration. The energy recuperated in this way amounts to from 35 per cent to 40 per cent of that used in acceleration, and to about 10 per cent of the total consumption.

This advantage is of the utmost importance in suburban railway service where heavy trains have to be started and stopped within relatively short distances. It has, for instance, been proved, in a project worked out for the Vienna suburban lines, that with a four step cascade connection, by means of one or two parallel working primary and two secondary motors connected in different combinations, more energy would be given back at stopping than the rheostat losses amounted to at starting.

The economical importance of this condition cannot be denied, either, in the case of main railways, inasmuch as both express and local trains must be stopped rather frequently from a high running speed. The acceleration of these trains represents an important part of the total energy required. With simple cascade working 35 per cent to 40 per cent of this energy, as above mentioned, may be saved; with four-step cascade connection even more.

In the case of hydro-electric power stations, the energy recuperation is so far of importance that it allows the operation of a longer line or heavier trains from the same plant than would be the case without recuperation. With steam plants the saving is shown in operating cost.

ENERGY CONSUMPTION AS A FUNCTION OF GRADES

For a certain speed the energy consumption may be represented very simply as a function of the grade. Assuming that the motors work with an efficiency of 100 per cent, the energy consumption per ton-kilometer expressed in watt-hours will be:

$$s = c\ (w \pm i)$$

c being a constant, w the resistance in level and i the grade represented in meters per kilometer. The plus sign is to be applied on up grades, the minus one on down grades. The equation represents two straight lines cutting the ordinate axis at the same point. By halving the sum of the ordinates, we get the average current consumption at a total period of running in both directions, with due regard to recuperation. The equation shows that, provided the motors would work with an efficiency of 100 per cent, the average current consumption would be the same on lines with grades as on level lines.

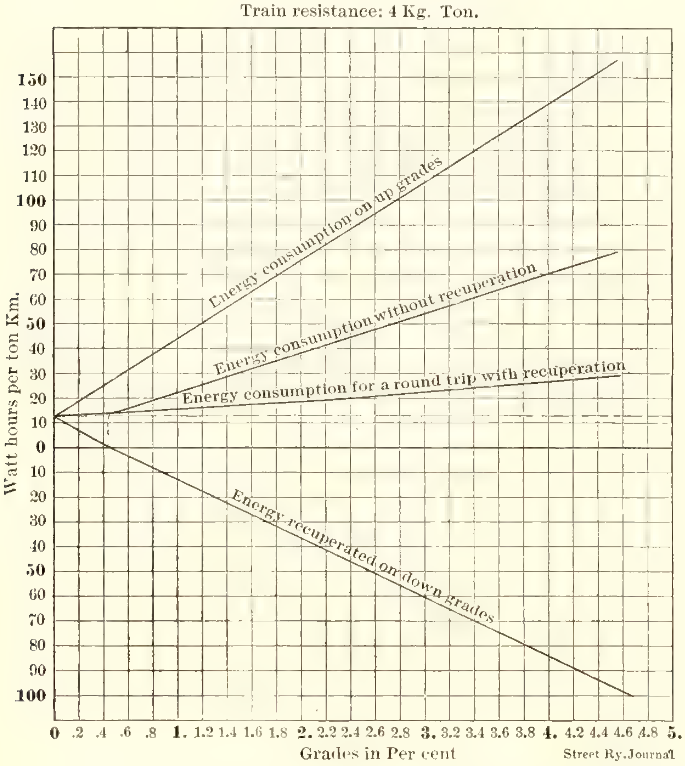
If we consider the motor efficiency, which, as is well known, increases with the load, the current consumption on up grades will be:

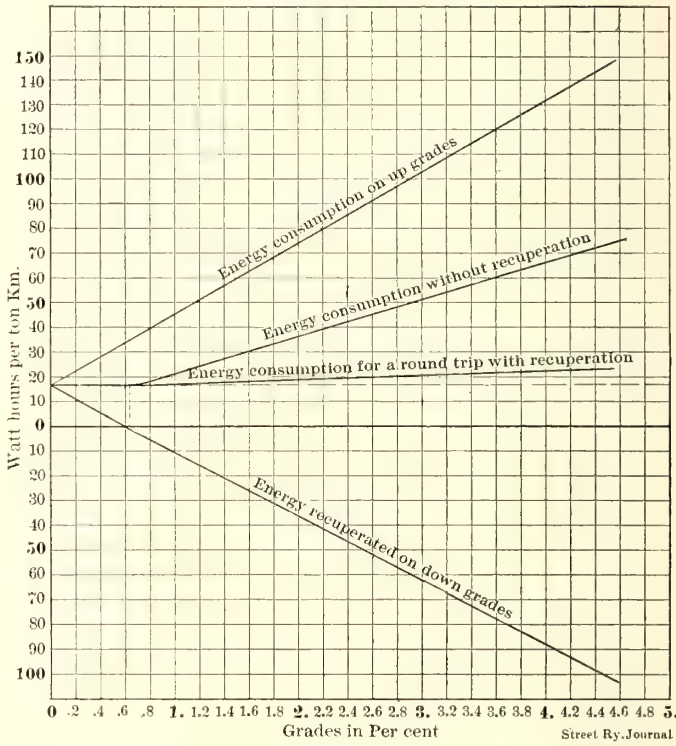
$$S_u = c \frac{1}{\eta} (w + i)$$

and recuperation on down grades:

$$S_d = c\eta\ (w - i)$$

By means of these two equations and the curves showing





FIGS. 1 AND 2.—SHOWING THE CURRENT CONSUMPTION AND RECUPERATION ON DOWN GRADES, FROM 0 PER CENT TO 4.5 PER CENT, FOR SPEEDS FROM 30 KM TO 60 KM

motor efficiency at different loads, the curves represented by Figs. 1 and 2 have been drawn, showing the current consumption and recuperation on down grades from 0 per cent to 4.5 per cent and for speeds ranging from 30 km to 60 km. The half of the algebraic sum of ordinates represents, also in these cases, the actual consumption at a period up and down the grade. As will be seen, the consumption increases with increasing grades relatively slowly, especially at higher speeds, on account of the motor efficiency at single connection being higher than in cascade.

Where the curve meets the abscissæ—when running down grade—we get the down grade on which the train requires no energy for traction. Figs. 1 and 2 also show a curve, giving the energy consumption when the train descends without recuperation. We therefore get the average consumption for a cycle by halving the ordinates for the run up grades.

From the above it will be clearly seen how the economy increases with a system affording recuperation compared with one lacking that quality. The difference in favor of the three-phase system, allowing recuperation on down grades, is as follows:

With grades of per cent.	1.0	2.0	3.0	4.0	4.3
At a speed of 30 km......	40	100	132	165	169
At a speed of 60 km......	21	90	*150	*200	*250

* Speeds of 60 km per hour have not yet been employed on the grades represented by these figures.

FLY-WHEEL EFFECT

As will be seen by the load diagrams, Figs. 3 and 4, taken at the Morbegno power station, the load peaks caused by the starting of even the heaviest trains are not higher than about 70 per cent to 80 per cent of the energy requirements corresponding to the average consumption of the trains in operation. This favorable circumstance is due in the first place to the use of water rheostats, allowing a smooth starting effort, so that there can be no sudden rush of current. In the second place it is due to the peculiarity of induction motors in taking no current from the line as soon as the periodicity is reduced by about 1 per cent to 2 per cent. If the latter is further diminished, current is even given back to the line, consequently, when starting a heavy train, the speed of the generators and prime movers falls slightly and the periodicity diminishes; therefore the short-circuited motors of the running trains take no current until their speed drops to the value corresponding to the number of revolutions at the power plant. In this way the load on the latter is equalized. If the speed of the generators should be reduced suddenly by more than 2 per cent, current would be restored to the line by the motors of all moving trains, that is to say, the moving trains would act like a huge fly-wheel, having the effect of flattening out the momentary peaks, an exceedingly valuable peculiarity of the three-phase traction system which should be duly appreciated, as up to the present time very little or almost no attention has been paid to it.

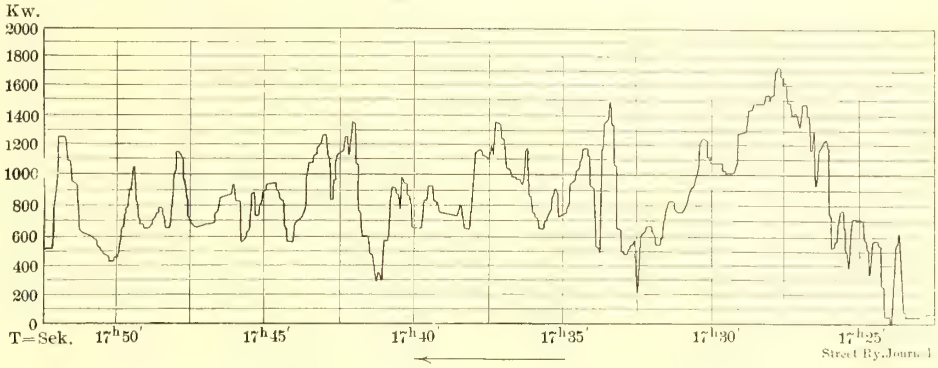


FIG. 3.—LOAD DIAGRAM, TAKEN AT THE MORBEGNO POWER STATION

OUTWARDLY DISPOSED COLLECTOR RINGS

On the latest type of the Valtellina locomotives, as described in a recent article in this paper, the collector rings are not placed on the motor shaft between the locomotive frames, but outside of the latter. By this arrangement they are much more accessible for inspection and repair, and the entire space between the locomotive side frames is available for the motor frames and rotors. This is not a difficult task with a three-phase motor, as only three conductors are required. If, however, the collector of a continuous or single-phase alternating-current motor were arranged in this fashion, more than 100 conductors would necessarily have to be cared for in this way. Although this would not be impossible in a technical sense, it at all events presents a great many difficulties. The possibility of thus equipping the locomotive with very powerful motors should be appreciated, for the smaller the number of motors for a certain capacity, the less the weight and the simpler the mechanical features of the electric locomotive. The three-phase motor is the only one with which this arrangement is possible.

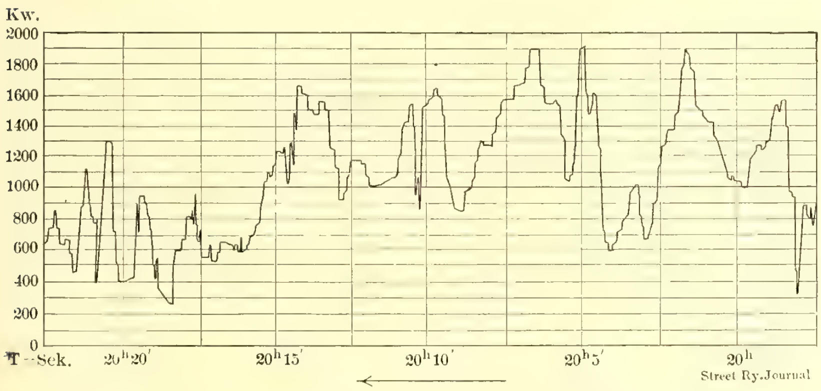


FIG. 4.—LOAD DIAGRAM, TAKEN AT THE MORBEGNO STATION

ENERGY CONSUMPTION COMPARED WITH THAT OF OTHER SYSTEMS

The current consumption per ton-kilometer is influenced by a great many circumstances, such as speed, grades, curves, weight of train, length of train, distance between stations, etc. It is therefore difficult to compare the figures showing consumption of different railways equipped with different systems of traction. Moreover, very little information is to be found in the technical publications in regard to the energy required in main line work or on lines with heavy traffic. Even the data which have been published are usually the consumption measured in the car or on the trolley wire, and not that measured at the switchboard plant. The gross consumption of 44 watt-hours per ton-kilometer, which includes all losses on the Valtellina, must be regarded as very low, as most of the figures published concerning other lines and representing the consumption in the car are higher. Further, it must be considered that with direct-current lines the losses between the switchboard and the rotary sub-stations amount to about 20 per cent. Never has a net consumption as low as 31 watt-hours, measured in the car, been reached on any other system with a profile as irregular as that of the Valtellina Railway.

Figures relating to consumption on d. c. lines do not offer any particular interest, as nobody is likely to think nowadays of equipping a line of any length with this system, as it is more expensive, both as regards first cost and working ex-

penses. More attention should be paid to the corresponding figures from single-phase railways, which, on the whole, offer the same advantages in regard to transmission of energy on an extensive railway system as the three-phase traction system. The STREET RAILWAY JOURNAL for Aug. 27, 1904, contains the interesting results of tests carried out by the General Electric Company on an experimental line equipped between Schenectady and Ballston. A test run has been made there with motors alternately with direct and single-phase alternating current.

The results show the following energy consumption: 53.5 watt-hours for direct current, and 78.1 watt-hours for single-phase alternating current. Hence, 46 per cent more current was consumed by the same motor under identical conditions for single-phase alternating current than for direct current. No further evidence need be furnished that three-phase motors may be built with at least as high an efficiency as that of direct-current motors, and therefore conclusions may be drawn from the above test results as to the respective behavior in regard to energy consumption of three-phase and single-phase traction motors. The latter will require about 40 per cent to 50 per cent more energy than three-phase motors, provided that conditions are the same as those prevailing at the tests mentioned.

According to Glaser's Annalen, 1904, No. 3, the Niederschöneweide-Spindlersfeld single-phase railway of 4.1 km length requires 45 watt-hours per ton-kilometer with a distance of 985 m between stations, a maximum speed of 34.4 km and a train weight of 170 tons. It should be remembered, however, that the line has no grades, except 2 per cent on a 500-m section.

In a project worked out by Ganz & Company for the Vienna Suburban Railway, the watt consumption of a train of the same weight at a maximum speed of 31 km and an average distance between stations of 906 m, as has been stated, was 30.7 watt-hours, and the manufacturers were prepared to guarantee that figure. In this case the difference amounted to 45 per cent in favor of the three-phase system, although on the Vienna line there are grades up to 2.9 per cent.

According to an article in the "Zeitschrift für Electrotechnik," issue No. 3, of 1905, the Stubaithal Railway requires 70 watt-hours per ton-kilometer. The corresponding energy consumption has been figured out on the basis of an exact profile of the above line for three-phase traction on the same speed as that given in the publication mentioned, and without using cascade connection. For a complete round trip an average consumption at the car of 29.4 watt-hours per ton-kilometer has been estimated, or about 31 watt-hours measured at the feeding point. This low figure is accounted for by the recuperation when trains run down the grades, and amounts to 27.6 watt-hours, whereas the consumption on the run up grade is 57 watt-hours per ton-kilometer.

The above figures relating to energy consumption on single-phase railways are taken from publications of the manufacturing firms. Those relating to the three-phase system have been ascertained by official tests of the Rete Adriatica, or at least represent conclusions drawn from the latter.

The peculiar advantages of the three-phase traction system as discussed in the foregoing article are then as follows:

1. The possibility of recuperating both the energy stored up in the moving trains when the speed is being reduced for stopping and the energy as represented by the train running on down grades; this energy reappears as electric current and is equivalent to the greater part of the original input. This circumstance results in a very low consumption of energy.

2. The possibility of reducing by "the fly-wheel effect" the load peaks caused by the starting of trains.

3. The possibility of removing the collectors from the motor axle and thus utilizing the entire space inside of the locomotive frames for the motors.

These advantages are obtained only by the use of induction motors, among which the three-phase motor alone has been found suitable for traction purposes. By choosing a motor other than of the induction type, all of these advantages are lost. On the other hand, it is not possible to have variable speed.

Steam locomotives, as is well known, may run at any desired speed within certain limits, which depend upon the capacity of the boiler and the security of service. The same range in speed is possessed by direct-current and single-phase series motors, whereas polyphase motors will run only at a few determined speeds, according to the frequency, number of poles and diameter of driving wheel.

This attribute of polyphase traction was at first regarded as a drawback. Now, however, especially since the results of the operation and the experience gained during a two years' service on the Valtellina Railway have become known, the peculiarity in question is recognized as an advantage by experienced railway men. The chief condition for regular traffic is exact observation of the time-table. All operating systems which permit their crews to regulate the running speed require a trained set of men, who, as it were, grow to be living tachometers. Even such experienced locomotive engineers can only perform safe service on lines with which they are well acquainted, and therefore their employment is limited.

The polyphase alternating-current traction system does not require such a thorough training of the personnel, as the speed remains automatically constant after having reached a value peculiar to the system. Indeed, even on lines with a very variable profile, the speed diagrams taken from actual service are almost horizontal lines. Thus individual skill of the staff is nearly eliminated, being restricted to correct starting and stopping.

ELECTRIC RAILWAY COURSE AT WORCESTER POLYTECHNIC

The Worcester Polytechnic Institute, at Worcester, Mass., has announced the establishment of a chair in electrical railroad engineering. To take charge of this branch of instruction, Albert Sutton Richey, chief engineer of the Indiana Union Traction Company, has been elected a member of the faculty, his title being assistant professor of railroad engineering. Cornell University and the Polytechnic Institute of Brooklyn are the only institutions that have previously offered a like course. Mr. Richey received a degree in electrical engineering at Purdue University in 1894. After having been associated with the Citizens' Street Railway Company, at Muncie, Ind., and the Marion (Ind.) Street Railway, he became, in September, 1899, chief electrician of the Union Traction Company of Indiana. He became electrical engineer of the Indiana Union Traction Company when it absorbed the other company in 1903, and remained as such until July 1, 1905, when he became chief engineer of the company's system of 400 miles of track. Mr. Richey was born in Muncie, Ind., April 10, 1874.

The Westinghouse Traction Brake Company, of Pittsburg, Pa., has secured an order for 160 equipments of the Westinghouse traction brake to be installed on the new cars of the United Railways & Electric Company, of Baltimore, Md. The contract was awarded after exhaustive tests conducted at Baltimore. The total number of equipments ordered was 200, of which 160 went to the Westinghouse Traction Brake Company and 40 to the National Electric Company.

DESPATCHING METHODS AND REPORTING TROUBLES ON THE WEST PENN RAILWAYS

BY J. W. BROWN,
Superintendent of Transportation, West Penn Railways

On the West Penn Railways the operation of cars is controlled by a double system of signal lights. At each passing point two controlling boxes are placed, one on the right and the other on the left. The one on the right controls the lights ahead and to the rear, the one on the left being for the control of the lights used by the car bound in the opposite direction.

Form 331

CREW LIST P. McK. & C. RAILWAY.

Division. Date.

Car No.	Route.	Time Out.	Motorman.	Conductor	Relief.	Motorman	Conductor

EXTRA LIST.

Motorman.	Conductor.

Dispatcher.

FORM NO. 331, FOR POSTING THE RUNS OF VARIOUS CREWS

Form 307

Pittsburgh, McKeesport & Connellsville Railway Co.

DAILY REPORT OF TRANSPORTATION DEPARTMENT.

Division, 190

DELAYS

Car No.	Route	Time	Location	Caused By	Duration	Car No.	Route	Time	Location	Caused By	Duration
		M.						M.			
		M.						M.			
		M.						M.			
		M.						M.			
		M.						M.			
		M.						M.			

ACCIDENTS

Car No.	Route	Time	Location	Injuries to Persons or Property	Car No.	Route	Time	Location	Injuries to Persons or Property
		M.					M.		
		M.					M.		
		M.					M.		

CARS DISABLED

Car No.	Route	Time	Trouble	Disposition	Car No.	Route	Time	Trouble	Disposition
		M.					M.		
		M.					M.		
		M.					M.		

Sweepers and Plows Operated

Car No.	Route	Name	On	Off	Hours Worked	Road Opened	Remarks
							Mileage

Dispatchers and Inspectors

Name	On	Off	Hours Worked	Located at	Weather	Rail	Remarks
					6 A. M. to 12 M.		
					12 M. to 6 P. M.		
					6 P. M. to 12 P. M.		
					12 P. M. to 6 A. M.		

Men Employed, SANDING, GREASING and SALTING

Route	Name	On	Off	Hours Worked

Remarks:

Division Superintendent.

FORM NO. 307, DAILY REPORT OF TRANSPORTATION DEPARTMENT

Contrary to the usual practice, the lights are not located in the signal box. The first one is mounted one pole ahead of the switch box, which makes it visible to the motorman as well as the conductor. The next three are placed on poles at curves or other important points along the line, while the fifth one is placed on a pole at the next passing point. The advantage of the intermediate lights is that the motorman can note that his protecting light is burning, or in case of any failure of the circuit the intermediate light apprises him of the fact. He must then proceed with caution, flagging all curves, and if by any means an opposing car should enter the block, the first light on the left hand would signify danger and a flag is sent out at once to protect the car.

All of the switches and switch boxes were made in the West Penn shops, and were designed with a view to durability. The contacts are very heavy, and as the major portion of the switch is made out of iron, there is little danger of trouble due to the rough handling that is generally accorded to a switch handle by a conductor who is in a hurry.

Owing to some portions of the road being used jointly by different routes, the headway at several places is as close as fifteen minutes, and even ten minutes at certain times of the day; this seemed to preclude a telephone system of despatching, but iron box telephones are installed at the switches,

Form 305

Pittsburgh, McKeesport & Connellsville Railway.

TRAIN REGISTER.

Station, 190

Both Motorman and Conductor must compare watches with standard clock upon leaving terminal on initial trip. Except on initial trip Conductor will sign for Motorman and notify him of all delayed cars, signals carried, etc.

J. W. BROWN, Supt. Transportation

Car No.	Route	Direction	Signals Carried	Time Arr.	Time Dep.	Conductor	Motorman	Condition of Track
				M.	M.			
				M.	M.			
				M.	M.			
				M.	M.			
				M.	M.			
				M.	M.			
				M.	M.			
				M.	M.			
				M.	M.			
				M.	M.			
				M.	M.			
				M.	M.			

UPPER PART OF TRAIN-REGISTER BLANK

400

BULLETIN NO.

Route No. Date

Supt. of Transportation.

Signatures to Bulletin No. Date

FORM NO. 400, SHOWING STYLE OF BULLETIN USED FOR POSTING SUPERINTENDENT'S ORDERS TO TRAINMEN

West Penn Railways Co. Division.

TROUBLE SHEET, 190

Trouble	Reported by	Time	Notified	Time	Reported O. K. by	Time

Despatcher.

FORM NO. 405, DESPATCHER'S TROUBLE SHEET

and are a valuable adjunct to the block system, as car, line or track troubles are reported by telephone.

The telephone system is quite flexible, and as the railway telephone lines can be connected with the system of the Pennsylvania, Maryland & West Virginia Telephone Company, it is possible to talk over 1000 miles of lines from any of the railway telephones. The high-tension lines are also paralleled by telephone wires, which connect all sub-stations with the main power station. These lines also join the rest of the system.

Classification signals are carried by all cars. The normal signals carried by a regular scheduled car are two red flags by day and two red target lamps by night, the latter being oil-burning. When two cars are running together, the first one

carries green flags by day and green lamps by night, the authority for this being a carbon copy order, form No. 308, given by the conductor of the second section. The arrival and departure of all cars from the terminals is recorded on a train register, showing the car numbers, time, direction, names of the motorman and conductor and the color of the signals carried. From these registers a report to the general manager is made, showing percentage of cars on time on the different routes at the various terminals.

Form 239.

DELAY REPORT.

Pittsburgh, McKeesport & Connellsville Ry. Co.

Division,

Route No. Car No.

Date, Time,

Length of TIME Delayed,

Cause of Delay,

If caused by defect in track or car, to whom reported,

Conductor,

Motorman,

These reports must be made in all cases of delay, however slight, and forwarded to the General Manager immediately.

FORM NO. 239, CAR CREW'S DELAY REPORT

Delays are reported by crews on form No. 239, and from these a delay report is made to the general manager, showing number of delays, length of delays and cause. A duplicate copy is sent to the superintendent of each division and to the master mechanic, who in turn sends copies to the foremen of the division shops. In this manner the causes of delay are reached and the department causing the delay is notified of the fact.

FORM 281

Reported by

Motorman No

Brakes
Motors
Controllers
Wheels
Journals
Lights
Headlight
Register
Doors
Sash
Trolleys
Curtains
Seats
Remarks

Repaired by

Date, 190

Car No. *Report for* *190*

FORM NO. 281, MOTORMAN'S REPORT ON CAR DEFECTS, MADE TO MASTER MECHANIC.

Orders for motormen and conductors are posted at all division headquarters. They are typewritten on a perforated bulletin blank, as per form No. 400. All bulletins must be signed by the men affected, the lower half with signatures being detached and sent to the transportation office, the bulletin proper being left in the crew room. This method of posting orders has been found very satisfactory, as it insures careful reading of the orders by the men, and in case of dispute at a later date the original signature can be produced.

PITTSBURG, McKEESPORT & CONNELLSVILLE RAILWAY CO.

DAILY STARTER'S REPORT.

PA. 190

Reg. No.	Car No.	MOTORMAN.	CONDUCTOR.	Register On.	Register Off.	Fares Registered.	Time On	Time Off	Hours Worked.	REMARKS.

FORM NO. 241, STARTER'S REPORT ON TRAINMEN AND REGISTER READINGS

The reports on the condition of the cars are made by motorman on "defective car" report, form No. 281. These reports are checked up daily by the master mechanic.

Each division reports delays, accidents, disabled cars and weather and track conditions daily on form No. 304, this report being sent to the office of the superintendent of transportation. The starters make their report on form No. 241, which gives the names of the crews, their times on and off, and the condition of the registers. The latter report is checked by the division superintendents and is then forwarded to the transportation office. Crews are listed up for their runs on form No. 331. Despatchers record the arrival and departure of all cars on form No. 305, which gives car number, route, direction, signals carried, arrival and departure, the names of crew and condition of track. Any track, line or car trouble is reported by them on trouble sheet, form No. 405.

Form 308

Car No. Carry Signals

to

for Car No.

M 190

Conductor.

FORM NO. 308, USED IN CONNECTION WITH THE SIGNAL SYSTEM

A MAGAZINE REVIEW OF THE CHARACTERISTICS OF SOME PROMINENT ELECTRIC RAILWAY MEN IN THEIR RELATIONS WITH PUBLIC LIFE

In "Ohio: A Tale of Two Cities," by Lincoln Steffens, which appeared in "McClure's Magazine" for July, there is a study of the methods of Mark Hanna and Tom L. Johnson, with an appreciation of Horace E. Andrews, of the Cleveland Electric Railway. As a brief review of the careers in public life in Cleveland of both Mr. Hanna and Mr. Johnson, the article is most complete. While little is told about either personage during his connection with the street railway business that is not well known to all connected with the industry, there is a wealth of other facts throwing considerable light upon the men themselves. This is particularly true of Mr. Johnson, and while many do not approve of some of the methods he has adopted to achieve his ends since entering public life, the fact remains that many laudable deeds stand to his credit. It is the spirit of equity shown by Mr. Andrews in furthering the public good by lending himself heartily to every project that at all presaged success that called forth the tribute from Mr. Steffens, and has endeared Mr. Andrews with the residents of Cleveland, who seem to be cognizant of his willingness to help them to solve problems with which the city is confronted.

NEW ELECTRIC SUBURBAN RAILWAY FOR EDINBURGH

A parliamentary commission, sitting in Edinburgh, has refused the application of a syndicate for the privilege of construction and operating an electric railway on the Queensferry Road from Edinburgh to South Queensferry. This commission has granted the application of a local syndicate (not yet incorporated), of which Peter Macnaughton, 20 York Place, is agent, to build and operate an electric tramway from Edinburgh to Dalkeith, with branches to certain other places. The total length of track will be about 7 miles. It will be a single line, along the side of the highway, with overhead wires.

THE QUESTION BOX

This issue of the Question Box contains a very interesting contribution on advertising methods from J. W. Brown, superintendent of transportation of the West Penn Railways Company; a number of opinions concerning the use of trailers, methods of fare collection, etc.; in the Master Mechanic's Department car fireproofing, brake-shoes, truck repairs are among the topics treated; while the Track Department contains several interesting replies relative to track work.

A.—GENERAL

A 1.—What means of advertising your road and its attractions have you found most effective?

This season we are doing some advertising on the West Penn system by means of single sheet and half-sheet posters. These are placed at prominent points, and attract attention on account of their bright colors and the wording. For instance, a large poster, showing an old farmer clinging tightly to his barn door which has blown off the hinges and is being carried through the air by a cyclone, serves as a vehicle for attracting attention, and the advice which is printed on the barn door to use the West Penn for business and pleasure is very often heeded. Several different semi-humorous posters of this nature have been used to good advantage.

Printed folders containing the summer schedule have also been very popular, giving, as they do, information as to the time of cars at various points along the line, connections, the time of steam railroad trains at the various points touched by the West Penn cars, the distance and stage connections, etc.

On hot evenings thousands of fans bearing the picture of an up-to-date young lady which is labeled the "West Penn Girl," and whose figure is surrounded by a map of the West Penn system, showing all the different towns served, and bearing on the reverse side the inscription "The finest cars, the smoothest roadbed, the most courteous employees, are found on the West Penn Railways," together with further information relative to points reached, and some facts about special car parties, have been distributed.

The company owns a large pleasure resort known as Olympia Park, and a large picnic held there lately was used to advertise the facilities of the West Penn for travel, by annoncing before the date of the picinic, that a transfer hunt would be conducted at the park on the day of the picnic. Various colored cards were distributed by the thousand with a colored cord attached, bearing the inscription "Look out for 133,333," and giving the information on it that hundreds of transfers would be scattered throughout the picnic grounds, and that these transfers were numbered consecutively, and to the lucky finder of transfer 133,333 would be given a book of tickets good for one hundred rides through any 5-cent limit of the West Penn Railways. Five thousand people were in attendance at the picnic, and as they went backwards and forwards through the grounds hundreds of these transfers were picked up and examined to see if perchance it should be the lucky number. It was eventually found by a little girl, and the book of tickets was awarded to her. A great deal of interest was taken both before and after the contest, and the transfer hunt was written up in all of the daily papers on the line of the West Penn.

The publishing of "Trolley Talk," a little paper printed for the transportation department, has been very successful, and it is believed that a more friendly feeling has been established between the company and its patrons by this means.

J. W. Brown, Supt. Trans.,
West Penn Rys. Co.

A 17.—At one time the use of trail cars was quite general on electric railways throughout the country. Then came a period when the running of trailers was looked upon with more or less disfavor. There seems to be a decided tendency at the present time to go back to trailers. Please give your ideas and experience relative to trailers. Under what conditions do trail cars properly find a place in the operation of a modern electric railway? Do trail cars cause a greater number of accidents? If they do, what can be done to make them safer? What is the economy in running trailers?

Trail cars for interurban roads are not usually practicable on account of the conditions existing, particularly curves and grades in city street, but if conditions can be made proper for their safe use, I believe there would be a great economy in using them for handling excursion traffic.

Theodore Stebbins, Gen. Mgr. for Receivers,
Appleyard System, Columbus, Ohio.

We have used trailers for years and have had but few accidents caused by their use. One objection to them is it takes much longer for a motor car to make a trip when a trailer is attached. We have adopted the policy of buying new cars of a size to accommodate our regular year around business. When full equipment is purchased we will purchase double-truck motor cars for special days, and also a number of double-truck trail cars, and will dispose of all of our small cars. The use of small cars for extra occasions requires too many men to operate. We place a conductor on the trail car. Mobile Light & Railroad Co.

A 35a.—Can a fifteen-minute service be given successfully upon a single-track interurban road? If so, under what conditions?

A fifteen-minute service cannot be given safely on a single-track, high-speed interurban road.

Theodore Stebbins, Gen. Mgr. for Receivers,
Appleyard System, Columbus, Ohio.

A 36a.—What is a proper rate per mile for interurban passenger business, and to what extent should these rates be reduced by the sale of commutation tickets, monthly tickets, coupon books, etc.?

For interurban railway conditions prevailing in this section, I believe 2 cents per mile is a proper rate. Slight reductions only, if any, should be given for round trips, or other form of ticket for inlividual travelers, except for passengers riding daily, to whom I would allow a rate of 1.6 to 1.4 cents per mile.

Theodore Stebbins, Gen. Mgr. for Receivers,
Appleyard System, Columbus, Ohio.

A 36b.—How do you handle your half-fares?

At one time we sold half-fare tickets from the ticket offices for children from five to twelve years of age, but it involved keeping such a stock of tickets with so few sales, that we withdrew them and collect half fare on the cars only.

Theodore Stebbins, Gen. Mgr. for Receivers,
Appleyard System, Columbus, Ohio.

A 51.—What is the best method of destroying tickets and transfers? If a machine is used for this purpose, what is its maintenance expense, and what would be the power required for a machine capable of handling, say, 300,000 tickets and transfers per day and macerating unused transfer pads containing 100 transfers bound with wire staples?

We use a ticket destroyer which will destroy 300,000 tickets or transfers in six hours. This machine will not, however, macerate complete pads containing 100 transfers stapled, as the staple in the course of time will dull the knives. In destroying transfers in pads, we always remove the staples and scatter the transfers in the hopper of the machine. No skilled labor is required to do this work, only someone of ordinary intelligence. We always have the ticket receiver attend to the destroying of tickets and transfers personally, and he is responsible for any tickets that would be stolen and apt to be used over again. From 1½ to 2 hp is required to operate the machine to the best advantage. There is no additional expense for operating, except occasional oiling. After the tickets and transfers are macerated by the machine, we sell the waste to the paper mills and receive as much in return as what it costs for the operation of the machine.

D. A. Hegarty, Gen. Supt.,
Railways Company General, New York.

E.—MASTER MECHANIC'S DEPARTMENT

E 11.—What can the master mechanic of the average surface road do to render his cars more nearly fireproof?

Make all motor leads short. See that all cables are kept dry, as far as possible, and clear of water thrown from wheels. See that cables passing through platform do not come in contact with water from front windows or side doors. See that small wires are properly installed, and protected with good switches and enclosed fuses. The use of single lamps instead of clusters, reducing the difference of potential will keep down fire risk. Leaky roofs may be the cause of fires starting from fixtures and dirty or bad adjustment, or bad location of circuit breakers, overhead switches or controllers easily start fires. Asbestos between floor and rheostat, and between adjacent metal parts and rheostat reduce fire risk. H. V. S.

E 64a.—What are the more frequent causes of broken axles, and how can they be prevented?

Crystallization in the metal is the most frequent cause of broken axles. If a flaw develops in an axle that has been in service for some time, take the axle out, heat it to a red color and allow it to cool in the air. This will relieve any internal stresses and rectify the crystallization. MASTER MECHANIC.

E 66a.—What has been your experience with different types of brake-shoes?

We find steel insert in face of shoe most satisfactory. Steel insert in back of shoe we find was of little value in preventing breaking of shoes. H. V. S.

E 70.—A road has had trouble with trolley rope leaking current when very wet; also with trolley rope becoming detached from the pole. How can some of these trolley rope troubles be remedied?

Have had no such trouble. Use a braided cotton rope.

J. CHAS. ROSS, Gen. Mgr.,
Steubenville (Ohio) Tract. & Lt. Co.

E 82.—What can be done to prevent car windows from sticking or binding at the sides?

Use a little soap on edge of sash.

J. CHAS. ROSS, Gen. Mgr.,
Steubenville (Ohio) Tract. & Lt. Co.

E 111.—When doing repair work on double-truck cars, which method is preferable; lifting the bodies from trucks and doing the work from the top, or doing the work from the pit? Please state what you consider the advantages and disadvantages of each method.

Lift the body from the trucks, pit or no pit. This operation allows free access to most all bolts on truck, also to electrical equipment or any parts attached under car body. Have a pit long enough to accommodate both trucks, also floor space back of pit to accommodate both trucks. Motors opening from the top can be worked on over the floor. Motors opening from the bottom should be worked on over the pit. The pit is desirable, as a good many truck and motor bolts can be tightened more readily from below.

J. L. SULLIVAN, Foreman Motor and Truck Dept.,
United Railways Co., St. Louis, Mo.

E 119.—Is there any satisfactory substitute for cotton tape as a covering for armature and field coils?

On a small road where tape is sometimes a scarce article, strips of canvas 2 ins. wide are a good substitute for cotton tape. If a good field compound is used, give the field a layer of canvas, apply compound with brush to avoid waste; before compound is dry give it another layer of the canvas, then another application of the compound after five or six hours. Field may be taped with black friction tape.

J. L. SULLIVAN, Foreman Motor and Truck Dept.,
United Railways Co., St. Louis, Mo.

E 127.—What is the best way of removing armatures and fields from cars, particularly on small and medium size roads?

Have portable armature lift in pit. J. CHAS. ROSS, Gen. Mgr.
Steubenville (Ohio) Tract. & Lt. Co.

E 131.—What is the best method of turning down a motor commutator?

We turn them in our lathe. J. CHAS. ROSS, Gen. Mgr.,
Steubenville (Ohio) Trac. & Lt. Co.

E 151.—How do you straighten a bent axle?

If axle is bent much it should first be straightened as much as possible by blacksmith. It is then put in a truing lathe arranged to turn the axle by hand, by means of a wheel at one end, lathe to have a presure-screw attachment. When high place is located, block under axle and apply pressure-screw at proper place. Repeat until axle is true.

J. L. SULLIVAN, Foreman Motor and Truck Dept.,
United Railways Co., St. Louis, Mo.

F.—STEAM ENGINEERING

F 17.—Have you discovered any schemes for simplifying the work of cleaning boilers? Please describe any of the little things which make the work easier. For instance, when necessary for a man to go inside the boiler, what kind of a light does he take with him?

For drilling boiler tubes where pump has no governor, we use a by-pass valve on drill when we wish to stop drill, and save wear and tear on pump. We use a torch and electric light, but great care must be taken to insulate cord so it will not ground when lighted from railway circuit.

E. G. HINDERT, Chief Engineer,
Cleveland & Southwestern Tract. Co.

F 41.—Can superheating be applied to existing electric railway power houses? What changes in piping, valves, engines, etc., are necessary? What advantages will follow? Cite instances.

Yes. Superheaters as manufactured by several companies can be installed. Some will set in present settings, while others directly over. Present pipe from boiler must be tapped so that steam shall go through superheater. It would require three valves. No changes in engines will be necessary unless superheat is carried too high. Advantages are in dry steam with no more fuel and less condensation in engines. I have used 100 degs. superheat from one to two-thirds of the boilers, and the other third saturated steam, and noticed no bad effects from pumps and engines. The majority of the steam went direct to steam turbines, and do not know how much superheat reached the pumps. We have run in this manner a year with from 20 degs. to 100 degs. superheat.

E. G. HINDERT, Chief Eng.,
Cleveland & Southwestern Trac. Co.

F 42.—What is the limit in size of station in which superheating can be used with economy?

I would put it in small-sized plants.

E. G. HINDERT, Chief Eng.,
Cleveland & Southwestern Trac. Co.

I.—TRACK DEPARTMENT

I 15.—Have you had any experience with waves developing in the top surface of rails? What is the cause of this phenomenon, and how can it be remedied?

In a number of instances we have experienced the effect of what is known as "waves" developing in the surface of our tracks. Upon investigation it was learned that the ties had been improperly tamped, whether the foundation consisted of broken stone or concrete. Occasionally, however, these waves were caused really by the foundation under the tracks settling, and frequently occurred on fills. We have had very little trouble on streets where we made cuts. The only solution we have found for this trouble after it has once developed has been to shim up the rails on the ties where they were in concrete and to retamp the ties in rock ballast.

CINCINNATI TRACT. CO.

I 28.—What is a good method for testing rail-bonds?

We use millivoltmeter, put on a light frame with contacts 1 ft. apart, to be spaced across joint, and contacts 3 ft. apart to get drop in the given length of rail. A three-point switch gave readings across 3-ft. length of rail, then across bond with adjustable resistance in series, and then across bond straight. A portable resistance connected to trolley with fishing pole gave about 30 amps. when current was not flowing otherwise. H. V. S.

I 30.—What has been the experience with soldered bonds?

Our experience has been very discouraging, whether on account of the bond or on account of method of application we are not prepared to state. H. V. S.

I 32.—What is the best form of portable rheostat to use in connection with bond-testing instrument?

We used german silver coils with porcelain spools and wood-enclosing box. H. V. S.

THE BRAKE-SHOE PROBLEM

The development of power braking systems of recent years has done much toward the promotion of high-speed operation of heavy cars and trains, and extremely fast schedules are maintained in both steam and electric service with safety. But the result of modern conditions of operation has been that of placing the question of safe train control ultimately at the brake-shoes; these, for the best results in bringing trains to a stop without skidding wheels, should be effective in bringing the maximum of frictional resistance upon the periphery of the wheels, and maintaining it most effectively irregardless of heating and wear. The latter feature of the problem, namely, wear, has proved to be a serious item, and under modern conditions of weights and speeds of trains, it has grown to be alarming. The cost of brake-shoes per 1000 car-miles under present conditions is nearly double what it was five to ten years ago, and, moreover, gives promise of still further increase. While many attempts have been made to produce shoes of greater wearing capacity, without loss in braking efficiency, the results have not been satisfactory, and the question as to probable relief from the difficulty is now engrossing the minds of both street railway officials and leading manufacturers.

In steam railroad practice considerable investigation has been made of the brake-shoe problem, to determine the best compositions, constructional features and methods of using brake-shoes. Many attempts have also been made to produce shoes of special construction, intended to give greater wearing qualities without loss of efficiency in braking, and shoes of such composite construction have been and are being largely used at the present time. Active work of investigation along this line was begun by the Master Car Builders' Association soon after the introduction of the Congdon composite shoe—of cast-iron body with wrought iron inserts in its face to reduce the rate of wear, which was the first attempt to depart from the use of the original plain cast-iron shoe in the search for greater wearing qualities. A series of independent tests was also made by the Pennsylvania Railroad in 1892, and had an important effect upon present practice. All tests and investigations that have been made, however, tend to indicate that the plain cast-iron shoe is by far the most effective in producing high-frictional resistance or braking qualities, while the more durable shoes of composite construction obtain their greater wearing qualities at the expense of effective braking qualities. This fact is now well established, and practically universally accepted, and in present practice all brake gears are designed with reference to the efficiency of the cast-iron shoe as the standard.

The cast-iron shoe was, in fact, practically officially adopted by the Master Car Builders' Association for steam railroad service, when, in 1901, following upon a long series of laboratory tests, which had been conducted over a period of several years by a special brake-shoe committee, a specification was approved, giving the minimum frictional qualities desirable in brake-shoes, as follows:

FOR STEEL-TIRED WHEELS

Brake-shoes tested on chilled wheels moving at a speed of 40 m.p.h. must show a mean coefficient of friction of 22 per cent, acting under a load of 2808 lbs., a mean coefficient of friction of 20 per cent under a load of 4152 lbs., and a mean coefficient of friction of 16 per cent acting under a load of 6850 lbs.

FOR STEEL-TIRED WHEELS

Brake-shoes tested on steel-tired wheels moving at a speed of 65 m.p.h. must show a mean coefficient of friction of not less than 16 per cent acting under a load of 2808 lbs., a mean coefficient of friction of 14 per cent under a load of 4152 lbs., and a mean coefficient of friction of 12 per cent acting under a load of 6850 lbs.

The plain cast-iron shoe, although most effective and efficient of any of the various types of brake-shoes that has been tried, has unfortunately shown two very distinct objections and disadvantages for general use, namely, rapid wearing qualities and lack of inherent strength against breakage. It was these two disadvantages, as experienced in steam railroad service, which early induced the brake-shoe manufacturers to attempt to produce shoes possessing the advantages of the cast-iron shoe without its disadvantages, resulting in the introduction of the various types of shoes which have become so generally known during the past twenty years. The patents that have been issued for improvements in this direction are almost countless.

Under exhaustive tests, the various types of shoes were found to group themselves, especially in reference to use on chilled wheels at the heavier loads, into three distinct classes with respect to braking results. The first class covers the unchilled or soft cast-iron shoe, which is the most efficient, though least desirable, on account of rapid wear; the second class embraces the composite shoes with soft or hard inserts, which occupy an intermediate position in braking efficiency and durability, and the third class, the heavily chilled cast-iron shoes, which are the least effective in braking, although most durable.

While this classification will apply in general to both iron and steel wheels, there is, of course, a marked difference in their action upon the chilled iron and the steel-tired or rolled-steel wheels. The soft cast-iron shoes give a somewhat greater braking effect upon the chilled-iron wheel than upon the steel tire, although they hold the highest relative position on both. The composite shoes, with hard or soft body metal with harder inserts, show variable results, according to the character of the inserts, those having inserts with effective cutting edges producing by far the best results on the steel tires by virtue of the tire cutting or dressing effect, while those which do not cut are less efficient according to the relative hardness of the inserts. The very hard and heavily chilled cast-iron shoes have practically the same effect upon both steel and iron wheels, giving high standards of durability with correspondingly low efficiency in braking.

The action of these various classes of shoes upon steel and iron wheels has been explained on the theory that the surface of an unchilled cast-iron shoe is characterized by sharp projections of a crystalline structure, and that these crystals under wear become readily detached and break along the cleavage faces, continually furnishing angular crystalline particles, to grind between the shoe and wheel. The face of the chilled wheel is a series of minute elevations and depressions, and when pressed together, the two surfaces interlock and mesh with the particles ground off from the shoe, so that there is a continuous grinding and rolling action and consequent high friction. The steel tire is not so hard as the chilled wheel, and possesses an element of ductility, so that projections on its face tend to flow or bend away from the brake-shoe, to become compact and polished over, and affording less resistance and permitting a sliding rather than a grinding action between the two surfaces, and hence have less friction. The composite shoes of various grades of hard and soft iron are less effective on the steel tire, while those shoes with cutting inserts of hard metal give better results on the steel tire when they cut it. Shoes with wrought iron or mild steel inserts give poorer results on the steel tire as long as there is no cutting by reason of hard spots forming on the insert; when there is cutting action the friction is raised. The heavily-chilled shoes have practically the same relation to the steel tire as to the chilled wheel, because the very dense structure of the chilled areas prevent intimate contact with the wheel, and there are less ground-off particles to roll beneath the shoe, resulting mostly in a sliding action.

In the records of the above-noted M. C. B. tests it ap-

peared that the shoes doing the most work were also those most affected by heat. The soft and medium hard cast-iron shoe tends to lose its grip under conditions of high heating, while the very hard shoe tends to stand up better under such conditions. There even appears to be a certain point in the higher train speeds where the retarding effects of the various shoes tend to be equalized by this effect of abnormal heating, and at which the stopping distance for a train would be about the same with any type of shoe. This fact, of itself, favors the use of the hard shoes for heavy passenger service in connection with the high-speed brake, although the hard shoes are the least effective at low speeds.

A promising source of economy in braking appears to lie in the use of flanged brake-shoes in connection with steel or steel-tired wheels. The additional frictional area offered by covering the flange gives considerably more retarding power, and permits a much harder shoe to be used with braking effect equal to that of the unflanged shoe of softer metal. It is also observed that the wear upon the tire is much improved in general by the use of the flanged shoe.

In spite of all the attempts along other lines, the cast-iron shoe still has the preference, and is in use on many of the large systems, under the most trying conditions with success. Strength has been added for protection against breakage by the use of steel reinforcing backs in one form or another, which are very effective for the purpose. In the use of these shoes the practice is to operate them until worn down to the reinforcing backs, when they are removed, so that the shoe is handled and in effect resembles the cast-iron shoe, the reinforcing back permitting a much longer wear without danger of breakage of the shoe with accompanying dangers.

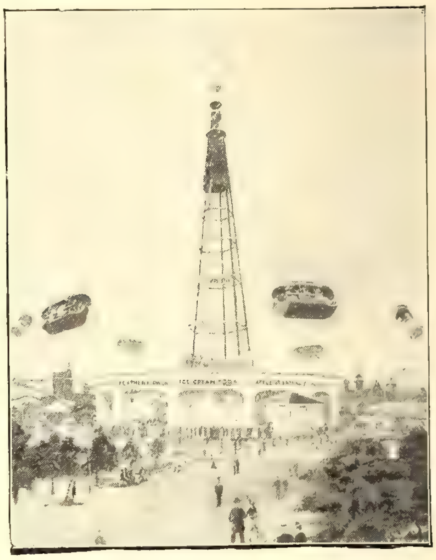
In the lighter classes of electric railway service, such as on street railway systems, braking conditions do not so closely resemble those of the steam roads, and less radical treatment will suffice. Here the narrow tread wheels predominate and flanged shoes are largely used. Because of the flanged shoe and of the slower speeds, the difficulty of heating is not encountered. The greater desideratum in light railway service has been durability in the brake-shoes, with consequent greater use of the harder and insert shoes. In fact, it is argued by many that the less efficient braking qualities of the insert shoes make them more desirable for the use of the average motorman in reducing the liability of flattening wheels. The question as to the proper shoe for general use is, however, largely unsettled, owing to the growing use of steel wheels.

One of the most important of the early accomplishments of the Master Car Builders' Association was the adoption of a standard brake head, which permits of keying the shoe upon the head with the utmost facility, and by which, furthermore, shoes will be interchangeable upon all cars operated on the lines associated. Such a practice has, however, never originated upon the street railways, for which reason there is an alarming lack of uniformity of practice in this respect. Many different designs of shoes have been introduced in connection with the use of light truck equipments, with undoubtedly the purpose of obtaining simplicity, but with the present multiplicity of designs that have come out, the result has become anything but simplicity. One large electric railway system in the East has a total of over thirty different styles of shoes, where the number should not be over three at the most, and could be reduced to a single one with great advantage. With the present rapid development of street railway service it is imperative that this subject should be investigated with standardization in view. A standard brake head of the Christie type was adopted by the American Street Railway Association at the Detroit convention in 1901, but nothing has as yet been done toward a general introduction of the new standard. The subject is an excellent one for discussion at the coming street railway conventions.

THE "AEROSTAT"

So many interesting devices for picnic parks have been brought out during the last three or four years to afford the amusement seeker all sorts of unusual sensations that it seems hardly possible there could be anything new in this field. Nevertheless, the Federal Construction Company, of Chicago, has come to the front with a novel contrivance called the "Aerostat," which is designed to give its patrons the delights of a voyage through space without the usual airship risk of broken bones.

The aerostat, as shown in the accompanying illustration, is a form of circle swing consisting of a six-leg steel tower of gusset plate bridge construction, over which is telescoped a solid steel cantilever crown truss with six or more radiating arms. The crown truss rests upon 153 1-in. steel balls, each having a special ball retainer, traveling in its own path between two case-hardened plates. The cars are suspended from the crown truss arms and the safety of the passengers is in no way dependent upon any part of the machinery. A thirty-six-passenger swing requires 6½ hp to operate. No brakes are used, but by the use of a controlling device the swing can be brought to a dead stop, without a jar, in thirty seconds. The structure has been designed as an ornament to any park, and when lighted presents a magnificent spectacle.



THE AEROSTAT IN USE

In addition to this interesting device, the company manufactures other popular specialties, such as the velvet coaster, Katzenjammer castles, mystic mills, water chutes, helter-skelters, etc.

The overcoat, it would seem, has practically ceased to be worn by the masses of the British people, and in consequence the winter trade of the clothing companies on this garment has been killed. "The Tailor and Cutter" says the trolley is responsible for all this. "The most important factor which has contributed to the decline of the overcoat is the great improvement in transit," says that journal. "The man who invented the electric tramways did a great deal to kill the heavy overcoat, and the issue of workmen's tickets has completed the thing. Tramway facilities are so many, and everybody rides nowadays." The article points out that the man who used to walk to work and needed an overcoat to protect him from the weather during six months of the year is now "whisked" the 4 or so miles to his work and back for a penny, and finds the heavy overcoat a nuisance while sitting in a comfortable car. The medical faculty also has aided the decline of the garment, by stating that the overcoat is unhealthy, because it is large and heavy, and does not permit of sufficient ventilation to the body, thereby inducing chills and colds.

Following an order from the Common Council, the Milwaukee Electric Railway & Light Company put into effect Tuesday, Aug. 15, for the first time, the rule that its cars should stop on the "near" crossing only.

NEW METROPOLITAN RAILWAY LOCOMOTIVES

The first of the ten electrical locomotives being supplied to the Metropolitan Railway by the British Westinghouse Company was delivered some few weeks back, and has recently been subjected to several tests under working conditions. On June 29 the locomotive was coupled to a freight train weighing 279 tons and made a number of most successful trips between Willesden Green and Uxbridge. It has also been tested on the Harrow line between Baker Street and Uxbridge on passenger traffic with equally good results. Fig. 1 is a dimensioned drawing of the locomotive, and Fig. 2 a general view.

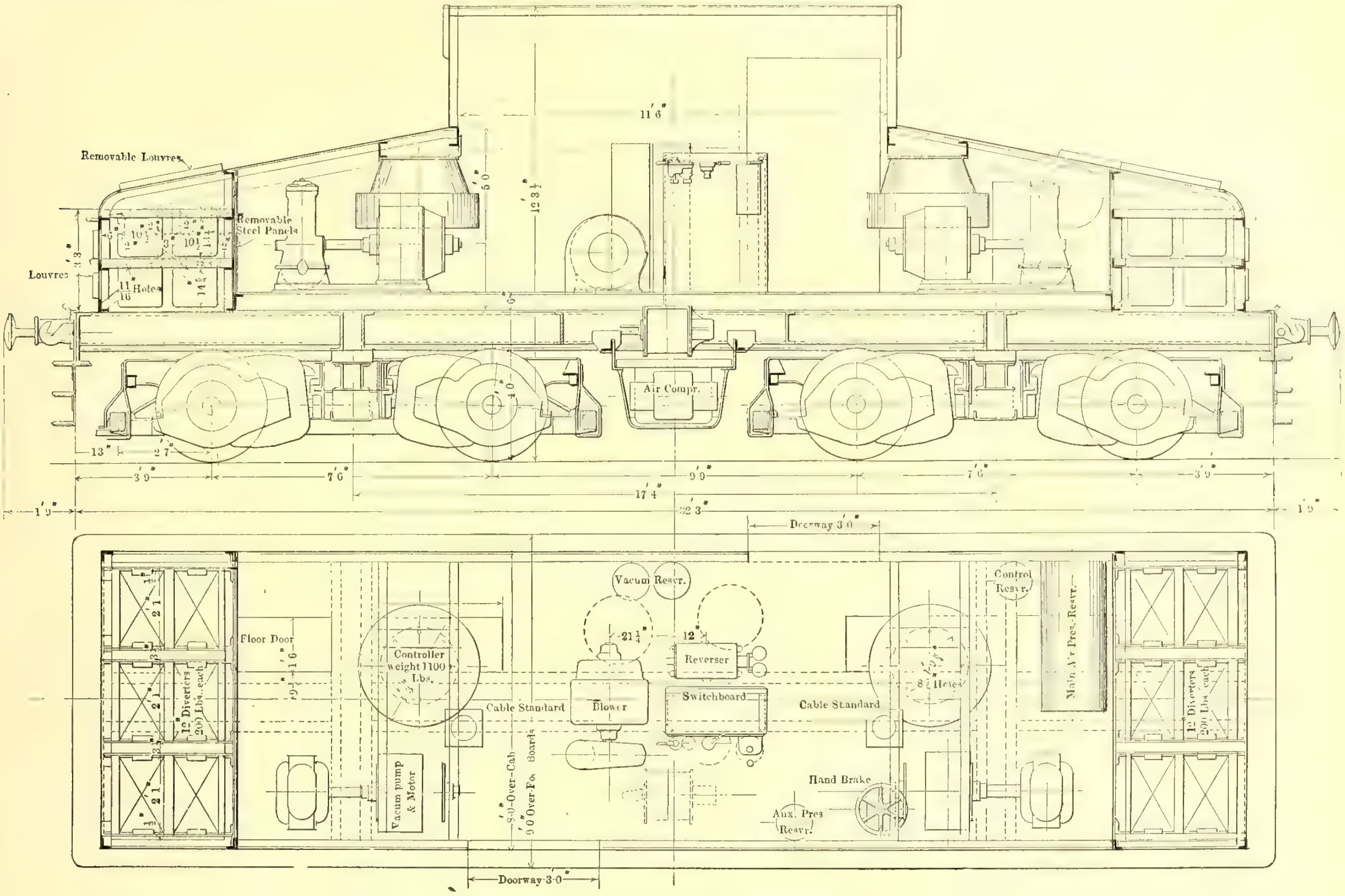


FIG. 1.—DIMENSIONED DRAWING OF METROPOLITAN ELECTRIC LOCOMOTIVE, SHOWING ALSO PLAN, ARRANGEMENT OF MACHINERY, ETC.

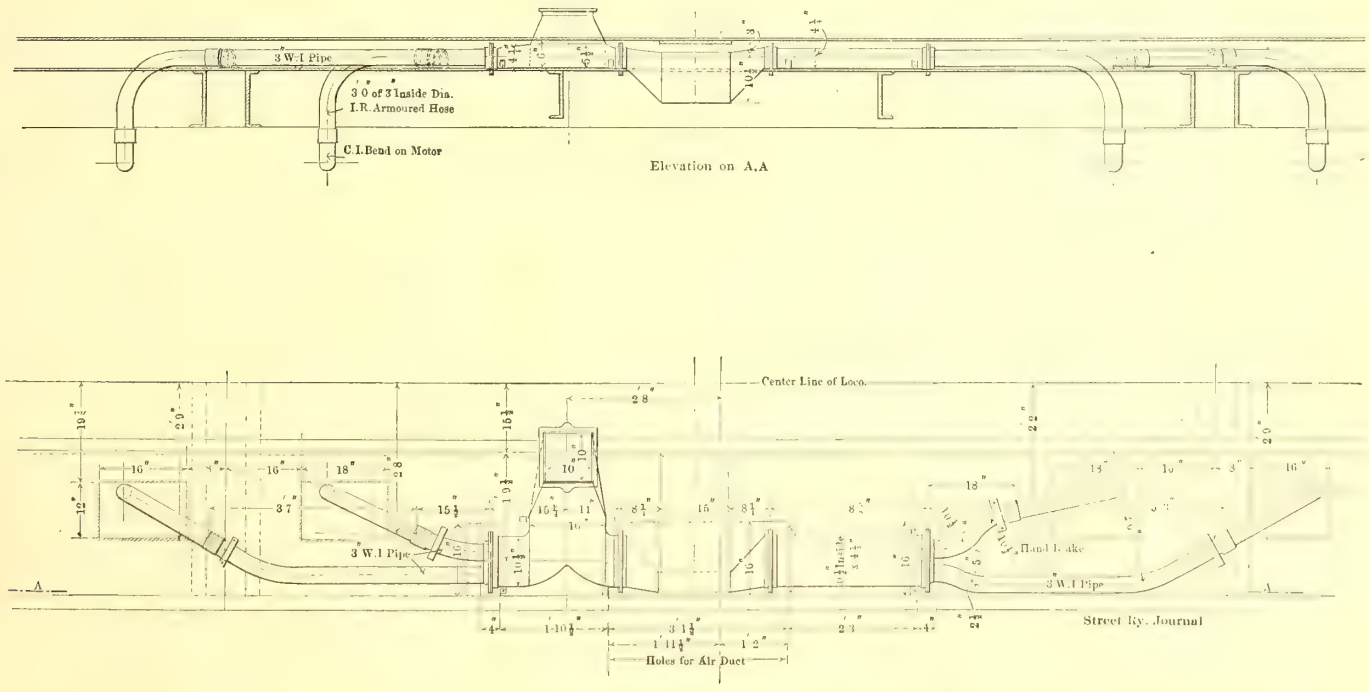


FIG. 3.—DETAILS OF THE VENTILATING AIR DUCTS

The ten locomotives on order will be used for hauling the Great Western trains through the northern part of the Circle between Edgware Road and Aldgate, for conveying the main line passenger traffic from Pinner, Rickmansworth, Verney Junction, etc., between Harrow and Baker Street, and also for

hauling freight trains over both the Circle and St. John's Wood Line. Owing to the length of the trains and the cramped conditions existing at the termini, it has been necessary to keep the length of the locomotives down to the lowest possible limit. This has been effected by using motors of a smaller size than usual and equipped with forced ventilation.

The locomotive equipment consists of four motors, the normal ratings of which are 200 hp each; but by aid of the forced ventilation, which is supplied by an air blowing set, the motors are rendered capable of developing 250 hp each with perfect safety. The locomotive is also equipped with both the Westinghouse automatic air brake and vacuum brake, and each is coupled to the foundation brake gear in such a way that either may be manipulated and caused to apply the brakes without making any changes whatsoever in the connections.

These locomotives are able to haul a train weighing 170 tons, exclusive of the locomotive, between Baker Street and Harrow at a maximum speed of 36 m.p.h.; and a freight train of 250 tons, exclusive of locomotive, over the Circle at a maximum speed of 27 m.p.h.

The motors of this locomotive are of the usual series-wound tramway type, and there is nothing novel in the winding. The drawing, Fig. 3, shows the details of the ventilating air ducts. The air is admitted to the motor at a pressure of 4 ozs. per square inch, and the mouth of the duct is so formed as to distribute the entering air over the entire end of the armature and field coils. The cover of the motor is of the ventilated type, so that this air, after it has absorbed the heat from the armature and field coils, passes into the atmosphere.

There are four motors with each locomotive, and these are arranged in pairs. Each pair of motors has a separate turret controller of the Westinghouse electro-pneumatic type. These controllers are manipulated by a single master switch and are not of the automatic type. The switches, however, are closed with the step by step method usual with tramway type controllers, this being necessary owing to the vast amount of shunting of freight and passenger trains in sidings.

The average weight on each wheel of the locomotive is 12,550 lbs. The blower is fitted with a resistance which can be switched in shunt connection with the field coils, so that the speed may be increased 25 per cent, and the pressure of the air thereby increased from 4 ozs. per square inch to 6 ozs. per square inch. This arrangement will be used when the motors are working under the most severe conditions of service.

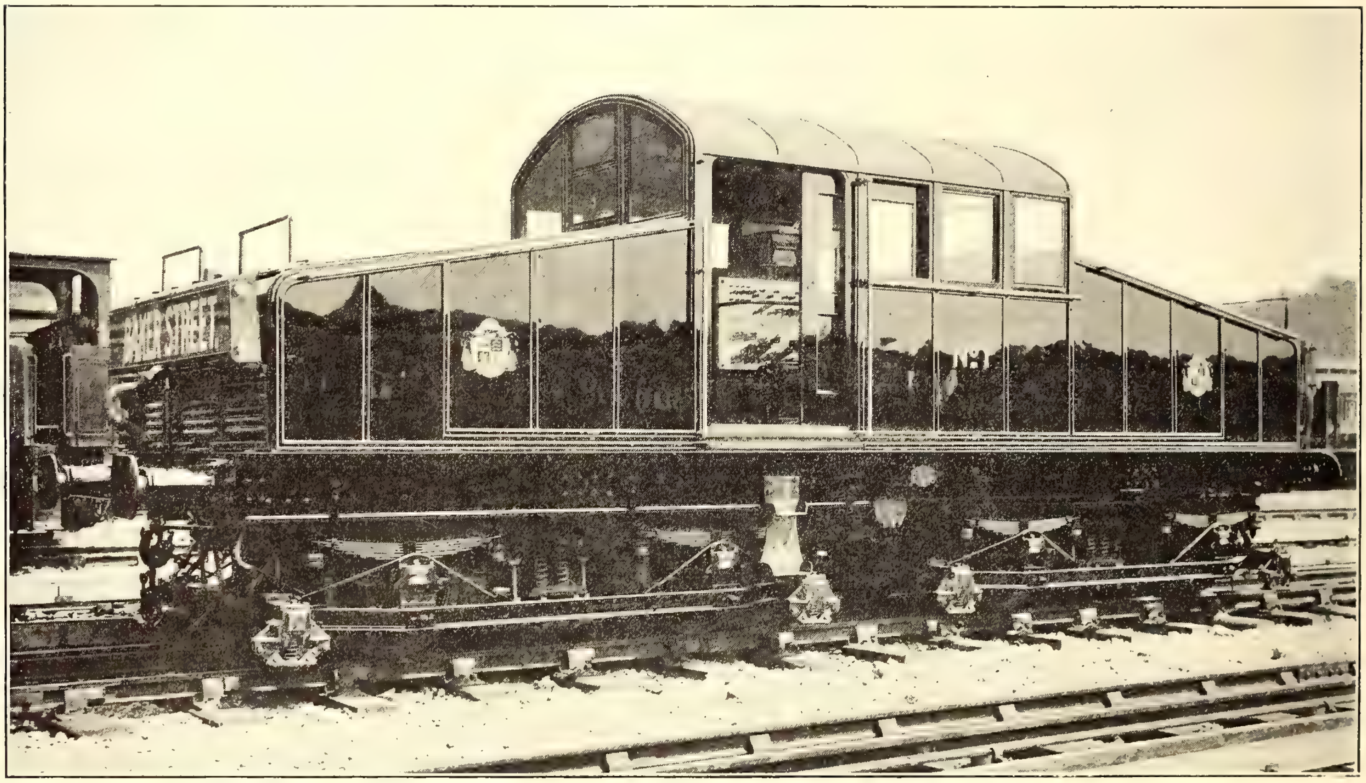


FIG. 2.—GENERAL VIEW OF METROPOLITAN ELECTRIC LOCOMOTIVE

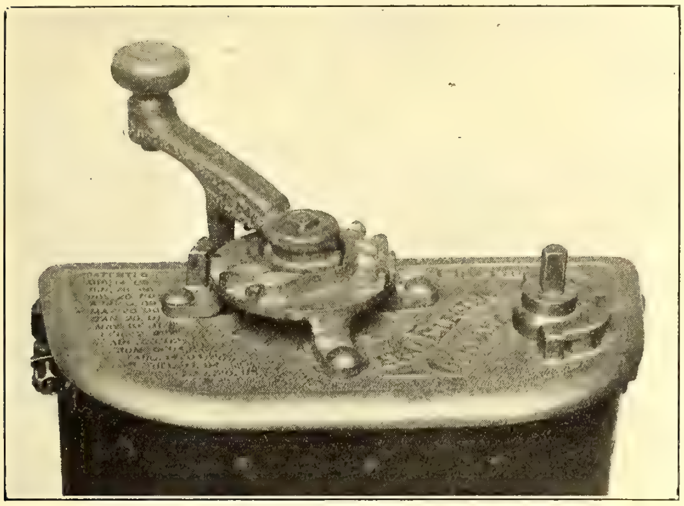
A SIMPLE GUARD AGAINST FAST FEEDING

The Durkin controller handle is a device for regulating the rate of controller feed on electric cars, which has recently been brought out by the Durkin Controller Handle Company, of Philadelphia. As shown in the accompanying illustrations, it consists of a rack, which is bolted to the top of the controller by means of three bolts, and a handle that is interchangeable with any rack made by the company. The rack is equipped with a series of teeth projecting outward, which engage a double-acting dog suspended under the handle, throwing the dog in contact with stops on the rack. The dog strikes each stop squarely, bringing the handle to a full stop; then at the slightest release of pressure,, the dog falls by gravity, striking the projecting tooth next in order, by which it is guided to the next stop.

This handle works automatically and compels the motorman to make a full stop at each position on the dial in turn, until the position is reached at which the full current is on. To move the Durkin handle from "off" to the last stop requires from five to seven seconds, a speed which feeds the current to the motors as rapidly as they can take it safely. A point of the utmost importance is that the current can be thrown off instantly from any point, the dog offering no resistance to the movement of the handle in returning to the "off" position.

This handle presents a strong claim to the consideration of railway managers in the simplicity of its parts and of the mechanical principles involved. To adjust the rack it is not necessary to remove either the star wheel or the pawl, or to dismantle the controller in any manner, and the device has no dash-pots, springs or complicated additions to the controller equipment. The handles and rack are of malleable iron

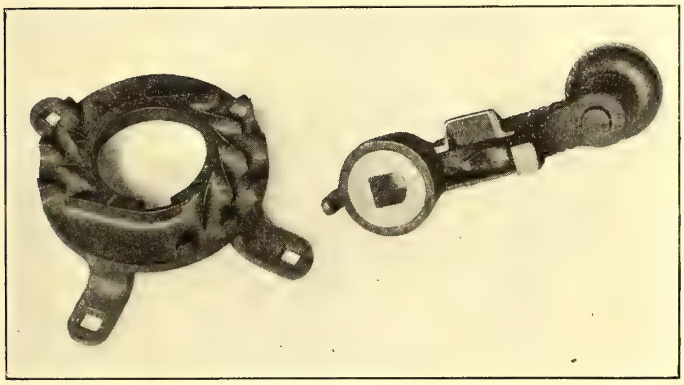
throughout, with the exception of the dog, which is of tool steel. In handles that have been in practical use on cars of the Philadelphia Rapid Transit Company and other lines, no



CONTROLLER HANDLE IN POSITION

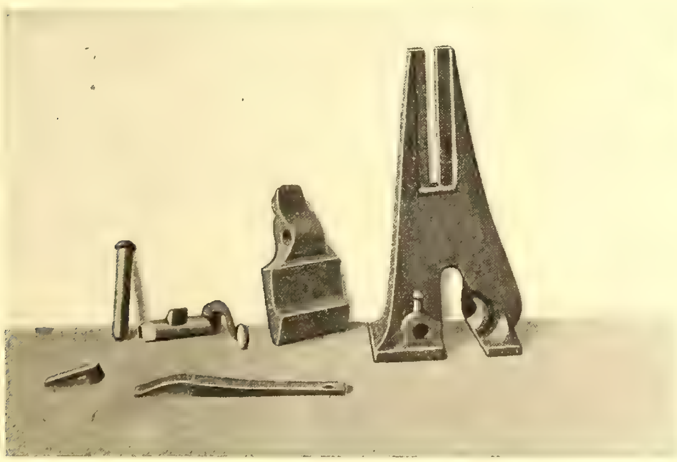
evidence of wear was shown in the dog—the only part of the device subjected to hard service.

While the chief value of this controller handle is in prevent-



RACK AND HANDLE

ing rapid, irregular feeding, with its attendant waste of power, injury of equipment and increase of power-house expense, it presents various incidental advantages. Among these may be



DETAIL PARTS OF CURRENT-CONTROLLING APPARATUS

named the fact that, as the handle makes a full stop squarely upon each point, the controller fingers are in exact contact, and are therefore not subjected to the uneven wear sometimes caused by carelessness of motormen in this matter.

In the operation of reversing, this handle serves to regulate the feed in exactly the same manner and degree as it does in the ordinary feeding, and with marked advantages. In an emergency reverse, when a motorman is especially tempted to swing on full current instantly, it compels him to feed the motor in the manner that will not only preserve the motor, but will stop the car in the shortest possible distance.

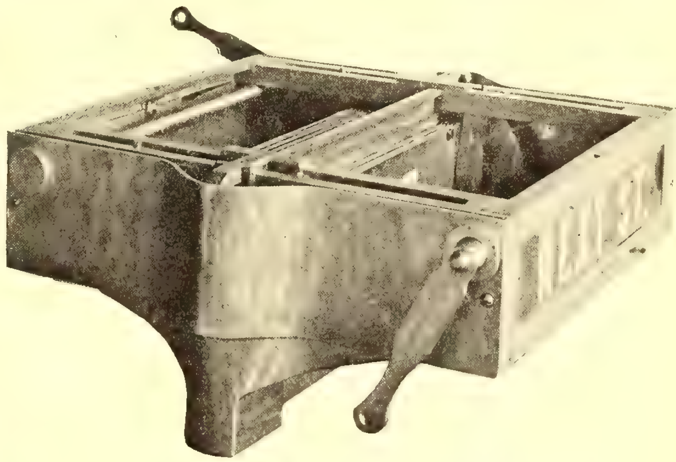
In practice this device is found to safeguard electric cars against the extraordinary wear and tear due to fast feeding and overfeeding. It also lightens the power house load, and on the smaller lines materially reduces fuel bills at the power house. It insures a regulated, even starting of each car, abolishing unpleasant jerking and avoiding the dangers arising from bad stops.

A NEW STATION INDICATOR

The indistinctness with which the names of stations on elevated railways are announced by the guards has long been the subject of humorous remarks in the joke columns of the daily

VIEW OF STATION INDICATOR IN SERVICE

and weekly papers. There is no doubt that there is considerable truth in the claim that passengers have difficulty in understanding the names as announced, and that visible station indicators would be of great convenience to many persons as well as passengers who are hard of hearing. A device for accomplishing this result has recently been patented by Edward



INTERIOR OF STATION INDICATOR

M. Skinner, and will soon be put on the market by Col. Giles S. Allison, of New York, who owns a half interest in the patents. It is illustrated in the accompanying cuts.

The indicator is a rectangular receptacle or box about 24 ins. wide and 8 ins. deep. Its length varies with the number of stops made, but 120 signs can be contained in an indicator about 14 ins. in length. The indicator, when in use, is mounted in the center of the car on the ceiling of the monitor. Each end bears the stationary sign "Next," or "Next Station," while

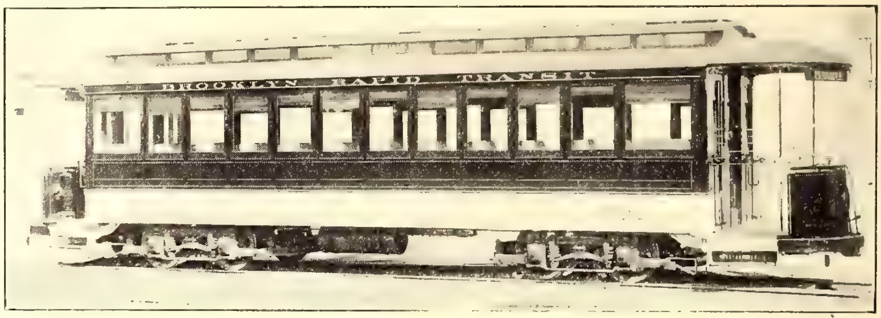
the name of the station itself is shown in a frame under the center, where it can be read from both sides.

The interior of the appliance is shown in the second illustration. The frame for holding the signs is divided in the middle by a floating plate, which is tilted slightly one way or the other by the operating mechanism, so that the signs can slide into or from the lower frame. The signs themselves are of metal, with white letters on a blue background, and slide on horizontal guides within the receptacle. When the operating handle is thrown, the sign nearest the central dividing plate is dropped down inside the lower frame, while the sign already there is thrown upward on the other side of the central plate. This process is continued after leaving every station until all the signs have been transferred from one side of the receptacle to the other. By operating the handle at the opposite end of the indicator, the process is reversed.

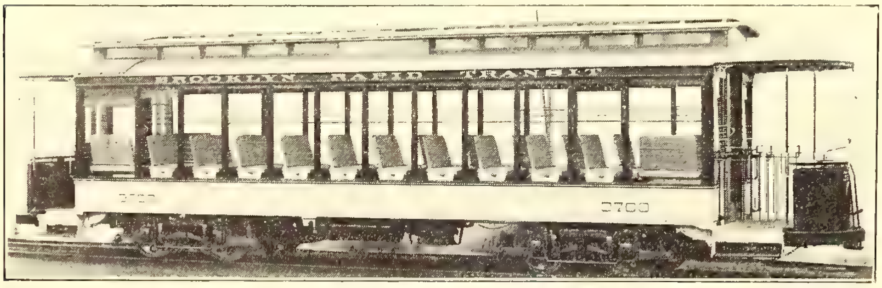
The operating handle can be thrown either by the guard or, if preferred, by an automatic device which would be set on the roof of the tunnel in the subway, or on the track in the case of an elevated structure. If this is done, the indicator would require no attention at all, being automatic in its operation. The device will be on exhibition at the Philadelphia convention in the space of the Security Register Company.

AN INTERESTING CAR FOR BROOKLYN

The J. G. Brill Company and the John Stephenson Company are delivering a lot of cars of the type shown in the accompanying illustrations to the Brooklyn Rapid Transit Company. The order being filled by the Brill Company is for 125, and that of the Stephenson Company for 50 cars. Although the type is not new, the design of these cars includes a number of features which have not been used heretofore. The style may be called semi-convertible, but not in the sense of the patented cars of the builders, as the windows are removable. In Baltimore and elsewhere cars of a similar type have been used, but the removable parts consisted of sashes with the panels separate, while in the Brooklyn car the space between each pair of posts when closed is filled with a sash and panel made in one section. In summer, when the sashes are removed, screens consisting of two groups of round bars take their place. These screens serve not only to protect the passengers from passing vehicles, but also to brace the posts horizontally. Instead of the usual fixed lower panel of wood, a steel plate 17 ins. x $\frac{3}{8}$ in. is employed, which serves the double purpose of panel and sill plate, and is considered to be an excellent mode of construction for cars of this length and style. The plates extend in one piece from end to end, and are bent around the corner posts and brought to the door posts; they are bolted to the sills, posts, cross timbers, bolsters, strainers and window rails, and, with the exception of the hexagonal heads of the tie-rod nuts at the cross members, the bolt heads are let into countersunk holes and smoothed flush with the plates. The window sashes are composed of cherry, and the frames include panels below the sash, the whole reaching from the window rail to the letter board. The sash panel is solid and is tenoned to the stiles.



THE BROOKLYN RAPID TRANSIT COMPANY'S CAR READY FOR COLD-WEATHER SERVICE



BROOKLYN RAPID TRANSIT COMPANY'S NEW CAR READY FOR SUMMER SERVICE

The sashes are held in place by half-oval metal bar secured to the outer face of each post by four screws running through the posts and with the heads sunk in brass washers set flush with the inner face of the post. These bars are also used to retain the screens which take the place of the sashes in summer. Window pockets are provided for the sash at the ends of the car; inner sashes are also furnished, which are hinged to the corner posts.

The bottom framing consists of $4\frac{3}{4}$-in. x $7\frac{3}{4}$-in. side and end sills, $3\frac{3}{4}$-in. x $5\frac{3}{4}$-in. cross timbers and $3\frac{3}{4}$-in. x $2\frac{3}{4}$-in. diagonals, all of white oak, except the side sills, which are of long leaf yellow pine. The side posts are $2\frac{1}{2}$ ins. thick, and the corner posts, $5\frac{3}{4}$ ins. Four steel knees support the platforms; these knees extend back to the bolsters, and at the outer end are capped by angle-iron bumpers of the builder's patented type. Steel carlines are furnished at each post, and are $1\frac{1}{4}$ ins. x 5-16 in. thick. The interior of the cars is finished in cherry, with birch veneer ceilings. Ratchet brake handles, "Dedenda" gongs and "Retriever" signal bells are included in the equipment, and are of Brill manufacture. The general dimensions of the cars are: Length over the corner posts, 31 ft. $5\frac{1}{4}$ ins.; length over the bumpers, 42 ft. 6 ins.; length of the platforms, 5 ft. $6\frac{3}{8}$ ins.; distance from center to center of the bolster, 20 ft.; width over the sill plates and posts, 8 ft.; height from the bottom of the sill over the trolley board, 8 ft. 10 ins.

A car on the Trenton, Lawrenceville & Princeton Railroad (New Jersey & Pennsylvania Traction System) narrowly escaped being wrecked a few days ago. Three boys, the oldest 18, and each of the others 10 years of age, placed some stumps on the track between Trenton and Reed's Manor, where a 4-deg. curve is located on a 10-ft. embankment. The car was running at a speed of about 45 m.p.h. when the motorman saw the stumps on the track. He applied the air brakes so successfully, however, that the car did not leave the track, although the wheels were raised from the rails by the stumps. General Manager Honecker, who happened to be on the car, saw some boys running across the fields, and he gave chase, with such success as to capture the oldest, John Morollo, in a pond a mile from the scene of the attempt at wrecking the car. Morollo is now held in the county jail, without bail, to await the action of the next Mercer County Grand Jury. The company has announced its intention of prosecuting him to the limit.

FINANCIAL INTELLIGENCE

WALL STREET, Aug. 23, 1905.

The Money Market

There was no material change in the money market this week. The tone was a shade firmer, but otherwise the market failed to reflect to any appreciable extent the fairly large shipments of funds to the West and South for crop-moving purposes, and a further reduction in bank reserves of nearly $3,500,000. Call money was under pressure during the greater part of the week, rates ranging from 1¾ to 2¼ per cent. The decided ease in this department was due in part to the offerings by stock commission houses of their unemployed balances in competition with the banks and trust companies. The time money market was practically at a standstill. During the early part of the week offerings were moderate at the recent low rates, but toward the close there was a disposition on the part of the banks to mark up the rates for all fixed periods. Sixty-day money was quoted at 3 per cent, and transactions in three months' funds were reported at 3½ per cent, as against 3¼ per cent a week ago. Four months' contracts ruled at 3¾, and five and six months' money was firmly held at 4 per cent. The volume of business, however, was extremely small, but at the same time there was no disposition on the part of lenders to press their funds, the opinion being quite general that higher rates will obtain in the near future. This belief is based upon the low bank reserves, and that the requirements at the interior for crop purposes will continue to grow larger from now on. In the meantime, borrowers are taking advantage of the easy rate for call money. Mercantile paper was unchanged, on the base of 4 to 4¼ per cent for the best names. Sterling exchange was weak, at 486½ for prime demand sterling. The foreign money markets continued easy at practically unchanged rates. The statement of the clearing house banks, published last Saturday, showed the surplus reserve to be only $9,355,675. This compares with a surplus of $12,846,800 in the preceding week, $58,613,075 in the corresponding week of last year, $21,058,300 in 1903, $9,743,350 in 1902, $18,148,150 in 1901, and $23,888,925 in 1901.

The Stock Market

An irregular movement characterized the stock market this week, but toward the close bullish sentiment was rather strongly stimulated by a sensational advance in Reading, due to active short covering in that stock, accompanied by rumors of a corner and a forced settlement on the part of some of the largest shorts. This movement was followed by aggressive buying of Erie at advancing prices and later by heavy buying of the Pennsylvania stocks and of Amalgamated Copper, the latter being influenced by the continued upward movement in the metal market. The peace situation has been a sentimental influence throughout the week, and at one time caused quite a little feeling of apprehension that the conference would be terminated without any agreement, but the intervention of President Roosevelt appeared to change the situation, and at the close of the week confidence in a final peace agreement had been restored. The feature of the market continues to be the buying of the high-priced investment issues, and the movement of these to new high levels. It is pretty generally recognized that developments of more than ordinary importance underlie this buying, which can only be for important interests, as the prices at which these stocks are ruling are prohibitive to the ordinary trader. The flattering crop outlook is the basis for the general confidence reflected in the stock market, and this feeling is encouraged by the activity and strength in the iron and steel industry and in the metal markets. Money is moving to the interior in fairly liberal volume, but thus far this has not had any appreciable effect upon the money market, although somewhat high rates for call and time money are generally expected. Public participation in the stock market is increasing, and the outlook continues favorable to the development of an active bull speculation in stocks, notwithstanding that prices for the general market are conceded to be high. Much attention is being paid to the railway situation in the Northwest, and intimation of something definite in the line of readjustment point to important developments in the near future. The iron and steel stocks and the copper shares attained some prominence in the latter part of the week, and all the conditions bearing upon these are regarded as favorable to higher prices for them.

There has been little activity and no movement of any importance in the local traction stocks, and these appear to be waiting developments in connection with the proposed new subway routes.

Philadelphia

There was a sharp falling off in the dealings in traction stocks during the past week, and although prices displayed some irregularity, the general tone was strong. Interest again centered to a great extent in Philadelphia common, which sold to the extent of about 5000 shares at prices ranging from 46½ to 45¾, while the preferred changed hands at from 47¾ to 48¼ for odd amounts. The recent strength in these issues was based upon the large gains in gross and net earnings, and it is said that the company will earn near 10 per cent on the common stock this year. Philadelphia Traction was in excellent demand, and the price rose in consequence to 101½, the highest point attained for a long time. Transactions amounted to about 500 shares. Philadelphia Rapid Transit was considerably less active, but very firm, upwards of 1000 shares selling at from 28½ to 29¼. In the lower priced issues American Railways sold at 54⅛ to 53½, but subsequently rallied to 54. Railways General was quite active, at prices ranging from 3⅞ to 4¼. Other transactions included Union Traction at 62 to 61⅞, Fairmount Park & Transportation at 10¾, Fort Wayne Traction preferred at 50, Consolidated Traction of New Jersey at 81¾ and 82, United Companies of New Jersey at 270, United Traction of Pittsburg preferred at 50.

Baltimore

The feature of the Baltimore market was the activity and strength in all of the Union Railway issues. The free stock rose from 14½ to 15¼ on the purchase of about 1000 shares, while the trust receipts moved up to 15¾ on the exchange of about 500 shares. The 4 per cent bonds were quiet but strong, about $15,000 selling at 94⅞ and 95. The incomes were in excellent demand, upwards of $350,000 changing hands at from 62¾ to 65¼ and back to 64¼, while the trust receipts brought prices ranging from 63⅛ to 63⅝ for about $220,000. Other transactions included Macon Street Railway 5s at 99, Charleston Consolidated Electric 5s at 98, Norfolk Railway & Light 5s at 93½ to 94, and Baltimore Traction 5s at 101⅝.

Other Traction Securities

Trading in the Boston market was extremely quiet, but apart from a decline in Boston & Worcester common from 27½ to 25, prices generally held firm. Boston Elevated was conspicuously strong, with sales of about 300 shares at from 154 to 155, an advance of a full point. West End common moved up from 97½ to 98 on light purchases. Massachusetts Electric opened at 19½, but later ran off to 18¼, but the preferred held firm, with sales of small amounts at 62 and 61¾. Boston & Worcester preferred sold at 74. The Chicago market was absolutely featureless. Trading was confined to a very few issues, and most of the transactions involved odd lots. Chicago & Oak Park Elevated common sold at 5¼, and the preferred at 18½ and 18. Metropolitan Elevated sold at 24 and 24¼, and the preferred changed hands at 64. South Side Elevated was strong, with sales of 125 shares at 95 and 95¼. In the New York curb market Interborough displayed moderate activity, but the price movement was very erratic. From 219⅜ at the opening the price slumped to 214, but later rallied to 215. Upwards of 5000 shares were traded in. New Orleans Railway issues developed strength, the common rising from 31¾ to 33 on the exchange of about 1500 shares, while the 4½ per cent bonds sold at 90⅛ to 90⅜ for $10,000. Washington Railway common advanced from 40 to 42½ on the purchase of about 600 shares, and the preferred advanced from 92½ to 93½ on the exchange of 450 shares.

It is reported that when the October quarterly dividend of the Syracuse Rapid Transit Railway Company is declared it will be on the basis of 5 per cent instead of 4 per cent per annum as hitherto, as this year's earnings will justify such an increase. A year ago the stock was selling around 75. Now the quotation is at least 87 bid and 90 asked. The issue amounts to $1,250,000, and there is $2,750,000 of common stock. The preferred stock is 6 per cent non-cumulative. A dividend of 6 per cent must be reached before anything is paid on the common stock.

Little activity in traction in Cincinnati. Cincinnati, Newport & Covington was practically the only active feature, the common ranging from 38 to 39½ on sales of 850 shares, while the preferred

moved up from 96¼ to 97. Cincinnati, Dayton & Toledo sold at 23. Unknown parties bought several blocks of Miami & Erie canal stock at 25 cents a $100 share. This was the first transaction this year and the stock was thought to be worthless. The sales are supposed to be based upon the whisperings that certain interests will make another move before the next legislature to secure canal concessions. C., D. & T. 5s sold at 96½, and Aurora, Elgin & Chicago at 95.

Last week was the heaviest in three years on the Cleveland exchange. A raid was started on Aurora, Elgin & Chicago and it effected almost everything on the board. Of Aurora common, nearly 7000 shares changed hands during the week, and the activity still continues. It started out at 20, and advanced rapidly to 25½, then a reaction took place and it declined a point, where it still stands. Some 300 shares of the preferred sold at 85 and 86. There is a general feeling that these stocks are selling too high, as the preferred is not yet earning a dividend, but the reports of improved earnings are most encouraging. Lake Shore Electric voting trust certificates came in for an upward movement. This property is also showing remarkable gains in earnings, and there is a report that it will take over the Lorain Railway. The common started at 10 and advanced to 13 on sales of about 3000 shares. The preferred sold at 50 for a small lot, but it is now hard to get at many points higher. Cleveland & Southwestern took a trend the other way. There are reports that the company will finance a heavy floating debt instead of paying the customary preferred dividend. The common started at 12½ and dropped to 9, while the preferred dropped from 54 to 50; sales 1500 shares. Northern Ohio Traction & Light was stationary at 23 and 23½; sales 1015 shares. Northern Texas advanced from 66½ to 68. Western Ohio sold at 15, and Cleveland Electric at 69. Aurora, Elgin & Chicago 5s sold to the amount of $137,000 at 95⅜ and 95½.

Security Quotations

The following table shows the present bid quotations for the leading traction stocks, and the active bonds, as compared with last week:

	Aug. 16	Aug. 23
American Railways	53	53½
Boston Elevated	154½	154
Brooklyn Rapid Transit	70⅛	69
Chicago City	a196	185
Chicago Union Traction (common)	8½	8½
Chicago Union Traction (preferred)	36	35
Cleveland Electric	78	71
Consolidated Traction of New Jersey	82	82
Consolidated Traction of New Jersey 5s	108½	108½
Detroit United	92⅝	95½
Interborough Rapid Transit	218¼	215
International Traction (common)	31	32¾
International Traction (preferred) 4s	68½	70
Manhattan Railway	167	166¼
Massachusetts Electric Cos. (common)	18	18
Massachusetts Electric Cos. (preferred)	61	61
Metropolitan Elevated, Chicago (common)	24	23⅞
Metropolitan Elevated, Chicago (preferred)	64	64
Metropolitan Street	129¼	129
Metropolitan Securities	83⅜	83
New Orleans Railways (common), W. I.	30	31⅞
New Orleans Railways (preferred), W. I.	71½	75
New Orleans Railways 4½s	89½	90
North American	100¾	101
North Jersey Street Railway	—	—
Philadelphia Company (common)	46¼	45¾
Philadelphia Rapid Transit	28¼	28½
Philadelphia Traction	100	100
Public Service Corporation 5 per cent notes	—	—
Public Service Corporation certificates	68½	68½
South Side Elevated (Chicago)	95	95
Third Avenue	127¾	127
Twin City, Minneapolis (common)	117¾	117
Union Traction (Philadelphia)	61¼	61¼
West End (common)	97	98½
West End (preferred)	113	113

a Asked. W. I., when issued.

Iron and Steel

The "Iron Age" says, although the volume of business entered during the past week has not been as large as in some previous weeks, conditions continue sound, and mills are taxed to utmost capacity, especially on building material and rails. The most interesting development in the pig iron market was the conference by representatives of the Bessemer Association with United States Steel Corporation officers concerning the purchase of Bessemer iron for September delivery. The Corporation is now using its surplus iron at the rate of 20,000 tons a day, and it will be necessary soon to make a purchase. It is understood that there is a slight difference of opinion as to price, but it is not thought that there will be any serious difficulty in reaching an agreement. It is probable that the purchase of about 40,000 tons will be announced before September 1. The sales of steel rails during the week amounted to 135,000 tons.

THE LAKE SHORE ELECTRIC

It is understood that in the near future the bankers' syndicate, which has had supervision of the operation of the Lake Shore Electric Railway since it was refinanced after the Everett-Moore embarrassment, will be dissolved, and the pool on the stock released. The property has been making gains in net earnings of from $8,000 to $10,000 a month, and it is figured that this year it will not only be in a position to pay all fixed charges, but have a surplus for preferred stock, whereas last year it had a deficit of $70,000. If the deal is closed the Lorain Street Railway and the Avon Beach & Southern, now controlled by the syndicate mentioned, will be merged with the Lake Shore company.

A syndicate of Cleveland men is trying to secure an option on the majority of the preferred and common stock of the Lake Shore Electric, offering 60 for the preferred and 15 for the common; both are selling at much lower figures at present.

IMPORTANT TRANSFER OF ELECTRIC AND GAS PROPERTIES AT HELENA, MONT.

J. G. White & Company, of New York, and associates have acquired the street railway, electric lighting and gas properties at Helena, Mont., known as the Helena Light & Traction Company. The electric railway system consists of about 17 miles of line, the greater portion of which is single track. There is an attractive amusement park operated in conjunction with the road. Current for both the street railway and the electric lighting system is supplied by the Missouri River Power Company. The incandescent and alternating-power distribution is three-phase, sixty-cycle, 220-volt, and rotaries installed in the sub-station provide a direct-current power system of 550 volts.

Howard S. Reynolds, superintendent of the operating department of J. G. White & Company, has been appointed manager of the company, and will leave shortly for Helena to assume his duties.

FIRE PROTECTION IN CLEVELAND

The General Fire Extinguisher Company has secured a contract from the Cleveland Electric Railway for equipping six more of its car houses with Grinnell sprinkler fire extinguisher outfits, making a total of twelve car houses to be, or being, equipped with the device. The outfits are practically the same as those described and illustrated in the car house test at the Broadway car houses in the STREET RAILWAY JOURNAL of June 3, 1905, with the exception that the sprinkler heads will be placed 7 ft. apart instead of 6 ft., a recommendation to this effect having been made by the fire underwriters as a result of that test. Otherwise the overhead and side sprinklers will be the same as in the installation described. Thirteen large wooden tanks and steel towers for these installations were furnished by the United States Wind Engine & Pump Company, of Batavia, Ill. The total investment to the Cleveland Electric Railway Company will be in the neighborhood of $150,000. The insurance will, of course, be reduced materially, and the company will be relieved of the fear of the disruption of the service through the destruction by fire of its rolling stock. The installations mentioned have been passed upon by the old line and the traction mutual insurance companies, and it remains to be seen which will get the insurance.

WIDENER-ELKINS NEGOTIATING FOR INDIANA PROPERTIES

While a deal is pending for the sale, by Tucker-Anthony & Company, of Boston, of the Columbus, Buckeye Lake & Newark, the Columbus, Newark & Zanesville, and the Indianapolis & Northwestern properties to the so-called Widener-Elkins syndicate, of Philadelphia, it had not been consummated previous to Wednesday, Aug. 23. These three lines embrace about 175 miles of road, and are among the best constructed and the most prosperous properties in the country. The Widener-Elkins syndicate evidently aims to control all the great through interurban roads in Ohio and Indiana. Already it has under control not far from a thousand miles of interurban lines in these States.

AN IMPORTANT GEORGIA INTERURBAN

Thomas B. Felder, of Atlanta, attorney for the Atlanta & Macon Interurban Railway Company, has secured a charter from the Secretary of State for the construction of an electric railway between Atlanta and Macon. The head offices of the company will be located in Atlanta. The capital stock of the company is placed at $1,000,000, divided into 1000 shares of a par value of $100 each. The application for the charter carried with it the names of Chas. J. Cranford, of Chicago; Geo. W. Sigart, W. H. Turnbull and C. C. Young, of Manistee, Mich.; Thomas B. Felder and Geo. W. Williamson, of Atlanta; J. Albert Johnson and Guyton Johnson, of Greenwood, Ind.; W. H. Wocher, of Indianapolis, and Jas. B. Nelson, of Greencourts, Ind. The line will, when constructed, be about 100 miles in length, running in a southeasterly direction from Atlanta through the counties of Fulton, Clayton, Henry, Spalding, Pike, Monroe and Bibb. Leaving Atlanta the road will pass through Jonesboro, Hampton, Griffin, Barnesville and Forsythe and thence to Macon, thus touching at all points of importance between the two cities. Mr. Felder says that all of the stock has been subscribed.

INTERBOROUGH REPORT

A statement of earnings of the Interborough Rapid Transit Company, of New York, covering its subway and elevated divisions, has been made public. The figures are for the quarter ended June 30, 1905, and for the six months ended June 30, 1905, for the entire system; for the quarter ended June 30 and the twelve months of the elevated division; and for the quarter ended June 30 and the period from the opening of the subway on Oct. 27 to June 30. In addition to these figures is the balance sheet as of June 30, 1905. Only in the case of the Manhattan, or elevated, division is it possible to give comparative figures. The several statements follow:

MANHATTAN AND SUBWAY DIVISIONS

Quarter ended June 30, 1905:	
Gross receipts	$4,548,843
Operating expenses	2,080,887
Net earnings	$2,467,956
Other income	156,553
Total income	$2,624,509
Fixed charges	1,922,566
Surplus	$701,943
Six months ended June 30, 1905:	
Gross receipts	$9,131,565
Operating expenses	4,140,204
Net earnings	$4,991,361
Other income	316,028
Total income	$5,307,389
Fixed charges	3,876,349
Surplus	$1,431,040

MANHATTAN DIVISION

Quarter ended June 30:	1905	1904
Gross receipts	$3,198,972	$3,746,101
Operating expenses	1,379,460	1,532,213
Net earnings	$1,819,512	$2,213,888
Other income	73,553	81,768
Total income	$1,893,065	$2,295,656
Fixed charges	1,694,328	1,537,222
Surplus	$198,737	$758,434
Twelve months ended June 30:		
Gross receipts	$14,010,381	$14,187,684
Operating expenses	6,006,190	5,846,052
Net earnings	$8,004,191	$8,341,632
Other income	324,066	341,504
Total income	$8,328,257	$8,683,136
Fixed charges	*7,046,668	*6,757,412
Surplus	$1,281,589	$1,925,724

* Includes dividends on Manhattan Railway.

SUBWAY DIVISION

Quarter ended June 30, 1905:	
Gross receipts	$1,349,871
Operating expenses	701,427
Net earnings	$648,444
Other income	83,000
Total income	$731,444
Fixed charges	228,236
Surplus	$503,208
From Oct. 27, 1904, to June 30, 1905:	
Gross receipts	$3,638,987
Operating expenses	1,850,358
Net earnings	$1,788,629
Other income	181,488
Total income	$1,970,117
Fixed charges	639,589
Surplus	$1,330,528

The general balance sheet as of June 30, 1905, compares as follows:

Assets:	1905	1904	1903
Cost lease and equipment of subway	$24,760,858	$15,330,167	$5,378,357
Stocks and bonds of other companies	17,565,682	15,555,113	13,527,266
Other permanent investment	1,781,928	1,150,216	1,738,341
Supplies on hand	534,413	859,847	550,291
Due by agents	3,196	258	164
Due by others	10,743	10,850	11,311
Open accounts	3,792,144	762,871	68,315
Cash	2,044,777	2,432,770	10,886,248
Loaned on collateral	492,500	143,000	1,015,000
Manhattan guarantee fund	4,107,190	4,018,812	4,018,812
Prepaid insurance	88,327	84,721	6,748
Sundries	15,781	9,225	....
Total	$55,197,539	$40,393,852	$37,180,852
Liabilities:			
Capital stock	$35,000,000	$35,000,000	$35,000,000
4 per cent 3-year gold notes	10,000,000	....	....
Interest on funded debt due and accrued	555,081	295,209	288,497
Sundries	152,603	63,003	7,636
Manhattan Railway Company lease account	377,450	382,323	430,920
Due by agents	3,196	258	164
Due for supplies, taxes, etc.	554,235	473,722	267,614
Open accounts	4,602,911	9,486	10,085
Interest and premium on capital stock	*220,000	646,502	371,073
Taxes in litigation	1,848,405	918,665	163,000
Profit and loss, surplus	1,794,311	1,773,048	547,324
Dividends unpaid	....	699,740	....
Total	$55,197,539	$40,393,852	$37,180,852

* Premium only.

HASTENING SAN FRANCISCO MUNICIPAL LINE

The Supervisors of San Francisco have taken action to hasten plans for the reconstruction of the Geary Street Railway. By resolution heretofore adopted the City Engineer has been instructed and authorized to prepare plans and specifications on which bids might be asked for the work of reconstruction. That there might be no delay in this, on account of a possible scarcity of funds in the City Engineer's office, Chairman Braunhart, of the public utilities committee, introduced the following resolution, which received the unanimous support of the board:

"Resolved, That the sum of $3,500 be and the same is hereby set aside out of the appropriation of $350,000 made in the budget of the fiscal year 1905-1906 for the construction of the Geary Street Railroad, for the purpose of enabling the City Engineer to prepare and transmit to the Board of Supervisors specifications in detail of said road as ordered by resolution No. 6159 of said board, approved July 24, 1905, said sum to be expended under the joint direction of the committees on public utilities and finance of the board of supervisors and of the City Engineer."

A NEW LINE OUT OF TRENTON

The Trenton, Hamilton & Ewing Traction Company has been chartered in New Jersey to build extensions of the Trenton Street Railway from a point near Cadwalader Park to Trenton Junction, and from East State Street and Johnson Avenue to Mercerville and Hamilton Square, via the Interstate Fair Grounds. Karl G. Roebling, of the John A. Roebling Sons' Company, has been elected president of the company, and Louis C. Taylor secretary and treasurer. The board of directors includes William Anderson, B. C. Kuser and Duncan Anderson, as well as Messrs. Roebling and Taylor. Work upon the new lines will be started very shortly, the preliminary work having been under way for some weeks. It is expected that the construction of the extension from Stuyvesant Avenue, Trenton, to Trenton Junction, via the State Hospital for the Insane and the Trenton Country Club, will begin within a couple of weeks. This line will compete with the Reading Railway to Trenton Junction, and will open up a most desirable suburban section. The total length of the line from the City Hall, Trenton, to Trenton Junction will be about 5 miles, and the extension will cover about half of this. The Reading Railway has an excursion rate of 15 cents, and operates eighty passenger trains per day, but does not run to the business center of Trenton, nor into the residential section of Trenton Junction. The Hamilton Square extension will compete with the Trenton & New Brunswick Railroad as far as Mercerville, but will have advantage over the latter. The new line will go direct into the town of Hamilton Square, while the Trenton & New Brunswick Railroad goes a mile to the west and north, and the latter line charges an excursion rate of 25 cents for the 6¼ miles. The new line will be only 4½ miles to the intersection of the Trenton & New Brunswick Railroad, or 5½ miles to the center of Hamilton Square. Both the Trenton Junction and Hamilton Square lines will be operated by the Trenton Street Railway, entering the city over that company's tracks.

NO INDEPENDENT SYSTEM IN YORK

After eight months of consideration, the Common Council of York, Pa., has defeated ordinances permitting Philadelphia capitalists to build lines in that city, and has adopted ordinances giving to the York Street Railway Company and allied corporations franchises to construct new lines and extensions. The action of the Council was taken because the Philadelphia corporations stated in a communication from Attorney John F. Kell, of York, that they were unable to comply with the provision of the bills before Councils granting privileges to the several companies. The York Street Railway Company, on the other hand, had submitted a communication, with bonds to the amount of $75,000, agreeing to carry out provisions specified by the Councils. The bills granting the franchises to the York Street Railway Company came to a vote without material discussion. The ordinances demand of the York Street Railway Company that upon all new lines constructed there shall be paid to the city 5 per cent on gross receipts for the first five years, 6¼ per cent for the next five years, and 8 per cent thereafter, as well as taxation fees on all cars, poles and wiring, together with an assessment on all suburban cars entering the city.

'BUS LINE IN OHIO

The automobile bus line from Springfield to Cedarville, Clifton and Jamestown has commenced operations. Thus far but one gasoline car, seating twelve passengers, has been placed in service, and this has been insufficient to carry the people. Other cars will be added within a very short time. Eventually there will be a car each way every two hours. The road in Clark County has been leveled by the company, but the Commissioners of Greene County have refused to let the company do anything with its route in the way of improving it. Jamestown people are delighted with the service, and hope to induce the company to operate between Jamestown and Xenia. The Commercial Transit Company, which operates these cars, is headed by J. C. Harshman, of Sprinfigeld, who has been prominently identified with the building of a number of electric railways in the vicinity of Springfield. He has great faith in the new project. The company expects in the near future to start a similar service between Springfield, Catawba and Mechanicsburg. The prejudice which still exists against such cars among the country residents is shown by the refusal of Mr. Harshman's application for the right to operate several of his cars at a county fair.

NINTH ANNUAL CONVENTION OF STREET RAILWAY ACCOUNTANTS

Secretary Elmer M. White has announced that the ninth annual meeting of the Street Railway Accountants' Association of America will be held on the second floor of the South Building, Philadelphia Museum, Thirty-Fourth and South Streets, Philadelphia, Pa., Sept. 28, 29 and 30, 1905. The Mechanical & Electrical Association and the Claim Agents' Association will meet on Monday and Tuesday, Sept. 25 and 26, and the American Street Railway Association, Wednesday and Thursday, Sept. 27 and 28. The hall can be reached via Walnut Street cars to Thirty-Fourth Street, where stages will be in waiting to convey visitors to the hall without charge. A light lunch will be served at moderate cost.

The headquarters of the Accountants' Association will be at the Hotel Walton, Broad and Locust Streets. (The Bellevue-Stratford, the headquarters of the American Street Railway Association, is across the street.) Rates are as follows, European plan: Single rooms, without bath, $2.00 and up per day; single rooms, with bath, $2.50 and up per day; double rooms, without bath, $3.00 and $4.00 for two persons, and double rooms, with bath, $4.00, $5.00 and $6.00 two persons. The annual banquet will be held Thursday evening, Sept. 26, at the Bellevue-Stratford.

The passenger associations have granted rates of fare and one-third on the certificate plan. A certificate must be obtained from the ticket agent when purchasing a ticket, and it should be left with the clerk when registering.

The report of the reorganization committee will be presented, and the members will be called upon to vote on some amendments to the present constitution and by-laws. As this is a very important period in the history of this organization it is earnestly desired that a full attendance be present.

AFFAIRS IN CHICAGO

Chicago seems to have taken sadly to heart a decision rendered a few days ago at Indianapolis by Judge Francis E. Baker, of the United States Circuit Court, who, in handing down a decision in the Indianapolis gas case, which involved the city and the gas company, held that cities have no power to take over the property of public service corporations, even when the right is stipulated in the franchise. Judge Baker's opinion is based on the incompetency of the gas company, under its powers derived by statute, to make such a contract as was made with the city of Indianapolis. He does not go into the question of the city's right to make the contract. "The complainant asserts," says the opinion, "that the option is void by reason of the want of corporate capacity on the part of both the city and the gas company. It is obvious, however, that if either party was wanting in capacity the contract, which must be a valid engagement between competent persons, must be held void, unless the complainant is estopped from raising the question." After deciding that the gas company is a quasi-public corporation and, therefore, without power to exercise authority not granted to it by "the charter under which it exists or from some other act of the Legislature which granted that charter," Judge Baker says:

"As there is no pretense that the gas company was authorized by its charter to enter into an option to sell all of its property in gross, it is very clear, under the above authorities, that the act of the gas company in giving the city an option to purchase all of the gas company's property was beyond the scope of the corporate rights of the gas company."

It was pointed out in Chicago that if the decision applies to that city it guillotines the thirteen-year tentative ordinance, and that it brings up the question whether the city will have the right at the end of the time limit to take over the property of the Illinois Tunnel Company, as specified in the franchise. Corporation Counsel Jas. Hamilton Lewis, however, pointed out that the finding would not apply to the Illinois Tunnel Company, for the reason that it does not operate under a State charter, but under a city ordinance. Another deduction that caused vexation was one indicating that if a city has the right to enter the business of operating public utilities only by the method of starting independent systems to compete with the private ones already in the field the fact would tend to invalidate the Mueller law. This is the only enabling law Chicago has. It gives the city the right to "own, construct, acquire and operate" municipal systems. If it is illegal for the city to "acquire," it is pointed out, the presence of that word in the Mueller law perhaps would make the whole act invalid. Another interpretation of the act was that the ruling is not applicable to Chicago. One authority says the ruling is based on the fact that there is no statutory authority in Indiana for the city's taking over the property of the gas company. It is pointed out that this point is covered in Illinois by the Mueller law, through which the Legislature has given Chicago the right to buy the street railway properties.

SPECIAL FREIGHT RIGHTS FOR MASSACHUSETTS COMPANY

By securing an amended grant from the town of Attleboro, it looks as if the Taunton & Pawtucket Street Railway had removed the last obstacle to the experiment in Massachusetts of carrying freight and express by electric railway. The company's line runs through Rehoboth, Seekonk and Attleboro, connecting Taunton, Mass., and Pawtucket, R. I., and the Railroad Commission on July 13 issued the necessary certificate for beginning the experiment in freight carrying through Taunton, Rehoboth and Seekonk, all of which are in Massachusetts. Attleboro, however, instead of granting an unconditional permit for this kind of business, made the grant conditional on the erection by the company of a waiting room at a point designated by the town authorities. While the railway company made no open objection to this, the Railroad Commission ruled that this condition related in no way to freight service and was outside the intention of the statute of 1904, under which the company contemplated beginning the freight and express business. The commission therefore declined to grant a certificate as to that part of the line in Attleboro; and its objection was not met until the company secured an amended grant from the local authorities of that town similar in form to those in the other towns, and unrestricted by conditions. It is not expected that the Railroad Commission will require an additional hearing, since the whole matter was gone over carefully at the original session, and the certificate as to Attleboro will probably issue within a few days.

This undertaking of the Taunton & Pawtucket Company is the first under the statute of 1904, which authorized street railways to act as common carriers of freight and baggage after obtaining permission from local authorities and approval of the Railroad Commission in similar procedure to that required for locations. It is of particular interest for the reason that both the company and the commissioners regard the whole thing tentatively. The project is authorized merely as an experiment, to continue six months from Sept. 1. If it proves profitable and satisfactory, the authorization may be extended indefinitely; if not, the whole business may be discontinued. No similar experiment has been given a fair trial in Massachusetts up to the present time. A number of roads have received common carrier privileges under special charters, but so far as the eastern part of the State is concerned, at least, none of them has ever made a systematic effort to develop the business.

To meet the objection raised at the outset of negotiations, that the company might at some time refuse to carry certain classes of freight or express matter, if it found the carrying of such matter inconvenient or disagreeable, the commission had the company submit a schedule covering the kinds of matter which it desired to carry, and this puts a limitation on the whole business that seems likely to prove advantageous for both company and shippers, in keeping the business within reasonable bounds for street cars. By the terms of this schedule the company will undertake to carry general merchandise, groceries, furnishings, furniture, household commodities, stationery and printed matter, mill supplies, machinery, tools, implements, building materials, if no single piece exceeds 6 ft. x 4 ft. x 3 ft. in measurements, or 1500 lbs. in weight. It will carry liquids in cases, tanks and barrels not more than 6 ft. x 4 ft. x 3 ft. in size; perishable goods, when storage is at owner's risk; and hay and grain; but the schedule, as required by the Railroad Commissioners, specially excludes all explosives, as well as naphtha, gasoline, benzine and kerosene. The company may also carry coal for railway purposes.

The type of car allowed is the ordinary box baggage car, to be in charge of a motorman and a conductor, with possibly an express messenger, if the business requires it.

STREET RAILWAY PATENTS

[This department is conducted by Rosenbaum & Stockbridge, patent attorneys, 140 Nassau Street, New York.]

UNITED STATES PATENTS ISSUED AUG. 15, 1905

797,021. Railway Switch; Rudolph H. Scheibert, Middletown, Ohio. App. filed June 2, 1905. The usual switch at a turn-out or siding is equipped with operating levers which extend along the track. The engine of a through going express is equipped with an arm which strikes said lever and operates the switch if the latter should be open.

797,098. Brake Mechanism for Cars; Francis L. Clark, Pittsburg, Pa. App. filed Dec. 3, 1902. A usual form of magnetic brake is provided with links which connect to brake-shoes upon the wheels so that when the magnetic brake is operated the shoes are applied.

797,141. Block Signal System for Electric Railways; Frank R. McBerty, Evanston, Ill., and Malcolm E. Launbranch, Chicago, Ill. App. filed Sept. 9, 1904. A pair of toothed wheels are stepped around whenever a car enters or leaves a block section. The semaphore is displayed as long as there is relative displacement between the two. The instrument at each end of the block is automatically cut out by the operation of the other, so that cars cannot simultaneously enter from both ends.

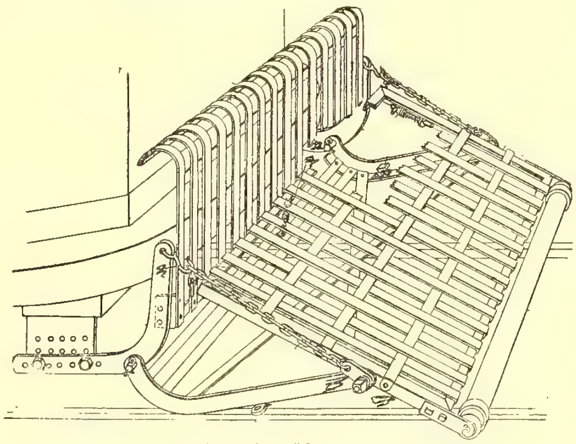
797,180. Electrical Apparatus for Signaling on Railways; Henri Cousin, Paris, France. App. filed April 3, 1905. When passing a danger signal certain contacts are made which absolutely stop the train, but a caution signal may be passed provided the engineer blows the whistle to show he is vigilant.

797,187. Car Signal; Frederic H. Ensign, Los Angeles, Cal. App. filed Sept. 20, 1904. A light is displayed at the rear of a train having a reflector which moves in accordance with the movement of the train so that the engineer of the following train may be informed of such movements and control his car accordingly.

797,191. Railroad Train Signal. Samuel E. Foreman, Paducah, Ky. App. filed March 28, 1905. A pair of conductors are laid along the track and a circuit is completed therefrom through each train. When two trains approach too closely together the resistance decreases and the increasing current indicates the danger.

797,229. Car Fender; William B. Rohmer, Bay St. Louis, Miss. App. filed Nov. 7, 1904. The fender carries in front of it a horizontal rod which acts as a sort of trigger or detent, and drops the fender whenever it encounters an obstruction.

797,252. Electric Switch; Milan V. Ayres, Newton, and Daniel E. Hennessy, Everett, Mass. App. filed Feb. 9, 1905. A U-shaped tube containing mercury is supported by the usual trolley wire. When a car passes the wire is inclined and the mercury breaks certain contacts which actuate the signals.



PATENT NO. 797,363

797,262. Switch Rod; William Kirkpatrick, Winnipeg, Can. App. filed Jan. 13, 1905. In order to prevent the breakage of a switch rod by the passage of a train when the switch is not properly set, the rod is extensible by means of a spring-pressed telescoping connection.

797,296. Metal Railway Tie; John A. Lippert, Buffalo, N. Y. App. filed April 10, 1905. An H-girder in which the lower base plate is formed with upwardly extending webs which increase the rigidity and facilitate tamping.

797,332. Car Door Operating Mechanism; John S. Stevenson, Detroit, Mich. App. filed March 10, 1905. The doors are opened by a system of levers and links having rollers at their pivots which are guided by a specially formed V-shaped rail.

797,336. Air Brake; Edwin B. Temple, Boston, Mass. App. filed Oct. 29, 1904. Each car door controls a valve in the train pipe, so that the brakes cannot be released until all the doors are closed.

797,363. Safety Device for Motor Cars; Benjamin Lev, Cleveland, Ohio. App. filed July 13, 1903. In order to prevent the rebound of a person from the spring back of a car fender, an attachment is provided for deflecting the fender upwardly after a person has fallen thereon.

797,398. Electrofluid Pressure Switching Mechanism; Walter J. Bell, Los Angeles, Cal. App. filed Aug. 25, 1904. The semaphore arm is operated from a branch of the same pneumatic pressure pipe that actuates the switch point. An ordinary D-valve is used for the operating cylinders, being moved into its alternate positions by a pair of electromagnets.

797,467. Switch-Operating Mechanism; Robert M. Stephens and James H. Holland, Carrollton, Ga. App. filed April 28, 1905. A pair of tappets in the roadbed are arranged to be actuated by arms upon the train manipulated by the engineer. The tappets are connected to move the switch point.

797,498. Block Signal System; Fred. B. Corey, Schenectady, N. Y. App. filed Jan. 21, 1905. A semaphore arm is actuated from an electric motor into three positions. The extreme positions correspond to safety and danger, respectively, and the intermediate position to caution. The circuits are arranged to actuate the motor to these positions.

12,381. Railway Passenger Car; George Gibbs, New York, N. Y. App. filed May 29, 1905. A construction of steel frame car having particular reference to the window frame. A complete steel plate construction is provided to form the sill and the guides for both of the sashes.

PERSONAL MENTION

MR. A. C. DENMAN, JR., has been elected general manager of the San Bernardino Valley Traction Company, of San Bernardino, Cal., to succeed Mr. John H. Fisher, resigned.

MR. F. L. MOWRY, of Boston, has been appointed general superintendent of the Stark Electric Railway, of Alliance, Ohio. He will have charge of the operating department. President C. R. Morley will thus be relieved of this portion of his duties.

MR. J. R. CURTISS, general superintendent of the Cleveland, Painesville & Ashtabula Railway, of Painesville, Ohio, has resigned to become superintendent of the Philadelphia, Lancaster & Christiana Electric Railway, which controls 80 miles of line. Mr. Curtiss will superintend the construction of an extension to Christiana, 24 miles.

MR. ALBERT A. COX, formerly superintendent of overhead lines of the Camden & Suburban Railway Company, and recently with the Schuylkill Traction Company, has started business as a contractor. His first contract is for the reconstruction of 28 miles of overhead line for the Schuylkill Traction Company, at Girardville, Pa.

MR HORACE C. STILLWELL'S resignation as general agent for the Indiana Union Traction Company, to take effect Sept. 1, has been accepted. With Mr. George F. McCulloch and others Mr. Stillwell is interested in the Muncie & Portland Traction Company, now building an electric railway to connect Muncie and Portland, and until that line is completed Mr. Stillwell will devote most of his attention to it.

MR. LINDEN P. WHITE, for a long time assistant superintendent and engineer for the Columbus Railway & Light Company, of Columbus, Ohio, will resign that position to become general manager of the Columbus Structural Steel Company, which has been organized in Columbus to build structural material and buildings. Mr. White will continue to act as one of the consulting engineers for the street railway company.

MR. R. P. WILLIAMS has resigned as inspector of special work for the Brooklyn Rapid Transit Company, to become roadmaster of the Northern Texas Traction Company, the duties of which office he has assumed under General Manager B. A. Mapledoram, of the company. Mr. Williams was with the Brooklyn company as inspector for two years. Previously he was with the Rochester Railway Company. At one time Mr. Williams was associated with Mr. Mapledoram in the management of the Lorain Company's plant at Johnstown.

MR. S. M. CLEMENT has been elected a director and Mr. Nelson Robinson vice-president of the International Railway Company, of Buffalo, to fill vacancies caused by the death of Col. Daniel S. Lamont. The present board is as follows: Arch M. Robinson, of Louisville, Ky.; Robert L. Fryer, Henry M. Watson, Pendennis White, Henry J. Pierce, S. M. Clement, of Buffalo, N. Y.; Thomas E. Mitten, of Chicago, Ill.; Col. Oliver H. Payne, Nelson Robinson, G. L. Boissevain, Daniel O'Day, Arthur Robinson, of New York; Thomas DeWitt Cuyler, of Philadelphia; Thomas Gibbs Blackstock and Edmund Boyd Osler, of Toronto.

MR. J. CLIFTON ROBINSON, managing director and engineer of the London United Tramways Company, Ltd., and of the Middlesborough, Stockton-on-Tees & Thornaby Electric Tramways, chief engineer of the Bristol Tramways & Carriage Company, Ltd., and director of the Metropolitan District Railway Company, which is now equipping its lines for electrical operation, was knighted June 30 on the occasion of the king's birthday. Mr. Robinson commenced his tramway work under the late Mr. George Francis Train, the pioneer of tramways in Great Britain, whom he subsequently accompanied to America. Mr. Robinson has been general manager of the Edinburgh Corporation Cable Tramways, and subsequently was responsible for the Highgate Hill tramways. He installed electricity on the Dublin, Southern, Bristol and Teesside systems.

MR. W. S. DORAN, on the occasion of his leaving England to return to the United States, was banqueted at the Hotel Cecil, London, by about one hundred of his associates in the British Westinghouse Company and other friends. Mr. Doran went to England in 1899 for the Worthington Pumping Engine Company, after an extended experience in the United States with this company, the Southwark Foundry & Machine Company and the United Gas & Improvement Company. In 1901 Mr. Doran joined the British Westinghouse Company, paying special attention to the organization of the branch offices, and also looking after important contracts with the railway companies and corporations. Mr. Doran has been appointed manager of the power department of the Allis-Chalmers Company, and will hereafter have his headquarters in Milwaukee.

MR. HOWARD S. REYNOLDS, superintendent of the operating department of J. G. White & Company, of New York, has resigned to assume the management of the electric light, street railway and gas properties in Helena, Mont., recently acquired by the White Company and allied interests. Mr. Reynolds graduated from the Massachusetts Institute of Technology in 1894, with the degree of B. S. The following year was spent with the Lowell, Lawrence & Haverhill Street Railway, after which he was with the Boston Elevated Railway and the Brockton Street Railway in various capacities. For six years Mr. Reynolds was with Stone & Webster, first as a draughtsman and street railway construction superintendent, and later as manager of their street railway, electric lighting and gas properties in Columbus, Ga. This position he resigned to become associated with J. G. White & Company.

PROF. HENRY H. NORRIS, who was in charge of the electric railway tests at the St. Louis Exposition, and who has recently done expert work for the American Street Railway Association in connection with its proposed plan of reorganization, has recently been appointed full professor of electrical engineering at Sibley College, Cornell University. In view of the importance with which the study of electric railway engineering is regarded at present, it is the purpose of the university authorities to allow those students who desire to specialize in this branch of electrical engineering an opportunity to do so, by a combined laboratory, recitation and lecture course. It is also the intention to increase the laboratory equipment at Sibley College in order to give special instruction in this department. Prof. Norris, who is now the head of the department of electrical engineering at Cornell University, is a graduate of Sibley College of 1896, and for the past five years has been assistant professor of electrical engineering at that school. He is a native of Philadelphia, where he was born in 1873. After graduating from the Manual Training High School in that city, he entered the employ of the Rhodes Manufacturing Company, a concern manufacturing dynamos, motors and other electrical machinery. Here he was assistant to the electrician, and was engaged in designing, constructing and testing electrical apparatus. In 1891 he took a position in Baltimore, where he attended the course in physics at Johns Hopkins University. After a short connection with the Arnold Electrical Manufacturing Company at Chester, manufacturers of dynamos, motors and storage batteries, Prof. Norris returned to Johns Hopkins University and took a special two years' course in electrical engineering, but in 1894, at the end of this period, went to Ithaca and finished his course there. In addition to his connection with the Electric Railway Test Commission at the St. Louis Exposition, Prof. Norris was a member of the official bureau of awards at St. Louis, being secretary of the group in electrical engineering. He has also acted as consulting engineer for a number of installations, and has been a frequent contributor to the technical and semi-technical press.

PROF. HENRY H. NORRIS

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Change of Address.—The old address should be given, as well as the new, and notice should be received a week in advance of the desired change.

Back Copies.—After July 1, 1905, no copies will be kept on sale beyond fifteen months prior to date of issue, except in bound volumes.

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office by 10 a. m. Monday preceding the date of publication, except the first issue of the month, for which changes of copy should be received two weeks prior to publication date. New advertisements for any issue will be accepted up to noon of Tuesday for the paper dated the following Saturday.

Of this issue of the Street Railway Journal 8200 *copies are printed. Total circulation for* 1905 *to date,* 285,750 *copies, an average of* 8164 *copies per week.*

The Detroit Prizes

The Detroit United Railway Company, through its "Detroit United Weekly" and in other ways, is conducting a steady and well-organized campaign to keep up public interest and stimulate both city and interurban travel. First it was a prize for a trolley song, which excited much interest not only in Detroit but all over the country. Another plan recently worked was the offering of a prize for the best list of flowers native to the communities through which the Detroit United Railway system runs. Now a contest is announced open to every school boy or girl in these five counties of Michigan, offering three prizes for the best short story,

A. R. M. and E. A. Convention

The advance copies of the papers prepared for the third annual convention of the American Railway Mechanical and Electrical Association which are now being sent out indicate what a wealth of valuable matter is to be considered by the master mechanics' track and power house departments at Philadelphia the last week in September. The quality and quantity of these papers, and the fact that they are prepared by track operating men, show what an important place these departments must be given in the pending reorganization and consolidation of the various department associations. In previous years shop and rolling stock matters have been considered almost to the exclusion of everything else by this association. The present year the track and power house departments are well represented. The association is to be congratulated on having a management and contributing members who make it possible to send out advance copies this far in advance of the convention, so that they may have due consideration by those who will attend and time need not be taken in the reading of the papers, which can be more profitably spent in discussion.

The Chicago Municipal Railway Estimates

We publish elsewhere a short abstract of the report made by A. B. Du Pont to Mayor Dunne, of Chicago, giving estimates on the earnings and operating expenses of the proposed 264-mile municipal street railway system to be built on streets where franchises are claimed to have expired and on streets where no street railways exist at present. The question of how much such a system can earn per mile of track is a matter of business and engineering judgment, to be based on what has been earned by other large city systems, taking into account the local conditions in Chicago. Of course, every traction expert has a right to his own opinion in such matters, but we must confess that we think our good friend, Mr. Du Pont, is over sanguine in his estimates of what such a system can earn when he figures gross earnings of over $45,000 per annum per mile of single track the first year the road is in operation. We do not know of any figures of similar American street railway systems which come anywhere near this. The Chicago City Railway Company, operating under almost the same conditions as would the proposed municipal system, earned last year in round numbers $30,000 gross per mile of single track. The Philadelphia Rapid Transit Company earned $29,000 per mile, and the Boston Elevated Railway Company $28,000 per mile. Chicago is not a city of great density of population, as land is plenty and the tendency has been to spread out over the prairies rather than to confine the population to narrow limits. In the item of first cost (about $95,000 per mile), Mr. Du Pont comes fairly near other estimates made on the entire reconstructing of roads in Chicago. Operating expenses, maintenance and depreciation are estimated at 55 per cent of the gross receipts the first five years, and at 60 per cent after that time. This is also a rather hopeful view to take of the situation, but as all the estimates depend on the gross receipts per mile of track assumed to start with, it is useless to discuss the matter further.

The Revised Constitution of the American Street and Interurban Railway Association

Elsewhere in this issue will be found the complete text of the proposed constitution and by-laws of the American Street and Interurban Railway Association which are to be voted upon at the Philadelphia convention. For the benefit of those who have not been following closely the proposed plans for reorganization, we might state briefly that following the meeting in New York, Feb. 3, of the executive committees of the various associations interested, the sub-committee on reorganization appointed at that meeting has been engaged in drawing up a working plan according to the principles agreed upon at that time. Suggestions were requested from all interested in the subject, and were considered at a meeting of the reorganization sub-committee in Philadelphia on June 12. As a result of this conference the original plan was modified in detail, although not in principle, and the wording of the constitution and by-laws was decided upon. Since that time the subject matter has been passed upon from a legal standpoint by a prominent attorney who has had a wide experience in corporate organization, the proportion of fees has been worked out upon a basis of the estimated budget, as decided at Philadelphia, and the revised form has been prepared ready for submission at the Philadelphia conventions to the various organizations interested. In view of the importance of the matter it has been thought advisable by the reorganization committee to make the form public some time previous to the Philadelphia convention, so that everyone should have an opportunity of reading the constitution and by-laws and of understanding the plan before attending the convention.

We have already expressed our hearty accord with the purposes of the committee on reorganization, and these purposes seem admirably embodied in the draft of organization before us. The change of name from the American Street Railway Association to the American Street and Interurban Railway Association has already been commented upon. Although somewhat long, the new name expresses the field covered by the organization better than any other combination of words which has been suggested. This is to be the parent body and will have certain "affiliated" associations, three at present, which will represent the present Accountants', Mechanical and Claim Agents' associations, whose organizations are to be entirely autonomous, but which will work largely upon lines suggested by the main association, and will receive grants of money to defray the expenses of the work done along these lines. Each of these organizations will receive a charter from the parent body, which will guarantee their "affiliation" with it and consequently its financial support, and representation upon its executive committee. The individual membership of each affiliated association and its membership dues are controlled by the association itself, as is also its selection of officers. The establishment of similar affiliated organizations destined to pursue investigations and studies along other branches of street railway work not covered by any of the present organizations is provided for in the constitution by the grant of additional charters.

A special feature of the new plan is the establishment of a permanent office and the appointment of a secretary, who shall devote his entire time to the needs of the parent and affiliated associations, and who shall also collect and compile information of value to all companies and be prepared to supply it to members of the association.

The scale of dues, as will be noticed, is based upon the gross receipts, and is approximately between 1 cent and 2 cents for each $100 of receipts, with a certain maximum. Each member company has the same privileges as every other member company, so that the plan should appeal especially to the smaller companies.

The proposed plan of reorganization should be of interest not only to those companies who are now members of the American Street Railway Association, but to those who have never joined that body. Statistics at present show that more than three-fourths of the operating companies of the country are not members of the American Street Railway Association. This condition ought to be changed under the new order of things. Whatever may have been the inducements for membership in the past, the new body ought certainly to unite the energies of the street railway companies of the country and should have a largely increased membership. It is not too much to say that this has been one of the principal purposes of the reorganization committee, and that the useful work which the new body can do in the future will depend largely upon the number of outside companies which will show their approval of the plan by becoming members. We urge upon all such a careful consideration of the advantages which membership in the American Street and Interurban Railway Association affords them, and as evidence of this approval their enrollment in the body. In conclusion, we wish to compliment the committee itself upon the thoroughly businesslike organization which is outlined in its report, and which should be of inestimable benefit to the street railway interests of the country.

Car Wiring in Conduit

The running of wiring underneath a car in iron-pipe conduit is a practice but recently adopted by certain elevated roads, but the superiority of this plan of car wiring appeals so strongly to various companies that it will probably not be long before all new surface cars will be wired in iron conduit. As far as street railway cars are concerned, this practice is decidedly at its beginnings, and many improvements will no doubt be suggested in the next few years which will simplify conduit wiring as well as improve its mechanical and electrical points. Some companies have for some time provided certain runways for cables the length of the car between certain sills. It would be but a step to line these runways with steel and so make them practically iron conduits. Considering the large amount of apparatus under a car, it is not always easy to find good locations for conduit pipes, as no provision has been made for them in the design of the car bottom. The plan of providing for the conduit in the building of a car would seem to be by all means the most rational. There is room for much improvement over current practice in the methods of connection to motor leads and the fireproofing of wires where they leave the conduits.

A Season for Weeds

The past season with its abundant rains continued well through the summer has been not only good for cultivated crops in the Central States, but has also been favorable to the raising of an immense crop of weeds along railroad roadbeds. In fact, not for years has there been a season that the growth of weeds has been so rapid or when they have sprung up so tenaciously and rapidly after successive weedings. The interurban road, with a limited amount to spend on maintenance of way as compared with steam trunk lines, has a harder time to cope with the weed problem. It has been suggested that roads having portable sub-stations might find it worth while to make

some experiments in the way of weed killing with high-potential alternating current. Inasmuch as the sub-station is equipped with step-down transformers, it might be run "back-end-to"—that is, taking direct current from the trolley wire and delivering high-potential alternating current for weed-killing purposes.

Overhead and Third Rail Equipment

It is a singular fact that with all the rapid advances that have been made in motors, trucks and controlling devices for electric railways, the progress in overhead construction and equipment should have been relatively so small. To be sure, there have been changes, so that the old joke of "Drop a nickel in the slot and see the trolley come off" has lost somewhat of its savor. Nor can one now break the monotony of a long ride by getting out to watch the motorman and conductor throwing clubs at the trolley end, stuck in a switch and dangling just out of reach and heedless of maledictions. Nevertheless, the overhead construction and the trolley equipment are essentially the same as they were in the good old times. The trolley wire, to be sure, is larger than of yore, for more current has to be carried, but it is in the same location, carried by the same sort of devices and the current is taken from it by the same sort of running contact, although the speed has been doubled and the energy required per car quite quadrupled. Such uniformity bespeaks either early perfection or extreme conservatism, or, what is more likely, something of both. In the whole country we know of very few roads, aside from the third-rail contingent, which do not use the ordinary form of trolley wheel underrunning a trolley wire hung in the regular way.

As to overhead work, by far the most important recent change is the importation of the catenary suspension. It is just now fairly starting in this country as a result of the move toward high tension and high speed. With the old construction heavy strains were necessary in order to get the trolley wire taut enough for comfortable running, with added risk of breakage everywhere, and particularly risk of jarring hangers loose or of jumping the wire near the hangers and knocking them off by a blow of the trolley pole. The catenary construction relieves these difficulties and at the same time gives a wonderfully even and smooth running line of trolley wire. For high-voltage lines designed for high-speed interurban service, this is of very great importance indeed, but the point which we here desire to raise is that there are many cases in ordinary electric railroading where a light catenary construction could be used to very great advantage. The immediate result is to make it possible to diminish considerably the number of lateral supports or of bracket poles while gaining at the same time a much better alignment of the trolley wire. A heavy catenary construction may, of course, require frequent supports, but we see no reason why rather long catenaries cannot be used to advantage, provided the weight of the trolley wire is not excessive, giving upon the whole a better looking and certainly a better working overhead line, especially for interurban work.

Ordinary trolley wheels will work with admirable smoothness under such a line, but if the bow or, better, the roller trolley is a good thing for taking off large currents at high voltage, why is it not also a good thing for taking off current at ordinary voltage? A road here and there has been driven to such construction by necessity, but are there not many cases in which a roller trolley and catenary overhead construction would settle the question of current collection on high-speed direct-current interurban roads? For these the new overhead methods and equipment seem on the face of things singularly well adapted, and we hope that such construction will be taken up and at least worked out to its legitimate conclusion. It is probably not perfect—few new things are—but it at least gives the promise of great usefulness and is well worth the labor required to reduce it to the form best adapted for American practice.

In this connection it is of extreme interest to consider the solution which the New York Central engineers have adopted in connection with their collection problem. In view of the large amounts of current required by the heavy trains and the use of direct current, an overhead wire was not practicable. At the same time, the commission which had the matter in charge looked askance at the ordinary third rail as somewhat dangerous, somewhat difficult to insulate, and involving a considerable amount of annual expense in the way of maintenance charges. It has been known for some time that the company has been experimenting on its tracks near Schenectady with an inverted third rail and under contact, but the announcement this week that this system has been decided upon will, we think, create no little interest. The under-contact third rail has been suggested before, but the system has never been worked out, or at any rate tried out, before. The principal objection which has been raised to this form of construction in the past has been the difficulty of designing a satisfactory system of switches and crossings, but this seems to have been more theoretical than actual. In other respects the system certainly possesses a number of advantages over the ordinary type of third rail, even with a protecting cover, and the adoption of the system by such a large corporation as the New York Central, and upon such an important scale as will be involved in this company's "electrical zone," promises to settle for all time the relative advantages of the two systems of third-rail contact.

Fire Protection of Car Houses

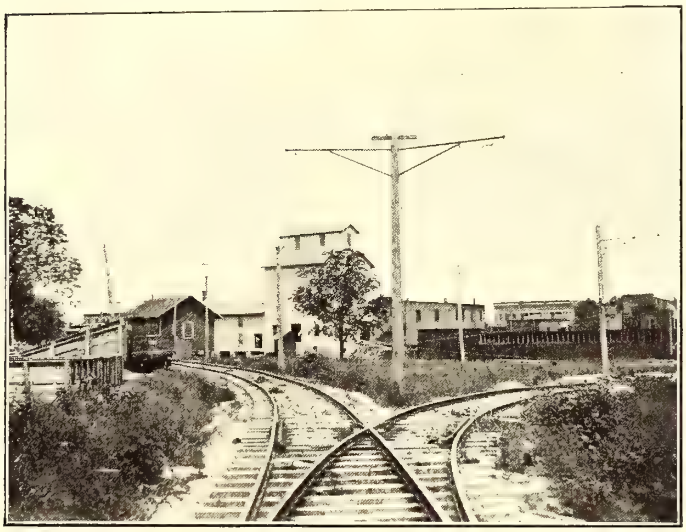
Readers of this paper are familiar in a general way with the tests which have been conducted by the Fire Underwriters and different railway companies in regard to the protection of car houses by automatic sprinklers, but all have perhaps not realized the principal object of these various costly experiments. Their main purpose has been to determine the relative efficacy of ceiling and aisle sprinkling for car house protection. A car house presents an entirely different kind of fire risk from a mill or store house, and must necessarily be treated in a different manner. The fire is apt to originate in a car into which it is extremely difficult to get water from above until the car roof has burned through. In the meantime the flames bursting through the windows may easily communicate to other cars. Furthermore, in some of the tests recently conducted, it has been demonstrated that with a heavy draft through a peaked roof car house it is more than likely that the ceiling sprinklers opened will not be those over the fire, but possibly 100 ft. or more away from it.

The object of sprinkling is, of course, to get the water on the origin of the fire. This seemingly can be accomplished by aisle sprinklers in a shorter time than in any other way, and consequently with a vast difference in the amount of smoke created. This latter is an important factor, because the smoke prevents free access of the firemen to the fire.

The question of water supply is also one of considerable importance, and the benefits of a heavy pressure were illustrated in the recent Newark tests, where centrifugal and rotary pumps were used to increase the city pressure, which in a great many cases is too low to be considered a good sprinkler supply.

FREIGHT DEVELOPMENT ON THE TOLEDO & WESTERN RAILWAY

Few electric roads have attracted as much attention from the freight-carrying standpoint as the Toledo & Western Railway, of Ohio. The property, which at that time was undeveloped, was fully described in the STREET RAILWAY JOURNAL of Nov. 29 and Dec. 20, 1902, and the major portion of the articles was devoted to the company's plans for freight business. Since then a great many interesting changes have taken place. It will be remembered that the main line of the Toledo & Western



TERMINAL YARD AT PIONEER, OHIO, SHOWING CATTLE PEN, FREIGHT STATION AND ELEVATOR

extends westward from Toledo, closely following the Michigan and Ohio State line. Within the past year the line has been extended to Pioneer, giving a main line mileage of about 60 miles, with a branch from Sylvania to Adrian, Mich., about 22 miles. The road has no competition between points on the main line and Toledo, and but three of the towns have railroad connection of any sort, these being located on north and south roads. In other words, the road was built through an undeveloped territory lying between two divisions of the Lake Shore & Michigan Southern Railway (steam), which are from 20 miles to 25 miles apart. It is a rich and fertile territory, but the handicap of having to drive 10 miles to 12 miles to a railroad caused the district to stand still for many years while the territory all around it was prospering.

The advent of an electric line equipped to handle carload freight as well as passengers was hailed with delight. The company instituted an intelligent campaign of education, and as a result the entire complexion and industries of the district have changed in a manner really astonishing.

New houses, buildings and factories have been erected in every town on the line. At Metamora, Berkey, Lyons, Fayette, Alvordton and Pioneer, grain elevators have been erected; in the latter place there are two. The farmers haul their grain to these elevators instead of to points on the steam roads, and the towns profit thereby. Due to these improved facilities, the cultivation of wheat, corn and other grain has increased considerably. The same is true of cattle raising. Cattle are brought in from Chicago and Western points when young and fattened on the rich lowland grass in this district. In the fall they are shipped East, many of them being sent abroad. The accompanying illustration shows a twelve-car train of fancy cattle for export. On practically all live stock the company gets a double haul—in and out. In every town it has long sidings and cattle pens.

Baling of hay is a new industry that is thriving, several establishments having been started for this work. Still another new industry in this district is the production of sugar beets. The company interested a number of farmers in this innovation, and this year over 1600 acres are under cultivation. Up to the present time the greater portion of the crop in this district has been shipped to Fremont, Ohio, the electric line carrying it to Toledo for reshipment. The importance of the new field caused the owners of the Fremont plant to decide on the erection of a large plant at Blissfield, on the line of the Toledo & Western. This plant is now partially completed, and it is the plan to have it in operation to take care of this year's crop. It is an enormous establishment, covering fully 20 acres, and having a capacity for grinding 600 tons of beets per day. Yards laid into the plant include over 2½ miles of track. The Lake Shore & Michigan Southern (steam) has a track connection with the electric line at this point, and all the material used in the construction of the plant was handled by the company's electric locomotives. About 70 per cent of this material was hauled over its line, either from Toledo or from Alvordton, where it has connection with the Wabash, the latter point giving the company a haul of over 50 miles. By the time the plant is completed the company will have handled over 600 cars of material. Three of the larger buildings of the plant are illustrated herewith, giving some idea of the size of the pieces handled. The large tank shown in the foreground extended over two flat cars. In the operation of the plant the beets will be unloaded from bottom dump gondola cars into bins by means of overhead trestles. The company will handle a large proportion of the ingoing raw material and a considerable portion of the finished product. It will be necessary to maintain a locomotive at this point practically all the time for switching purposes; and as it may be used at night, when the plant is shut down, and because of the undesirability of stringing and maintaining expensive overhead lines in the rather intricate yards, the company decided to purchase a steam locomotive for this work. The announcement that the company proposed buying such a locomotive recently gave rise to the

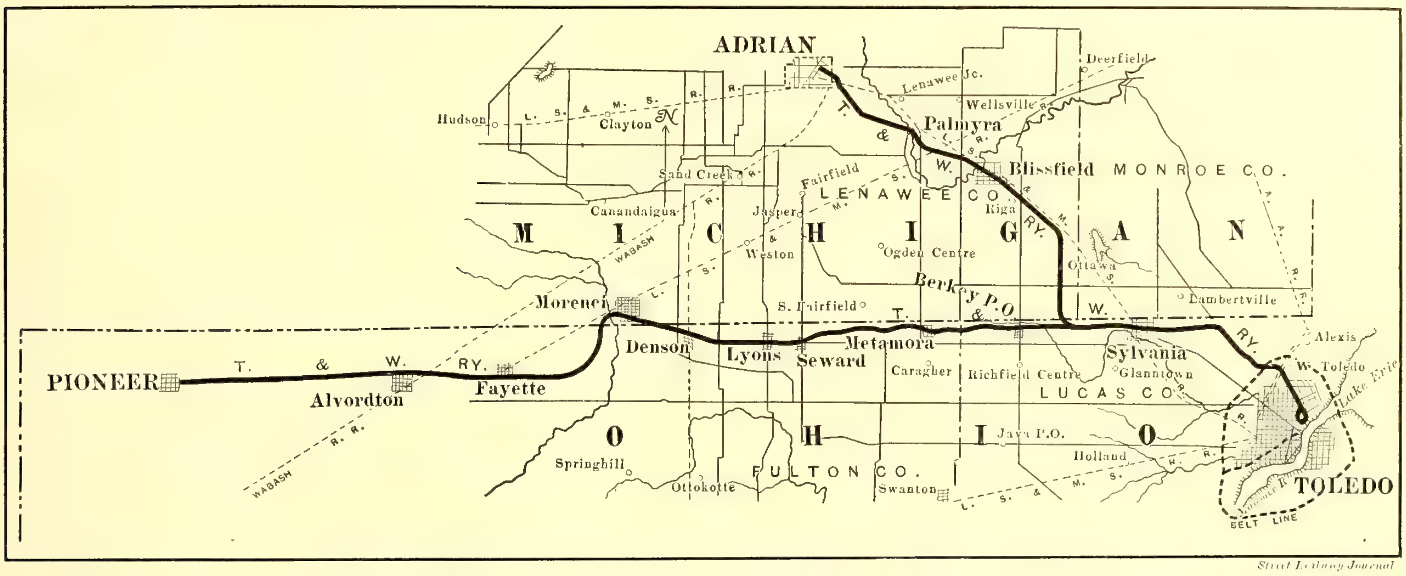
HANDLING LIVE STOCK FOR EXPORT ON THE TOLEDO & WESTERN RAILWAY

report that it had abandoned the use of electric locomotives in its freight service, but there is no truth in this.

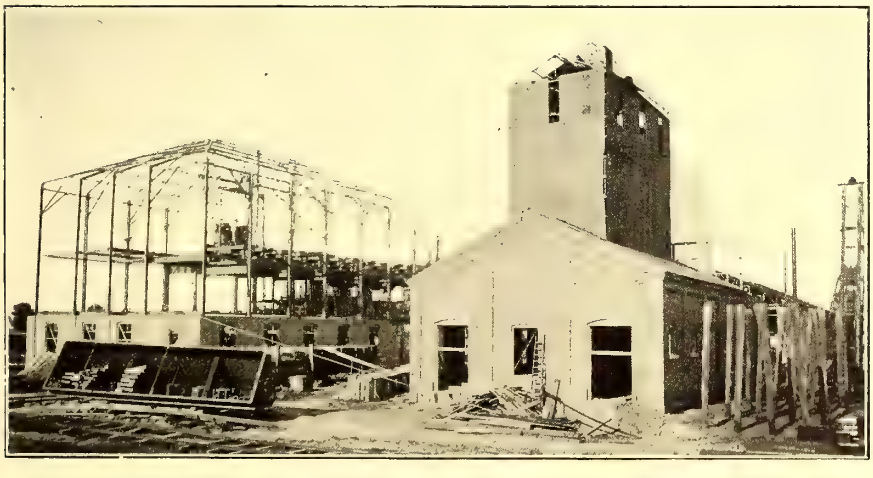
In the erection work on the beet sugar plant, the company laid the tracks and is furnishing power for motors used for various purposes, such as a sawmill, crane, etc. It also furnishes power to several industries, including a stave mill and a machine shop. Several of the elevators above mentioned are not "elevators" in the strict sense of the word, but the

grain is fed into the cars by means of motor-operated blowers. Current is furnished to industrial establishments from the trolley circuit at 5 cents per kw-hour. At first the company installed meters, but this was found too expensive, and now it meters and inspects each circuit about once a month and bases the charge accordingly.

When the road started it had no interchange of business with the steam roads, but gradually it has secured recognition, until at present it has satisfactory arrangements with nearly all the steam roads in its district. It is a member of several of the steam road associations, including the Master Car Builders' Association and the Auditors' Association, and while it has not secured recognition from the Central Service Association or the Joint Traffic Association, it receives foreign cars from some of the roads, receiving a pro rate for the haul over its line, and its cars have been sent all over the country, from Maine to California, although as a rule it endeavors to keep them at home and use foreign cars for distant shipments. Foreign cars requiring repairs are taken care of in its shops, as on all steam roads, and an association inspector examines its cars.



MAP OF TERRITORY SERVED BY THE TOLEDO & WESTERN RAILWAY


MAIN BUILDING OF NEW BEET SUGAR PLANT, BLISSFIELD, MICH.—ALL MATERIAL HANDLED BY TOLEDO & WESTRN RAILWAY

A connection with the Wabash at Franklin furnishes an excellent outlet to the west and south, and at this point it has a connecting yard equal to almost any connection between two steam roads. It has its own transfer station, with a receiving track and a delivering track. At the crossing there is a full interlocker, maintained by both roads, and giving both equal rights. A view of this crossing and connecting tracks is shown on page 328. At Denson it has a very good connection with the Detroit Southern, giving it an outlet north and south. The interchange with this road has been so great at times that the steam road has started trains from this point.

Originally it was impossible to ship carload material into Toledo, and the company maintained a yard at West Toledo, from which point goods had to be carted into the city. Recently a very satisfactory arrangement has been made with the Toledo Terminal & Belt Company, which operates a steam belt entirely around the outskirts of the city, touching a large number of manufacturing establishments and having connection with all the steam roads entering the city. It transfers cars to points into Toledo at from $2 to $3 per car, and it practically gives the Toledo & Western track connection with all the steam roads entering Toledo.

At the present time the Belt line offers no facilities for loading or unloading broken lots of package freight, and the electric line still operates package freight cars independent of its freight trains. These run to the interurban union freight station in Toledo, and they make practically express time. There are two of these runs over the Adrian division and one on the main line. These cars handle only package freight to and from Toledo, and while it is spoken of as package freight, they handle practically anything that will go into the car, and rates are the same as though the goods were handled in the freight trains. General Manager Franklin, of the company, is satisfied that this branch of the business is not profitable, but it is necessary to give patrons who ship material in and out of Toledo equal facilities with those who ship package freight between way points, or to foreign points. If better facilities for package freight in Toledo could be obtained, it would be his idea to institute an express business, charging higher rates than for freight, which would be reasonable, owing to the faster service afforded.

On the main line, which, of course, furnishes the heaviest portion of the freight, there is a local freight train each way daily except Sundays. Trains leave either terminus early in the morning as soon as possible after the switching has been done. The trains attend to the switching in each town, and the through run of about 58 miles requires about eight hours. Each train has a local car for local freight, and a four-wheel caboose, together with the loaded or empty cars to be handled. Occasionally, if cars are received at junction points after the

departure of the regular trains, extra trains are made up, and these, of course, run through on faster time. On the Adrian division there are no regular scheduled freight trains, the local business being taken care of on the package express cars and the carload business being handled special. Freight crews are paid by the month instead of by the hour. Each train has a motorman and conductor and one or more brakemen, and where there is a lot of switching to be done there is a trolley man. Conductors and engineers receive $60 per month, and the brakemen $45.

The company employs twenty-two station men, who handle freight, baggage and passenger business. Nine of the stations

CROSSING OF THE TOLEDO & WESTERN RAILWAY AND THE WABASH RAILROAD, SHOWING INTERLOCKER, TRANSFER TRACKS AND TRANSFER STATION

are in connection with rotary sub-stations. It will be seen that the stations average about 8 miles apart, which is closer than on the majority of interurban roads. Five of the stations are operated on double shift, it being the practice to close down four of the stations in the evening after the freight trains are off from the road.

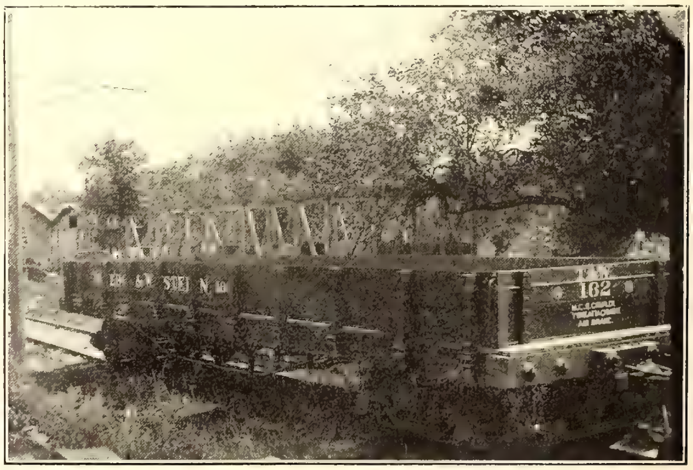
An ice house has recently been erected at Sylvania for iceing cars of fruit or dressed meats, of which the company has been handling considerable of late. A charge of $2.50 per car is made for iceing. The company is also considering selling ice to towns along the route.

All trains, passenger as well as freight, are inspected and journals lubricated as they pass Sylvania, and a complete oil house has been erected. It is absolutely fireproof, the walls being of concrete block, the roof of steel and tile and the floor of cement. There are large tanks for the various varieties of oils and lubricants, and zinc-lined compartments for waste and scrap.

The present freight car equipment consists of twenty 60,000-lb. box cars, eighteen gondolas, five 80,000-lb. Rodgers convertible gondolas, three stock cars, twelve flat cars and two four-wheel cabooses. There are also three locomotives equipped with four 50-hp motors. These are geared very low —14 to 59—and they will handle from twenty to twenty-five loaded cars at a speed of 12 m.p.h. to 15 m.p.h., which is the limit for freight trains. They are building in their shops a locomotive of considerably heavier type; it will weigh 110,000 lbs. The flooring is made up of 10-in. I-beams, and it will be equipped with four Westinghouse No. 76 (75-hp) motors. It will have special Dorner trucks, weighing 10,500 lbs. each, and 34-in. wheel, 6-in. axles and 5-in. x 9-in. journals. It will be fitted with Westinghouse K-15 controllers having two sets of resistances and fourteen points, and will have a No. 2 Christensen air compressor, capable of handling thirty-five cars, which it is figured the locomotive will haul without trouble.

Additional rolling stock is now on order, including ten bottom dump gondolas for handling beets and coal. The company has built several cars at its own shops, and has under construction six gondolas and several box cars. Some of its productions are illustrated herewith. It is necessary to retain three men for passenger and freight car repair work, and when these men are not busy they work on new cars. A good gondola can be built for $600. All cars are equipped with Westinghouse air brakes and M. C. B. couplers, so that they can go anywhere. An electric shovel was recently built. It consists of a Baby Giant shovel outfit, furnished by the Vulcan Iron Works Company, of Toledo, mounted on a low flat car. The shovel is operated by a 25-hp motor, and the current is taken from the trolley. It will load twenty-five cars per day. Several 120-ton track scales have recently been installed at points along the line. Depressed side-tracks have been laid at a number of points to accommodate large shippers of beets and grain, so that the goods can be loaded directly from wagons into cars.

The theory that the handling of heavy freight trains in connection with passenger service produces a very uneven load on the power station is not borne out by the observations of the electrical engineer of this line. He claims that the load is remarkably steady for the character of work done, and that it fluctuates but little more than on roads having all passenger service. He claims that a locomotive with from twelve to fifteen cars requires but little more current, either in acceleration or in steady running, than the passenger cars. The locomotives are geared as low as it is possible to make them, and, as stated, never exceed 15 m.p.h. The passenger cars are geared for 45 m.p.h., and average about 28 m.p.h. to 30 m.p.h. between stations. The freight trains seldom make stops between stations, while the passenger cars have many stops. The road is



CAR BUILT BY THE TOLEDO & WESTERN RAILWAY, FRAME FOR BOX CAR UNDER CONSTRUCTION

remarkably level, having no grades over 1½ per cent, and few of these. It is claimed that a skilled motorman can effect a greater saving of power on a heavy loaded freight train than on a passenger car, and the possibilities in this case are well known to all engineers. It is claimed that not only should a train be started very slowly, but the current should be thrown on and off intermittently, first giving it enough to start the locomotive and allowing the momentum gained to help start the first car, then giving it some more to assist the first car, which in turn starts the second car, and so on, building up slowly. A great deal of current is also saved in coasting on grades and rolling into sidings and up to derailing switches.

Sidings are all 1200 ft. to 1800 ft. long, so that in the majority of cases freights do not have to stop in passing passenger trains. The power station is equipped with two 750-hp and one 500-hp engines. Normally, during the day time, there are two freight trains, two express cars and five passenger cars, in addition to about 250-hp of motors. This load is taken care of by one of the larger and the small machine. In the evening, as before stated, four sub-stations are cut out and the small machine is shut down.

It is perhaps unfortunate that no accurate record is kept at this station of the cost of producing current; neither is it known exactly what portion is used in moving freight, hence the cost of operating the freight department cannot be accurately determined. It is stated that the cost of operation per car-mile for all classes of service is about 17 cents, and it costs somewhat less than 60 per cent of the gross receipts to operate the property. It should be stated, however, that a large number of investments, such as building cars, stock pens, sidings and additional ballasting since the road was completed, have been charged to operating rather than to capital account.

C. F. Franklin, general manager of this property, is an old steam road man, having been general superintendent of the Clover Leaf, a Toledo road, and his acquaintance and influence with steam road people have been of immense importance in securing the recognition which this road has obtained. After three years of experience in the operation of an electric railway under steam road conditions, Mr. Franklin has arrived at some conclusions which are of interest to all traction managers.

He believes that package freight business handled in single cars at rates equal to steam freight is unprofitable, and that an electric road having business enough to warrant high-speed half-hourly, or even hourly, service should not undertake freight business, unless, perhaps, it can afford double track. The Toledo & Western is so situated that it could not live on its passenger business alone, the receipts from this source just about paying the operating expenses of the road, the freight taking care of the fixed charges and leaving a small balance at present. The passenger schedule gives a car every two hours to Adrian, and the same to Fayette, while the traffic to Pioneer warrants a car only every four hours at present. The patrons are largely country people, and high speed is not essential, hence passenger cars can afford to lay up for freights occasionally, if necessary. Mr. Franklin is satisfied that a road of this character cannot be operated as cheaply as an exclusively passenger road, or one doing only a small freight business, this being due to the increased number of station agents, train crews, shop men and office force necessary to handle the business as compared with passengers. He believes that a road should have private right of way through villages as well as in the country to handle freight successfully. Grades over 2 per cent make such traffic almost prohibitive, as it is necessary to cut trains and handle a car or two at a time, besides which the strain on the power station is greatly multiplied by heavy grades. While it might be possible for an electric road having steam competition to secure a portion of the carload business, it could hardly prove a large item, due to the tendency of other roads to favor the steam road, also because of the advantage the steam road has on long hauls. Where roads are situated as the Toledo & Western is, he is most enthusiastic on the subject of freight, and finds there is more money in it than passenger business.

The passenger as well as the freight earnings of the road have shown steady gains, and the figures indicate that the freight is making better gains than the passenger. It is estimated that the gross earnings this year will reach $240,000, of which $90,000 freight is expected. The following statements, covering a period of three years, are from the reports of the Auditor of State for years ending April 30:

	1903	1904	1905
Passenger	$95,644	$123,637	$135,735
Freight	24,879	46,368	60,536
Mail	1,227	1,935	3,801
Other	412	3,826	5,333
Totals	$122,162	$175,766	$205,405

SINGLE-PHASE TRACTION IN BELGIUM

According to "Elektrische Bahnen," a 12-mile single-phase railway has recently been put in operation in the Borinage district, which is the southern coal region of Belgium. The railways in this district are owned, like all interurban roads in Belgium, by the Société Nationale des Chemins de Fer Vicinaux, which operates at present more than 1300 miles of track. This company was one of the first which introduced electric traction in Europe, but could do so on only five of its lines, which in their character resemble street railways. All other lines were continued to be operated by steam, although the company has always manifested great interest in electric traction. When direct current at 600 volts was found to be uneconomical, the company asked for bids for a three-phase system, but the tenders did not fulfil the expectations. It was then decided, in March, 1903, to use the single-phase system, and this would have been the first commercial line of this system in Europe if there had not been delays in acquiring some land needed. The total length now equipped with the single-phase system is 12 miles, but this will be extended to 77 miles, which will be supplied from one point with single-phase current at 6600 volts. For the lines equipped at present, the voltage is reduced in transformers along the line to 600 volts, while for further extensions a higher voltage will be employed on the trolley wire, in order to reduce the number of transformers needed. The company has not yet its own power plant, but buys the current from a lighting and power company. The frequency is 40 periods per second. The power plant contains only three-phase generators, but for traction, two phases only of the generators are used. There will be four transformer stations, operating in parallel on the system. Since there are telephone lines in the neighborhood which use the earth as return, the rails could not be used for the return railway current; there are therefore two trolleys and two overhead wires. The motors are of the Winter-Eichberg type. Each motor car contains two motors, each of 40 hp. The characteristic curves for a frequency of 40 are not as good as for a frequency of 25, but are said to fulfil all requirements of the service. Regulation is obtained by series-parallel control in connection with a regulating transformer; the connections of the stator windings only are changed, while the rotor windings are always connected in series. The regulating transformer is built as an autotransformer. There are no resistances used for starting, but a resistance is employed for the change over from the series to the parallel connection. The system has been in successful operation since April 6.

Two electric locomotives have just been completed in the shops of the Los Angeles Pacific Railway. It is intended to put the new machines into service for freight hauling over the standard gage divisions of the Los Angeles Pacific, and also to handle the passenger traffic which this electric road is planning to take from and deliver to the Santa Fe and the Southern Pacific at Inglewood and Sunset stations respectively, for Venice and Playa del Rey. In this way the company expects to make ample provision for passenger traffic on exceptionally heavy days at this resort. At both of the above-named stations the steam trains will be switched to the tracks of the electric railway company, coupled to the electric locomotives and hauled down to Venice, and returned by the same route.

THE NEW REINFORCED CONCRETE SHOPS AND CAR HOUSES OF THE CENTRAL PENNSYLVANIA TRACTION COMPANY, AT HARRISBURG, PA.

BY MASON D. PRATT, MEM. AM. SOC. C. E.

The Central Pennsylvania Traction Company, of Harrisburg, Pa., operates under lease and otherwise several systems of which the old Harrisburg City Horse Railway Company is the foundation, including, in addition, the Harrisburg Traction Company, Steelton, Highspire & Middletown Electric Railway Company, Citizens' Passenger Railway Company, Linglestown & Blue Mountain Railway Company, East Harrisburg Passenger Railway Company and the Harrisburg & Hummelstown Street Railway Company. Four of these companies had car houses located at different points throughout the district covered, but none of them was large enough or well located with reference to the consolidated system. It was therefore decided last year to concentrate at one place all of the car houses and repair shops. For this purpose the leasing company purchased 8 acres fronting on North Cameron Street, Harrisburg, between Forster and Herr Streets. On this ground there is now a car house 75 ft. x 360 ft., in two bays, and a repair shop building 50 ft. x 375 ft., with wings containing a blacksmith shop, storeroom, winding room and steam heating plant. All of these buildings cover an area of 53,000 sq. ft. They are constructed entirely of reinforced concrete, and are perhaps the first example of structures of this kind in which this method has been used in practically every detail. This construction was decided upon primarily to eliminate all fire risks as far as possible.

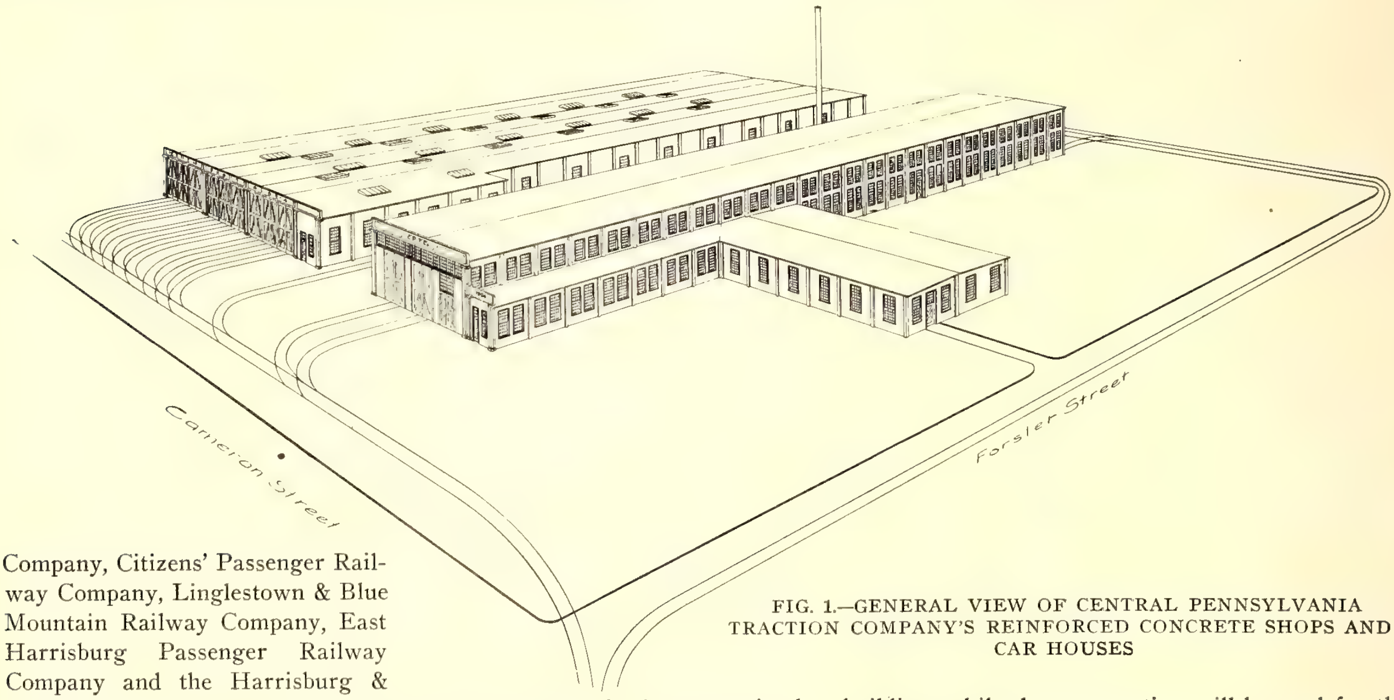


FIG. 1.—GENERAL VIEW OF CENTRAL PENNSYLVANIA TRACTION COMPANY'S REINFORCED CONCRETE SHOPS AND CAR HOUSES

GENERAL ARRANGEMENT

A general plan of the layout is shown in Fig. 4, from which it will be seen that ample space has been allowed between the buildings and from the streets to the buildings. If found necessary in the future, an additional building can be erected at the corner of Forster and Twelfth Streets, either for a paint or carpenter shop, and further bays added to the car house as needed. The present repair shop, including all machine tools and the winding room, occupies 225 ft. of the front end of the main shop building, while the rear portion will be used for the present as a carpenter shop and paint shop. These are separated by partitions, which, on account of their temporary nature, will be constructed of a steel frame with a corrugated steel covering and corrugated steel rolling lift shutter doors. The machine shop portion will be served by a 44-ft. electric crane, furnished by the Cleveland Crane & Car Company, of sufficient capacity to raise an entire car body. This crane also has movement speeds which will make it useful in serving the machine tools. The latter are placed along the south wall, and since the center of No. 1 track is 22 ft. from the center line of this wall, sufficient space is given for the tools and for handling the work around them. The two tracks through the shop are spaced 15 ft. center to center, and as the No. 2 track is 10 ft. from the central line of the north wall, ample space is given between

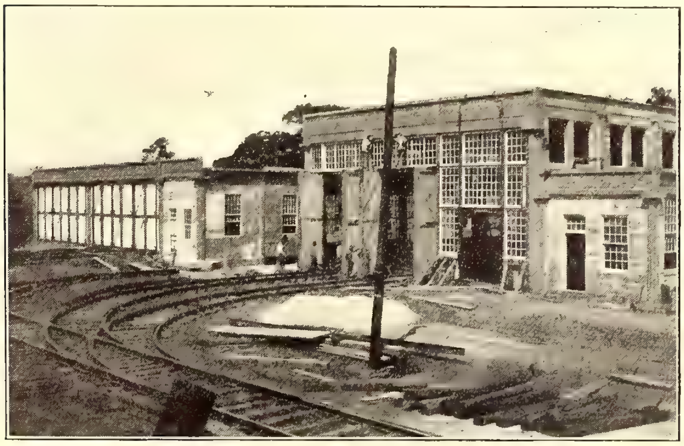


FIG. 2.—PUTTING ON THE FINISHING TOUCHES ON THE FRONT OF THE BUILDING

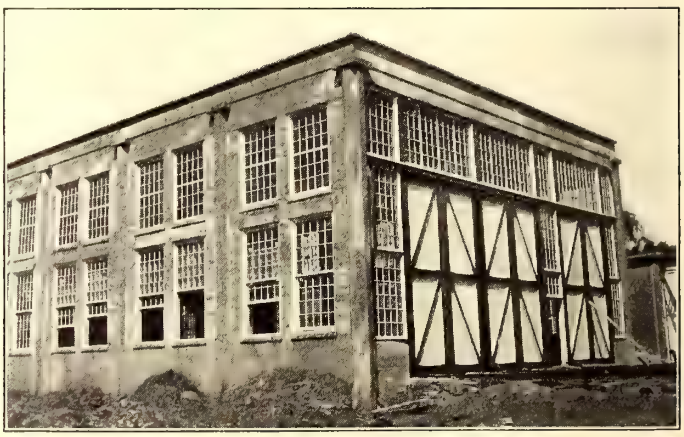


FIG. 3.—REAR END OF SHOP, SHOWING DETAILS OF FINISH

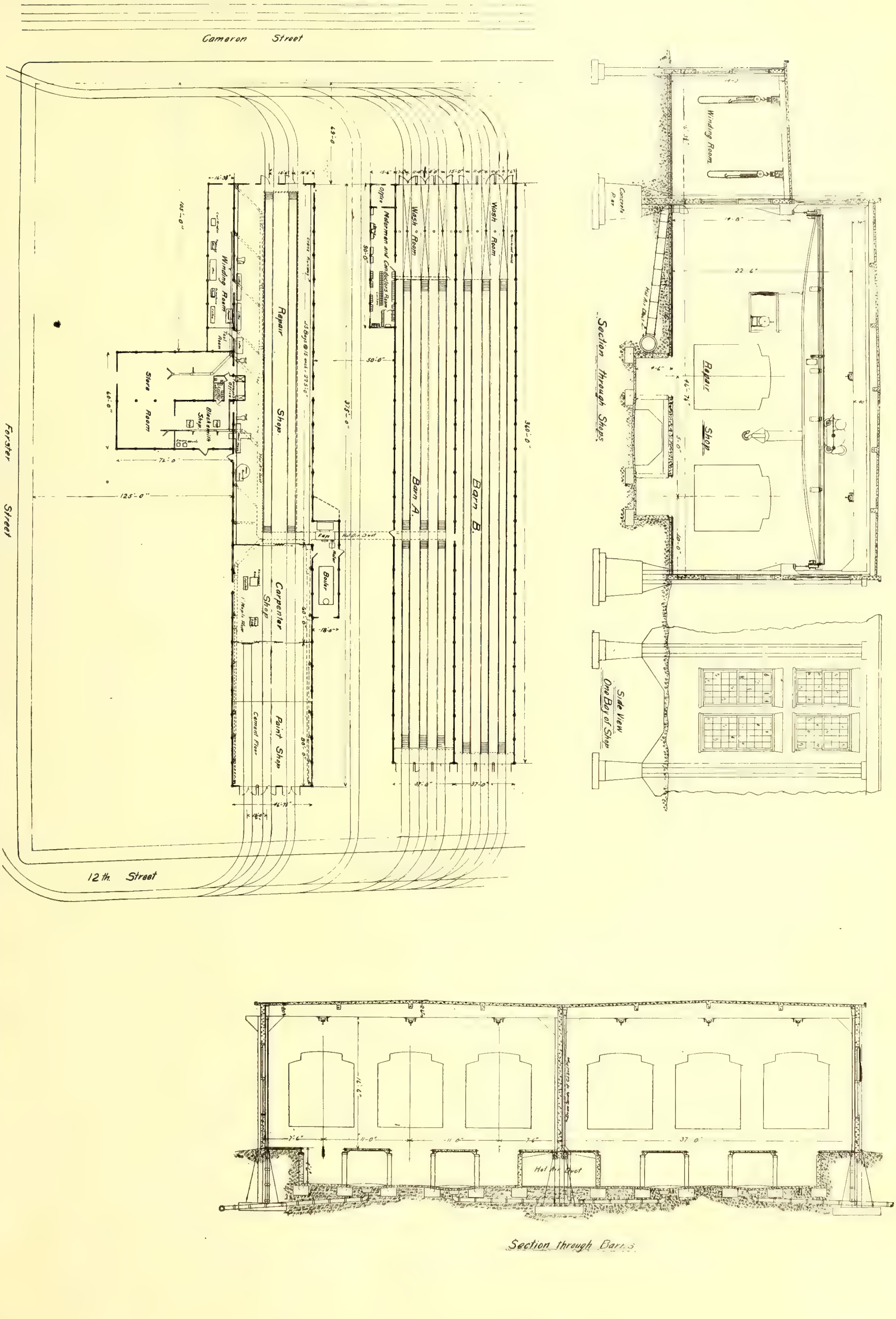


FIG. 4.—PLAN AND SECTIONS OF THE CENTRAL PENNSYLVANIA TRACTION COMPANY'S NEW SHOPS AND CAR HOUSES

and around cars for getting at all parts. The trolley wire is placed directly over the center of the tracks, and is 22 ft. from the floor, giving just sufficient room for the operation of the

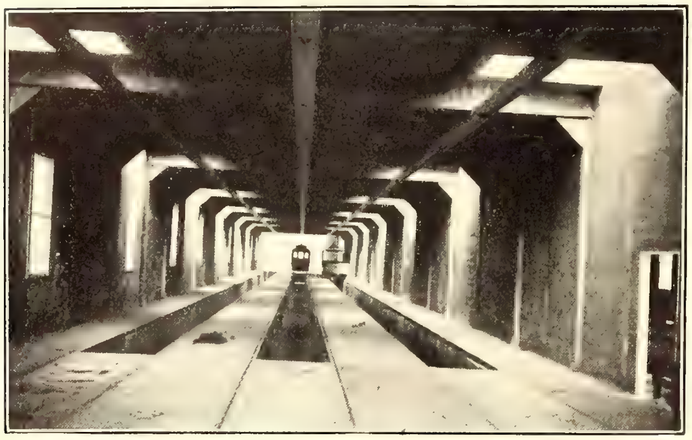


FIG. 5.—INTERIOR OF COMPLETED CONCRETE CAR HOUSE

electric crane—the movement of the cars being effected by their own trolley. The crane itself will also take its operating current from the central trolley wire, as it is provided with 500-

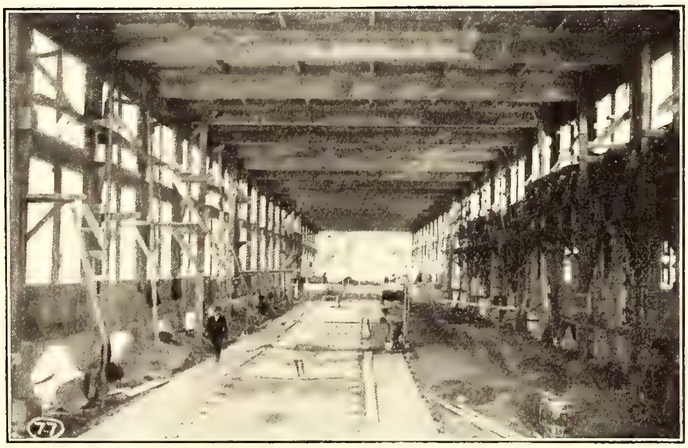


FIG. 6.—INTERIOR VIEW OF SHOP, SHOWING SCAFFOLDING FOR FILLING IN WINDOW SPACES. LAYING CONCRETE FLOOR TO PITS

volt direct-current motors. Every machine tool will be operated by a separate Robbins & Meyer motor of the same voltage.

An inspection of the plans will show that the lighting facili-

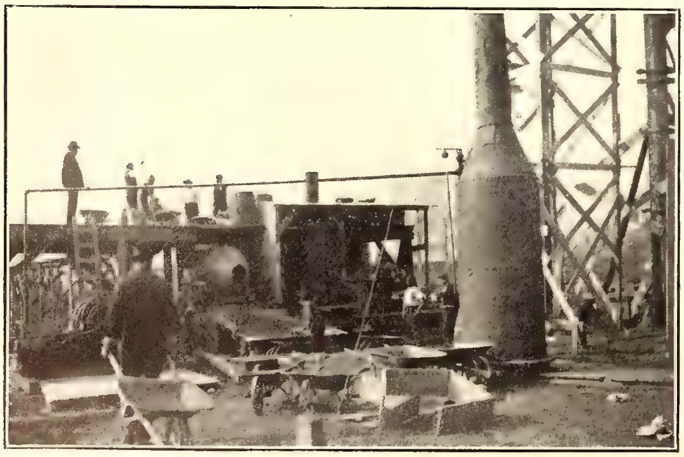


FIG. 7.—CONCRETE MIXING PLANT AND ELEVATOR

ties of the shop are excellent, four large windows being provided in each bay, while the building itself, both inside and out, has been left with the natural cement finish. The soft gray light diffused throughout the shop is very restful to the eye.

The floor of the shop and of the pits is of concrete, while the pit tracks themselves are carried on reinforced concrete posts 6 ins. in diameter, spaced 3 ft. 9 ins. centers, longitudinally. The pits extend the entire length of the building, with the exception of 45 ft. at the front end of each bay, which portion has a well-drained concrete floor, and is provided with hose

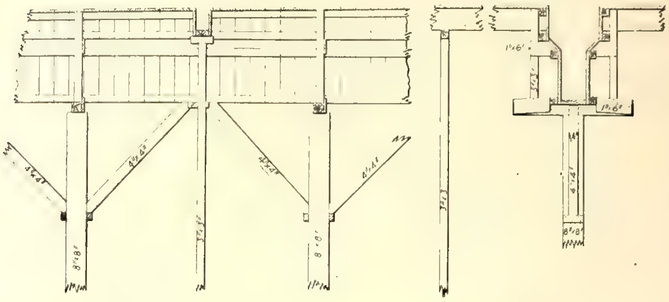


FIG. 8.—DETAIL OF GIRDER CENTERING

connections between each track for washing the cars. Concrete steps lead up from the pits at each end. The space between the tracks is open beneath the floor, thereby giv-

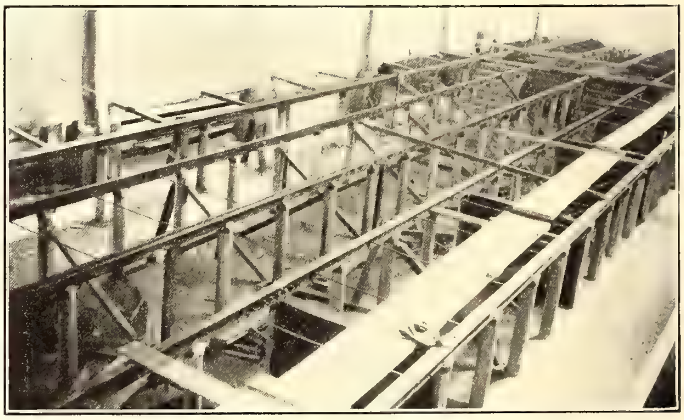


FIG. 9.—METHOD OF SUPPORTING PIT TRACKS ON REINFORCED CONCRETE POSTS, CONCRETE STEPS AND CASE WALLS BETWEEN PITS

ing ample room for easy passage between the car pits.

The floor of the carpenter shop is of 1-in. matched maple on 1-in. rough hemlock boards laid on stringers. In the ex-

FIG. 10.—MAKING HEXAGONAL COLUMNS FOR THE CAR HOUSE

treme rear end of the paint shop the floor is cemented and provided with drains so that cars may be washed.

The storeroom and blacksmith shop is located in a wing 60

ft. x 72 ft., placed nearly central with the repair shop, the supply room having a concrete floor and partition walls. The shop foreman has an office at this point, with a fully glazed bay window extending 5 ft. into the repair shop, so that he can have a full view of practically the entire repair shop and all operations therein.

DETAILS OF CONSTRUCTION

As will be seen by the plan and cross sections, the car house, composed of two bays, 37-ft. span center to center each, and 360 ft. long, divides into twenty-four bays of 15 ft. each. Each bay contains three tracks, spaced 11 ft. centers. The headroom from the floor to the under side of the roof girder is 16 ft. 6 ins. Curves lead from every track, both front and back, to a siding on the company's property. At present this building provides only sufficient room for the fifty-six active cars; summer and winter cars are now being stored in the Third Street car house. A novel feature of this car house is the method of hanging the doors by means of a 2½-in. x ½-in. steel strap hinge, formed to fit around 5-in. wrought-iron pipe posts resting on collars secured to the posts by bolts, the doors themselves being 3 ins. thick. The hinges are offset in such a way as to allow the two wings hanging from each post when open to fold flat against each other, thus giving the maximum possible clearance for cars. Swinging wooden doors were selected in preference to rolling steel shutters, on account of the greater ease and quickness of opening in case of fire. The drainage system embraces the use of cast-iron trapped drain boxes placed in pits between the tracks at frequent intervals, while all down spouts, which are of cast-iron soil pipe, lead directly to the sewers. All drains lead directly to a common main sewer, located midway between the shop and car house, which connects with the city system at a manhole in Cameron Street.

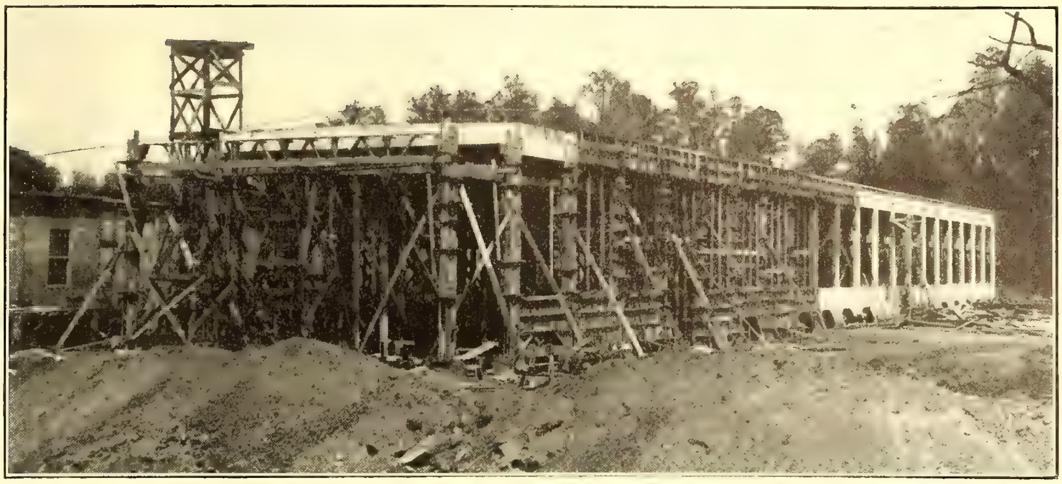


FIG. 11.—VIEW SHOWING THE "PROGRESSIVE" CONSTRUCTION OF THE SHOP

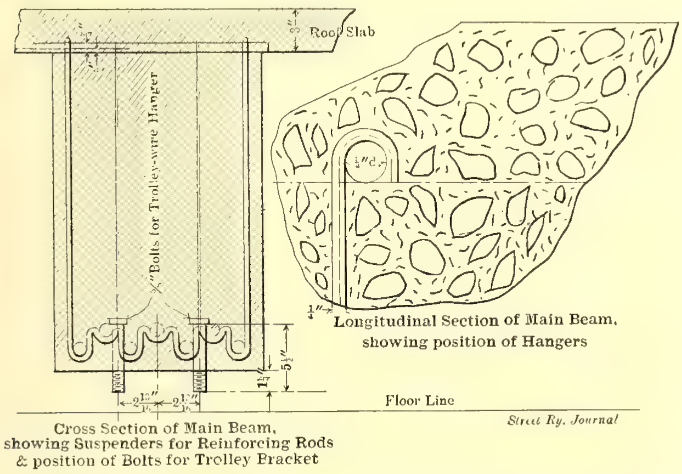


FIG. 12.—SOME DETAIL WORK IN THE CENTRAL PENNSYLVANIA TRACTION COMPANY'S NEW CAR HOUSES

The shop has a span of 46 ft. 7¼ ins., and is 375 ft. long, with one T 60 ft. x 72 ft. for the blacksmith shop and a store house, and a leanto 16 ft. wide and 90 ft. long for the armature winding room, and one leanto 18 ft. x 60 ft. for the boiler and heating apparatus. The surface of the ground on which these buildings are located was from 2 ft. to 10 ft. below floor level, thus greatly increasing the height of the centering supports. The column forms, which were hexagonal in the case of the car house and octagonal for the shop (all with 8-in. faces), were built horizontally on the ground and raised by hand, as will be seen in Fig. 10. Sufficient lumber was bought for centering up about one-half of the car house, and as the concreting proceeded, the first forms were taken down, carried forward and re-erected, as may be noted in Fig. 6. The lumber, which was all

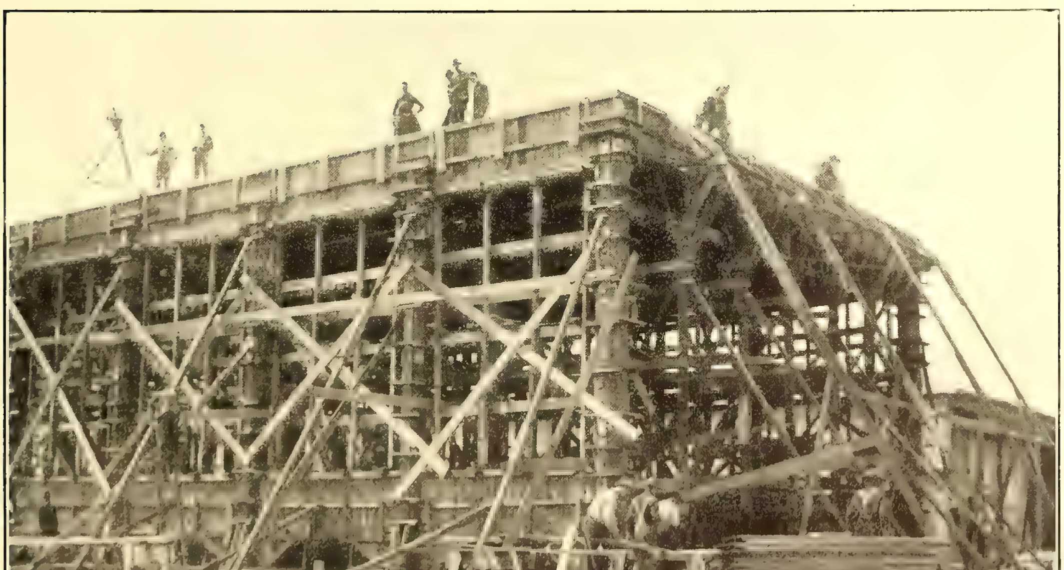


FIG. 13.—CENTERING FOR SHOP; HOISTING THE REINFORCING RODS

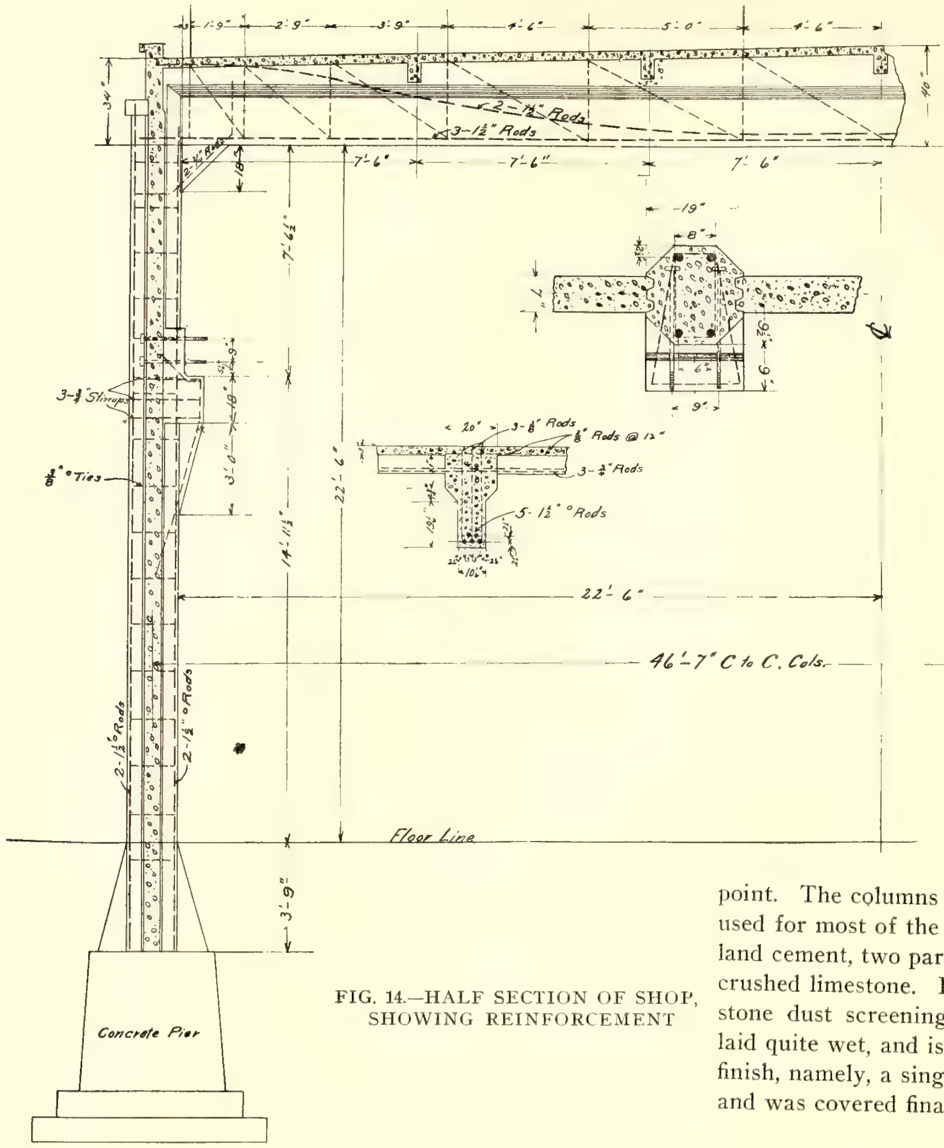


FIG. 14.—HALF SECTION OF SHOP, SHOWING REINFORCEMENT

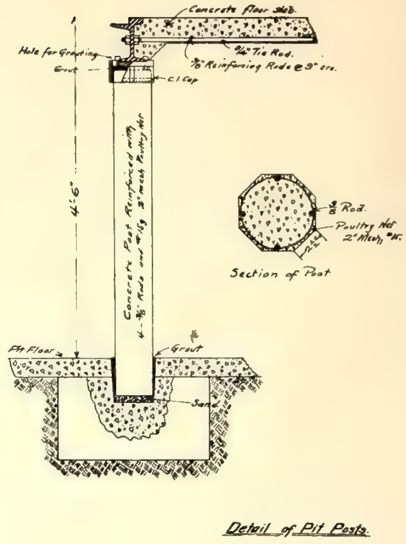


FIG. 16.—DETAIL OF PIT POSTS

hemlock, was used as often as six times. In this manner the columns, main girders and roof slabs were constructed, with a longitudinal girder both at the top and the bottom of the columns, which was utilized later as a means of holding the wall forms in place. The Smith concrete mixer used was located centrally and moved about from place to place as the construction proceeded, the ingredients being dumped directly into the hopper of the mixer from wheelbarrows. The concrete, which was made quite wet, was shoveled into wheelbarrows, hoisted to the roof and carried directly to the required point. The columns were all filled from the top. The mixture used for most of the work consisted of one part "Giant" Portland cement, two parts Susquehanna River sand and four parts crushed limestone. For the roof slab the sand was replaced by stone dust screenings. The slab, which is 3 ins. thick, was laid quite wet, and is nearly impervious. It was given but one finish, namely, a single good troweling closely after concreting, and was covered finally with a coat of roofing pitch.

REINFORCEMENT

As the car house roof was carried by three rows of columns rising 16 ft. 6 ins. above the ground, it was not considered necessary to use any reinforcement in them. The main girders were reinforced with seven 1¼-in. round steel bars, five of which lay parallel to the bottom of the girder and two having their ends raised to the level of the top of the girders. These rods were carried by hangers of the special form shown in Fig. 12, made of 1¼-in. round iron, the rods being all suspended in the

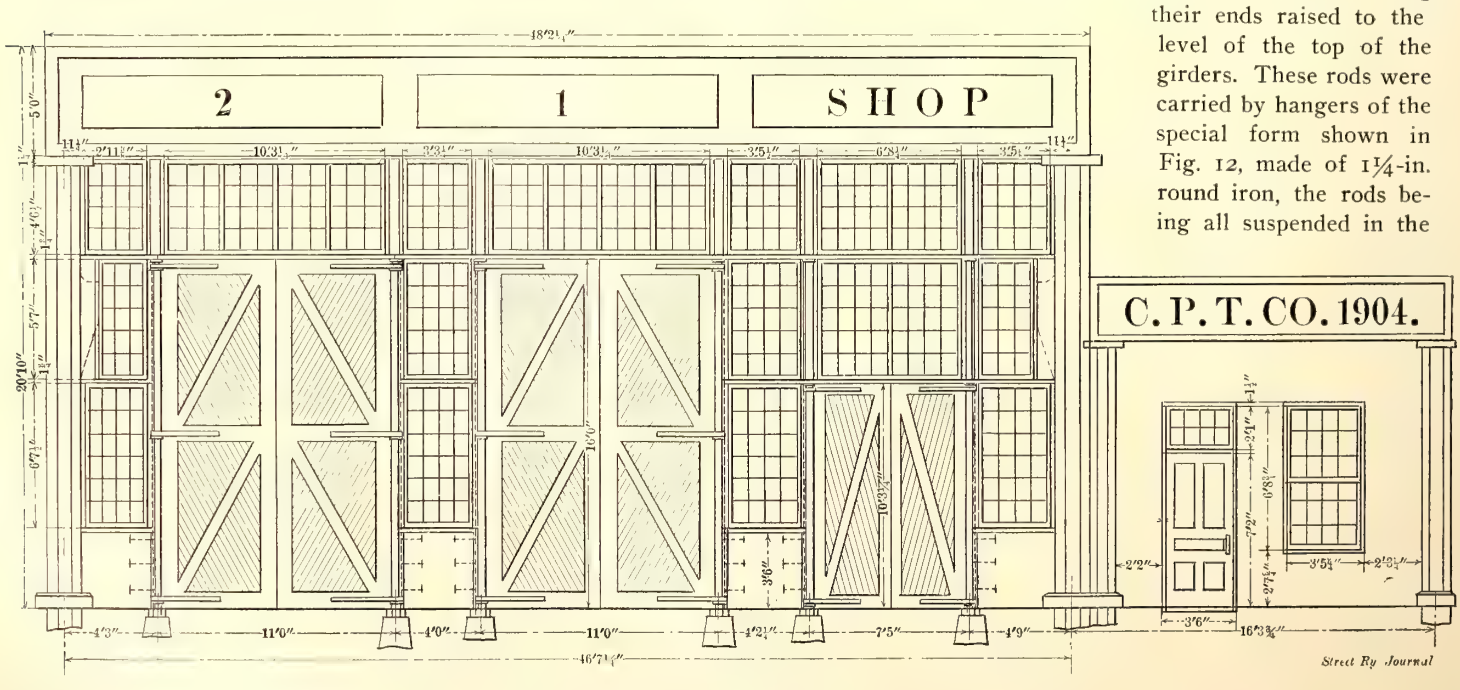


FIG. 15.—FRONT ELEVATION OF CAR HOUSE BUILT FOR THE CENTRAL PENNSYLVANIA TRACTION COMPANY

girder boxes before any concrete was placed. This method of placing the reinforcement was not entirely satisfactory, as it was found that even with wet concrete voids would be left owing to dumping too much concrete at one time; hence the method of placing a layer of concrete 3 ins. deep along the full length of the girders was adopted before placing the rods. This proved more satisfactory. The longitudinal beams supporting the roof slabs are reinforced with three ¾-in. plain round bars, while the roof slab is reinforced with ⅜-in. rods. The roof has a slope of 1 in. in 3 ft.

The columns for the repair shop, owing to their greater height and their having to carry the eccentric crane load, were reinforced with four 1½-in. rods tied together at 18-in. intervals with a bridle of ¼-in. iron, formed with a complete loop at each corner, snugly fitting the vertical rods. The crane brackets were further reinforced with ¾-in. round bridles which were attached to the vertical rods near the outer face of the columns. A departure from the usual practice was adopted in the case of the roof girders, in that they were made with the heavy top chord or T-section shown in Fig. 14, the reinforcement consisting of five 1½-in. plain round bars, on the three lower rods of which was formed a truss of ⅜-in. round rods; the trussing from the center of the beam to the outer end is of one piece, the roof slab being reinforced as on the car house building. The skeleton continuous method of construction was also followed in this case, columns and roofing being placed at one time and the wall space containing the window frames filled in later.

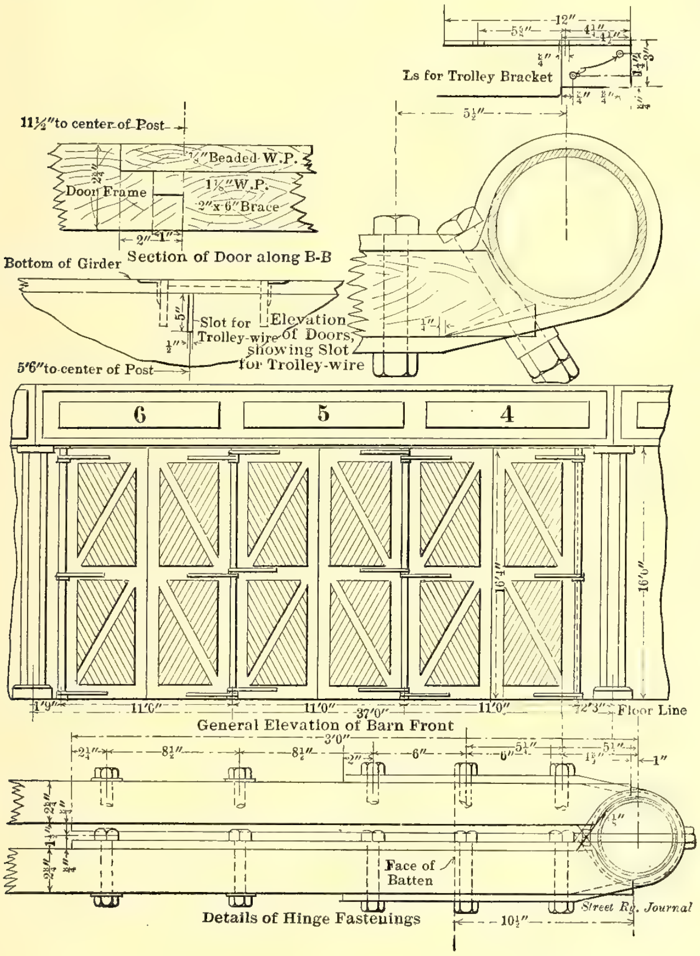


FIG. 17.—CONSTRUCTION DETAILS OF CAR HOUSE

An interesting detail is shown in the construction of the pit tracks, which were supported on reinforced concrete posts 6 ins. in diameter, the reinforcing consisting of four ⅜-in. rods vertically with a 2-in. mesh No. 15 wire poultry netting cylinder. These posts, of course, could not be made in place. They were cast in octagonal wooden forms similar to the main columns of the building, about 1000 being required in all. As previously stated, these posts are spaced 3 ft. 9 ins. center to center, longitudinally of the building, carrying a 6-in. girder rail in the car house and a 7-in. girder rail in the shop. The floor space between tracks is filled with reinforced concrete slab, and a concrete cross wall 6 ins. thick is placed at 15 ft. intervals for lateral stiffness.

The carpenter shop is floored with maple, but all other floors are of concrete. The shop building, which was constructed last, is made entirely of stone dust concrete, as it was found that this gave a much denser and stronger concrete, and also came from the forms with a smoother surface and sharp corners.

FIRE PROTECTION AND WATER SUPPLY

The fire protection and water supply consists of a 6-in. cast-iron main laid in the space between the shop and the car house, with 4-in. branches extending into each building, leading to fire hose carried on reels. Each reel contains 50 ft. of 2-in. cotton hose, and there are three in each car house and six located at different points throughout the shop, all being easily accessible to the doors.

HEATING SYSTEM

All of the buildings are heated through underground ducts. The larger size ducts are constructed of concrete and the smaller sizes of terra-cotta pipe in the storeroom, blacksmith shop, winding room and men's room. In the car house, where the pipes come up above the floor, the warm air is distributed through galvanized piping overhead. The repair shop and car house are heated by warm air delivered through the pit walls into the pits through 12-in. openings. It is the intention to have 12-in. diameter canvas hose with galvanized-iron sleeves which will fit into these openings, and by means of which the hot air can be directed against the under part of the cars, thus enabling them to be more quickly thawed out in emergencies. It is believed that this method of heating through the pits will not only make them more comfortable to work in than is usually the case, but that the building will be heated more uniformly. Steam for the heating apparatus is supplied from a 72-in. x 18-ft. tubular boiler having a 30-in. x 70-ft. wrought-iron stack. A 10-ft. Sturtevant motor-driven fan is employed.

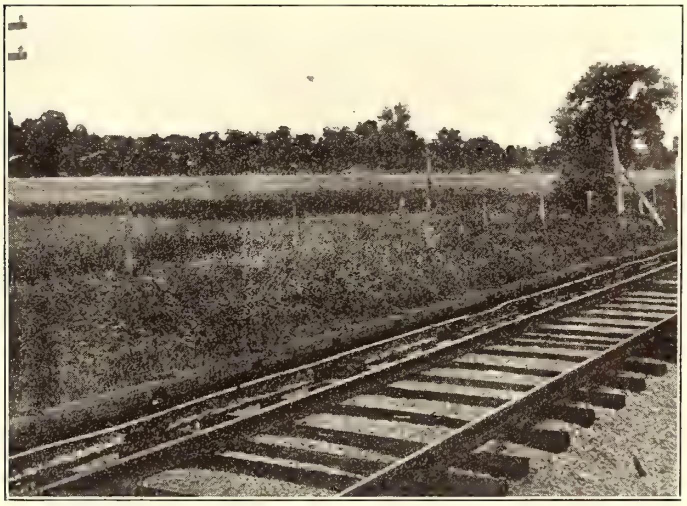
EMPLOYEES' ROOM

Accommodation for the motormen and conductors is provided in a room at the south side of the south car house, 75 ft. x 16 ft., in which will be placed individual steel lockers and an excellent lavatory. There will also be provision for reading matter and games.

President Mathew Slush, of the Detroit, Monroe & Toledo Short Line, recently hit upon a novel method of advertising the company's resort at Monroe Piers. He obtained permission from the managers of each of the different roads out of Toledo to run a special car over the road, not stating for what purpose it was intended. He took personal charge of the various trips and plastered every fence, post and building, wherever it was possible to stop a car, with posters calling attention to his resort. He also called on the newspapers in each town and arranged for an excursion on a certain date. Each manager and his assistants were invited to participate in the outing at Monroe Piers. All the towns within a radius of 50 miles of Toledo were represented by newspaper men and the outing wound up with a fine fish dinner at the Piers Hotel. The company has spent in the neighborhood of $60,000 in improving this resort this season, including the erection of a casino building, bath house and special attractions, and it is proving one of the most popular resorts on the lake district. As a result of the advertising campaign mentioned, all of the Toledo roads have been sending special excursion parties to the Piers in their own cars.

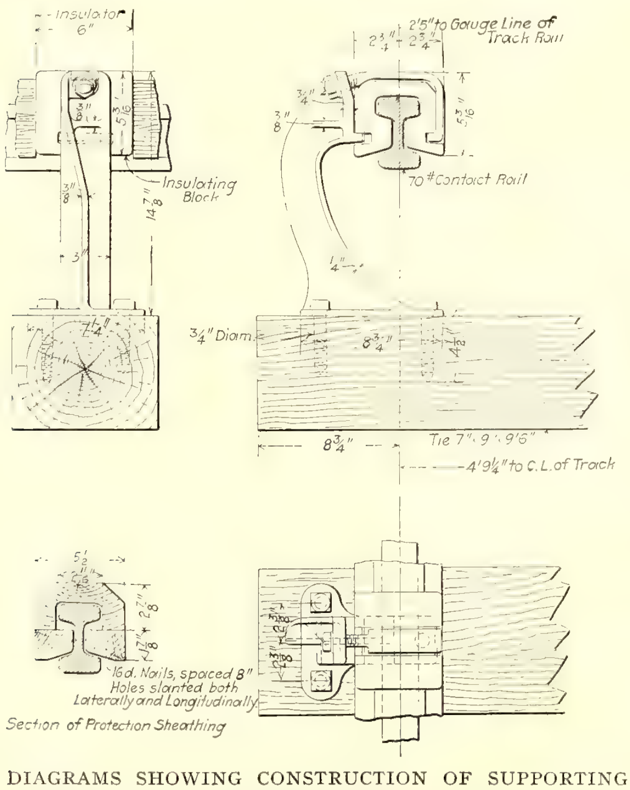
UNDER-CONTACT THIRD RAIL FOR THE NEW YORK CENTRAL

After extended experiments with various types of third rail on its experimental track near Schenectady, and an exhaustive study of the subject, the Electric Traction Commission of the New York Central Railroad has decided upon the adoption, for its New York City electrical zone, of the under-contact third rail illustrated in the accompanying en-



EXPERIMENTAL TRACK NEAR SCHENECTADY, WITH TOP-CONTACT PROTECTED RAIL

gravings. The third rail, as shown, is supported every 11 ft. by iron brackets, which hold the insulation blocks by a special clamp. The blocks, which are in two pieces, are 6 ins. long, and are designed so as to be interchangeable. Experiments

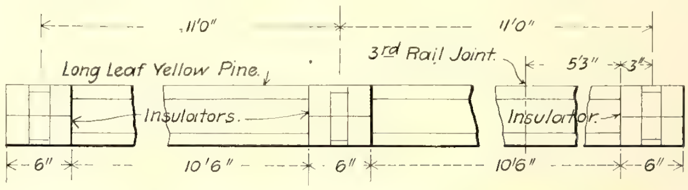


DIAGRAMS SHOWING CONSTRUCTION OF SUPPORTING BRACKET, INSULATOR, THIRD RAIL AND WOODEN SHEATHING USED BETWEEN SUPPORTING BRACKETS

are now being conducted with insulators of reconstructed granite, vitrified clay, rubber and indurated fibre to determine the relative advantages of these materials for the conditions. Between the supporting brackets the upper part of the rail is covered by wooden sheathing. This sheathing, as shown, is applied in three parts, which are nailed together. At the joints where the third rails are bonded, and at the feeder taps, the wooden sheathing is mortised.

To afford the same clearance as would be permitted with a top-contact protected type of third rail, such as used on the Long Island Railroad, the New York Central third rail requires a location of from ½ in. to ¾ in. further out, but to secure a wider clearance, the New York Central engineers have decided to place the rail 1½ ins. further from the gage line, or a total of 29 ins. This difference will not preclude the interchange of equipment with a suitable shoe which can be arranged so as to pass automatically from the under-contact to the top-contact third rail, and vice versa. The under surface of the New York Central third rail is 2¾ ins. above the top of the service rail, while the upper surface of the Long Island third rail is 3½ ins. above the top of the service rail. This difference can be taken up automatically by the spring pressure due to the shoe sliding on its under and upper surface in each respective case.

The principal reason for adopting the under-contact rail is that it can be more thoroughly protected, and hence is safer than the ordinary type of contact rail. There are no projecting live edges or bolts, and no slot between the third rail and its cover through which an animal or any person ignorant of danger can make contact with the live conductor. The only possibility of reaching the third rail is from below and by an upward movement, and this fact, it is thought, greatly decreases the chance of injury from shock. Other advantages which it



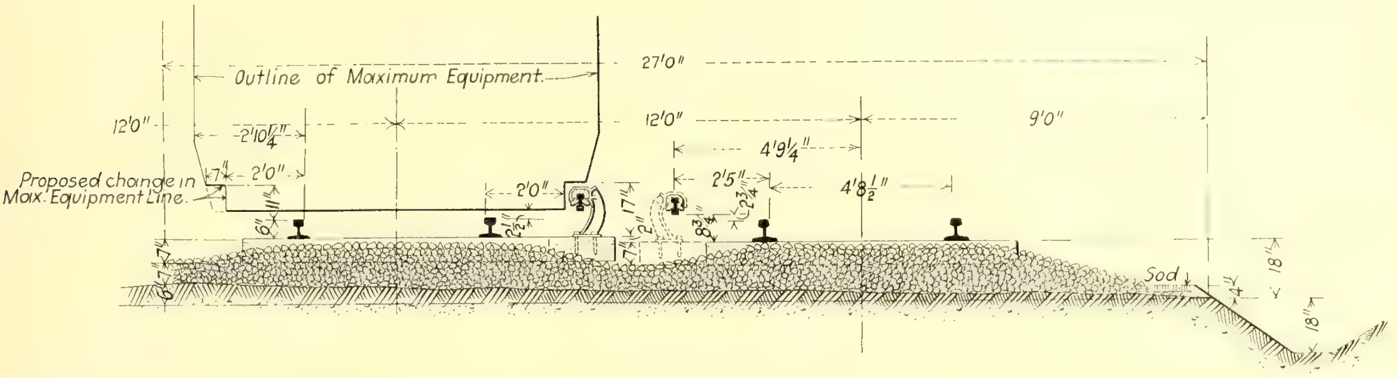
PLAN OF THIRD-RAIL CONSTRUCTION, SHOWING SPACING OF SUPPORTING BRACKETS

EXPERIMENTAL TRACK NEAR SCHENECTADY, WITH UNDER-CONTACT THIRD-RAIL—THE TYPE NOW ADOPTED

is claimed are possessed by this arrangement over the ordinary type of third rail are: (1) There is less strain on the insulators, as the pressure from the shoe acts against instead of with gravity; (2) the board protection, having a continuous support, is less apt to crack and warp; (3) the rail is more protected from the weather, and hence less liable to corrode; (4) the contact surface is more thoroughly protected from sleet and snow; (5) the construction is self-cleaning, and as there is a much greater space between the lower portion of the third

rail and the tie, there will be less danger of an accumulation of snow, ice and rubbish, and consequently less leakage.

The system is the joint invention of W. J. Wilgus, fifth vice-president of the New York Central Railroad Company, and Frank J. Sprague, who is a member of the Electric Traction Commission of the company. The working details of the system have been developed under their direction by E. B. Katte, electrical engineer of the company, and a complete and satisfactory system of crossings, switches, approaches, etc., has been designed.



HALF CROSS SECTION OF FOUR-TRACK NEW YORK CENTRAL LINES, SHOWING POSITION OF UNDER-CONTACT THIRD RAIL

The third rail is not mounted rigidly in the insulators, but is given a little play for expansion and contraction, except at certain central points, where it is anchored. It weighs 70 lbs. per yard, is of special section and composition, and has a resistivity between seven and eight times that of copper. The accompanying views show sections of track near Schenectady equipped with the new and old systems.

THE WEST SHORE ORDER AWARDED

Contracts have been awarded for the electrical equipment of the West Shore Railroad from Utica to Syracuse. This is in line with the plans of the Andrews-Vanderbilt New York Central interests for interurban electric service across New York State. Contracts were placed with the General Electric Company for motor equipments and sub-station apparatus. The placing of the latter contracts settles the much vexed question of whether or not the single-phase a. c. system would be adopted in this electrification work. The contracts indicate that it will not. The present contract is for four sub-stations, each to have four 300-kw rotary converters.

The kind of contact for the cars has not been decided upon; the engineers are still undecided between third-rail and a side-contact system. As intimated some time ago, an overhead trolley was considered undesirable because of the gases arising from steam locomotives, and because of the danger to trainmen on top of freight cars. The line voltage therefore will be in common with that of the Utica & Mohawk Valley, with which the Syracuse-Utica line will be connected. The West Shore between these points is being four- tracked, and two tracks will be equipped for electricity. The work is to start in the very near future. The West Shore through passenger trains between these points will be diverted to the New York Central tracks; in fact, this is being done very largely at the present time. Freight trains will continue to operate as heretofore. Four 125-hp motors will be the car equipment, and the GE type M control will be used, as it is proposed to run the cars in trains of three or four. In entering the streets it will be necessary, of course, to cut the trains and operate the cars through cities singly.

It was intimated some time ago that the Auburn branch would be electrified to fill the gap between Syracuse and Rochester. This plan has been modified. Instead the syndicate has acquired the Rochester & Eastern Railway, operating from Rochester to Geneva, 50 miles. The 50 miles from Geneva to Syracuse will be filled either by electrifying that portion of the Auburn branch or building a separate line. Between Rochester and Buffalo the syndicate has no plans that it cares to speak of at present, but the West Shore tracks could be utilized. As outlined this gives a continuous line from Rochester to Little Falls, a distance of about 160 miles, the plan for operation of which has been fully determined upon. As is generally known, the syndicate owns the Schenectady Railway, operating a 14-mile line from Schenectady to Albany, with other lines to Troy and Ballston Spa. From Schenectady westward to Tribes Hill, 22 miles, is the fine double-track line of the Fonda, Johnstown & Gloversville Railway. It is denied that this system has been acquired, but it seems reasonable to suppose that it will come into the chain when the links are connected up. From Tribes Hill to Little Falls, 35 miles, there is no line at present.

At the present time the Utica & Mohawk Valley leases power from the Trenton Falls water-power. This service will be abandoned as soon as the 33,000-volt transmission lines from the plants of the Hudson River Power Company near Lake George, and which are now supplying the Schenectady system, are extended westward to Syracuse, giving a transmission line of about 126 miles. From Syracuse westward the power will be supplied by Niagara Falls power, a contract having recently been made with the Ontario Power Company.

Under the plans outlined, it is apparent that the local traffic through Central New York is to be taken care of by means of frequent service on these interurban lines, but there is nothing to indicate that at the present time the New York Central has plans for electrifying its main lines for the through passenger service. The electrification which is being done out of New York City is simply to improve the metropolitan terminal facilities and suburban service.

Montreal, and particularly the east end of the city, was in gala attire a few evenings ago in honor of the opening of the second annual picnic of the Montreal Street Railway Mutual Benefit Association at Riverside Park. Fully 10,000 people attended the opening, but the event of the twenty-four hours was easily the electric car street parade in the evening. Some thirty cars, strung with lanterns, brightly illuminated with electric bulbs and bedecked with flags and bunting, took part, the various sections of the city being covered with different divisions, the whole finally getting into one long line and proceeding east to Riverside Park, which was literally jammed with people. Aside from the vaudeville programme, there were various sports which interested the thousands of people both afternoon and evening. There were tugs of war between the various branches of the service, these to be continued throughout the week, a handsome prize going to the champions, while the hose-coupling competition in the afternoon attracted a great deal of attention.

PROPOSED CONSTITUTION AND BY-LAWS OF THE AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION

CONSTITUTION

NAME AND LOCATION

I. a. The name of the association shall be the "American Street and Interurban Railway Association."

b. The headquarters of the association shall be located in the city of New York.

OBJECTS

II. The objects of the association shall be as follows:

a. The discussion and recommendation of methods of construction, management and operation of street and interurban railways, and of safeguarding the interests of the same.

b. The establishment and maintenance of a spirit of co-operation among the members, and the encouragement of friendly relations between the companies and the public.

c. The acquisition of experimental, statistical and scientific knowledge relating to the construction, equipment and operation of street and interurban railways, and the diffusion of this knowledge among the members.

MEMBERS

III. The membership of this association shall consist of two classes, as follows:

a. Active members, consisting of American street and interurban railway companies, or lessees, or individual owners of street and interurban railways. Each member shall be entitled to one vote, which shall be cast by the properly accredited delegate.

b. Associate members, consisting of individuals who are or have been at some time actively identified with street and interurban railway interests, and other persons who in the opinion of the executive committee have had experience of such a nature as to render desirable their connection with the association. The privileges of the associate members shall be similar to those of the active members, excepting that they shall not be entitled to vote or hold office, nor shall they have the privileges of the floor unless permitted by the association.

AMENDMENT

IV. This constitution may be amended by a two-thirds vote of the members present at a regular meeting, provided the proposed amendment shall have the approval of the executive committee, and provided that a copy shall have been sent to each of the active members at least thirty days prior to the date of the meeting at which the proposed amendment is to be acted upon.

BY-LAWS

ELECTION OF MEMBERS

I. Every applicant shall signify his desire to the secretary, enclosing the requisite fee. All applications for membership shall be referred to the executive committee, a two-thirds vote of the members of the executive committee by ballot being necessary to election. In case of rejection, the membership fee shall be returned. The executive committee shall report at each meeting the names of new members elected.

OFFICERS

II. a. The officers shall consist of a president, vice-presidents equal in number to the number of affiliated associations, a treasurer and a secretary. The officers shall assume their duties immediately after the meeting at which they are elected.

b. The president, vice-presidents and treasurer of the association shall be elected at the annual meeting of the association. All such elections shall be by ballot, and a majority of the votes of all members present shall be necessary to an election. The secretary shall be appointed by the executive committee.

PRESIDENT AND VICE-PRESIDENTS

III. The president shall be the chief executive officer of the association. He shall preside at the meetings of the association and of the executive committee. In the absence of the president, any duties devolving upon him may be performed by one of the vice-presidents.

TREASURER

IV. The duties of the treasurer shall be to receive, safely keep and account for all moneys of the association; to keep correct accounts of the same, and to pay all bills approved by the president. He shall make an annual report to be submitted to the association. He shall give a bond to the president in such sum, and with such sureties, as shall be approved by the executive committee. He shall be paid a salary fixed by the executive committee.

SECRETARY

V. The duties of the secretary shall be as follows:

a. To take minutes of all proceedings of the association and of the executive committee and to enter them in books proper for the purpose.

b. To conduct the correspondence of the association.

c. To read minutes and notices at all meetings, and to present papers and communications if the authors wish it.

d. To collect and file for the benefit of the members information and statistics regarding matters relating to the purposes of the association.

e. To receive applications for membership and to lay such before the executive committee.

f. To attend to the publication of the proceedings of this association; and, in conjunction with the secretaries of the affiliated associations, to the publication of the proceedings of such affiliated associations.

g. To send notices to all members of the association at least thirty days before each meeting, mentioning papers to be read and any special business to be brought before the meeting.

h. To perform such other duties as may be required of him by the constitution and by-laws, and such duties as may be assigned him by the executive committee.

The office of the secretary shall be maintained at the headquarters of the association. He shall be paid a salary fixed by the executive committee. He may or may not be in the employ of an active member of the association.

THE EXECUTIVE COMMITTEE

VI. a. The entire charge and management of the affairs of the association shall be in the hands of an executive committee, which shall consist of the president, the vice-presidents and one member appointed by each of the affiliated associations. The executive committee shall make arrangements for carrying out the objects of the association.

b. The executive committee shall hold a regular meeting before each regular annual meeting of the association, and shall hold such special meetings as may be necessary. Such special meetings may be called by the president or any five members of the executive committee. Five members of the executive committee shall constitute a quorum at all meetings.

The secretary shall give such reasonable notice of all meetings as the committee shall by vote prescribe, and all such notices shall specify the business to be brought to the attention of the committee at such meetings.

c. The executive committee may assign to its allied association, the American Street Railway Manufacturers' Association, the management of the exhibit features of the annual conventions, and it may arrange with the said Manufacturers' Association the details of such entertainments as may be given in connection with the annual conventions of this association.

d. The executive committee shall present a report to each regular annual meeting of the association, and shall include

in such report the names of members elected during the year, and its recommendations for the future work of the association.

MEETINGS

VII. a. Regular annual meetings of the association shall be held at such time between the 15th day of September and the 15th day of December, in each year, as the executive committee may decide to be best suited to the locality in which the meeting is to be held; the time to be decided upon and each member notified of the selection by the 1st day of May in the year in which the meeting is to be held. Special meetings may be held upon the order of the executive committee. Notice of every meeting shall be given by the secretary, in a circular addressed to each member, at least thirty days before the time of the meeting. Fifteen members shall constitute a quorum at any meeting.

b. At all meetings of the association discussion shall be limited to active members, provided, however, that special privileges may be accorded others at the will of the meeting.

c. At any regular or special meeting, executive sessions may be held. Such sessions shall be open to active members only.

ORDER OF BUSINESS

VIII. The regular order of business shall be:

1. Reading of minutes of last meeting.
2. Report of the executive committee.
3. Address of the president.
4. Report of the treasurer.
5. Reports of standing committees.
6. Reports of special committees.
7. Reports from affiliated associations.
8. Reading and discussion of papers.
9. General business.
10. Election of officers.

COMMITTEE ON SUBJECTS

IX. In order to secure continuity of work and uniformity of general purpose, a committee on subjects shall be appointed each year by the executive committee. The function of this committee shall be to suggest topics for the work of the American Street and Interurban Railway Association and its affiliated associations for each year in advance.

The committee shall consist of one member from each of the affiliated associations and a number from the American Street and Interurban Railway Association equal to the total number from the affiliated associations. The committee, at each annual meeting, shall present its plans for the coming year.

VOTING

X. All votes except as herein otherwise provided shall be viva voce; and in case of a tie, the presiding officer may vote.

READING OF PAPERS

XI. All papers read at the meetings of the association must relate to matters connected with the objects of the association, and must have been previously approved by the executive committee.

AFFILIATED ASSOCIATIONS

XII. This association shall do all in its power to promote the welfare of other associations organized with its approval to investigate technical matters connected with street and interurban railway construction and operation. To this end it will, in the following way, and in others which may be determined by the executive committee, assist in the work of such affiliated associations:

a. By granting charters to and approving the constitutions of such associations.

b. By admitting to the executive committee a member from each of such associations.

c. By granting financial assistance to such associations for specific purposes.

d. By editing, printing and binding the reports of the proceedings of such associations.

e. Through its secretary and committee it will assist in arranging for conventions, suggesting suitable subjects for investigation; it will file information for reference and distribution, and in every way endeavor to stimulate interest in all of the affiliated associations.

PAPERS, DRAWINGS, ETC.

XIII. All papers, drawings and models submitted to the meetings of the association shall remain the property of the owners; subject, however, to retention by the executive committee for examination and use, but at the owner's risk.

FEES

XIV. Active members shall pay an admission fee of $10 and annual dues, payable in advance, based on gross earnings from railway operation during the preceding fiscal year, as follows:

Gross receipts under $100,000	$25
Gross receipts between $100,000 and $250,000	50
Gross receipts between $250,000 and $500,000	100
Gross receipts between $500,000 and $1,000,000	150
Gross receipts between $1,000,000 and $2,500,000	250
Gross receipts between $2,500,000 and $5,000,000	350
Gross receipts between $5,000,000 and $10,000,000	500
Gross receipts over $10,000,000	600

Associate members shall pay in advance an annual fee of $5.

ARREARS

XV. No member whose annual payment shall be in arrears shall be entitled to vote.

WITHDRAWAL

XVI. Any member may retire from membership by giving written notice to that effect to the secretary and the payment of all annual dues to that date, but shall remain a member and liable to the payment of annual dues until such payments are made, except as hereinafter provided.

EXPULSION

XVII. A member may be expelled from the association by the vote of two-thirds of the members present at any regular meeting of the association, upon the written recommendation of the executive committee.

RULES OF ORDER

XVIII. All rules not provided for in these by-laws shall be those found in Roberts' Rules of Order.

AMENDMENT

XIX. All propositions for adding to or altering any of these by-laws shall be laid before the executive committee, which shall bring them before the next regular meeting of the association, if it shall consider such course desirable; and it shall be the duty of the committee to do so, on the request, in writing, of any five members of the association.

FORM OF CHARTER TO BE GRANTED BY THE AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION

The American Street and Interurban Railway Association, in order to promote the acquisition of experimental, statistical and scientific knowledge relating to the construction, equipment and operation of street and interurban railways, and the diffusion of this knowledge among those persons interested in the improvements of street and interurban railway service and the reduction of its cost, hereby agrees to co-operate in the work of the Street and Interurban Railway —————— Association in the following ways:

1. By admitting to its executive committee a member of the said affiliated association.

2. By granting financial assistance for specific purposes to the said affiliated association.

3. By editing, printing and binding the reports of the proceedings of the said affiliated association.

4. By suggesting subjects for investigation and in every way

encouraging such investigation on the part of the said affiliated association.

5. By managing the details of conventions and other meetings for the said affiliated association.

6. By collecting, filing for reference and distributing such information as may be desired by members of the said affiliated association.

In consideration of this assistance, the .... Association by the acceptance of this charter agrees that the constitution and by-laws of the said affiliated association shall be subject to the approval of the American Street and Interurban Railway Association, and all amendments to and changes in the same shall be subject to such approval; and that the American Street and Interurban Railway Association shall have the right to withdraw its support and assistance whenever, in the judgment of its executive committee, the said .... Association is not satisfactorily accomplishing its objects as stated in Article II. of the constitution of the said affiliated association.

In witness of this agreement, we, the presidents and secretaries of the American Street and Interurban Railway Association and of the .... Association have affixed our signatures hereto, this .... day of ...., 190..

....

Secretary of A. S. I. R. A.

....

Secretary of ....

....

President of A. S. I. R. A.

....

President of ....

EQUIPMENT OF THE NEW PLANK ROAD CAR SHOPS OF THE PUBLIC SERVICE CORPORATION

BY MARTIN SCHREIBER, M. E.

In the July 22 issue of this paper the writer described the general arrangement and construction of the new car shops and houses which the Public Service Corporation of New Jersey is now erecting on the Plank Road, Newark. It has been the aim of the management that these shops should represent the most modern practice and engineering, not only in the buildings themselves, but in their equipment. Several of the shop tools are especially designed so that they will be of more than ordinary interest to those concerned in the maintenance of the rolling stock of street railway systems. The new equipment will embody apparatus to manufacture to a considerable extent as well as to replace the defective parts of the car. The company believes that a combination of such an arrangement with that of standardizing the parts which go to make up the rolling stock is the ideal method for satisfactory and economical maintenance.

Prabably no other railway company has such a severe condition to meet as the Public Service Corporation, on account of the endless variety of both the mechanical and electrical equipment which it has, and which was brought about by the consolidation of so many independent roads. Not only have repairs up to this time been made at different points about the system, but many small parts were obtained from outside sources, so that the management has been not only a victim in a great part to high prices, but has also been handicapped to some extent by unsatisfactory deliveries. However, by the centralizing of the heavy repairs at the new extensive Plank Road shops, with its splendid equipment, the officials of the corporation expect to reduce very materially the cost of operating its 1700 cars.

THE TRUCK SHOP

The accompanying large drawing, which for convenience is reproduced from the previous article already referred to, shows the plan of the machine shop building, where most of the repairs, exclusive of painting and woodwork, are to be made. Along the east side of this building are twenty-one pit tracks equipped with electric car hoists and air jacks, and one pit track arranged with a newly-designed wheel-grinding apparatus. The pit tracks are 80 ft. long, so that when a car body is jacked up over the pits there is ample room to run out the trucks for inspection and overhauling. The illustration on page 342 shows the pits, which are 60 ft. long. This is considered the practical length necessary to take care of the largest size cars in service and still have room in the pits so that the air jacks may be run clear of the car bodies. The pit walls are built entirely of concrete and are solid, and arranged so that they do not connect. Connecting pits were thought undesirable, for the reason that the space between generally forms a lodging place for grease and debris, and also because they are unpopular with the fire underwriters. The rails over the pits are fastened to ties at about 7-ft. 6-in. intervals along the length of the pit. The ties are anchored to the pit walls by ¾-in. anchor bolts 2 ft. long, and extend across between tracks, leaving the pits clear. Four-inch pilasters are placed on the inside of the pit walls at the tie spacing. The pit walls, except at the pilasters, are on a line with the center of the rail. It will be seen that the space between pits was made to suit the driving mechanism of the electrically-operated hoists, and is only 3 ft. 6 ins. deep, while the pits are 4 ft. 6 ins. from the top of the rail to the floor line. The space between pits is covered over at the floor level with steel reinforced concrete.

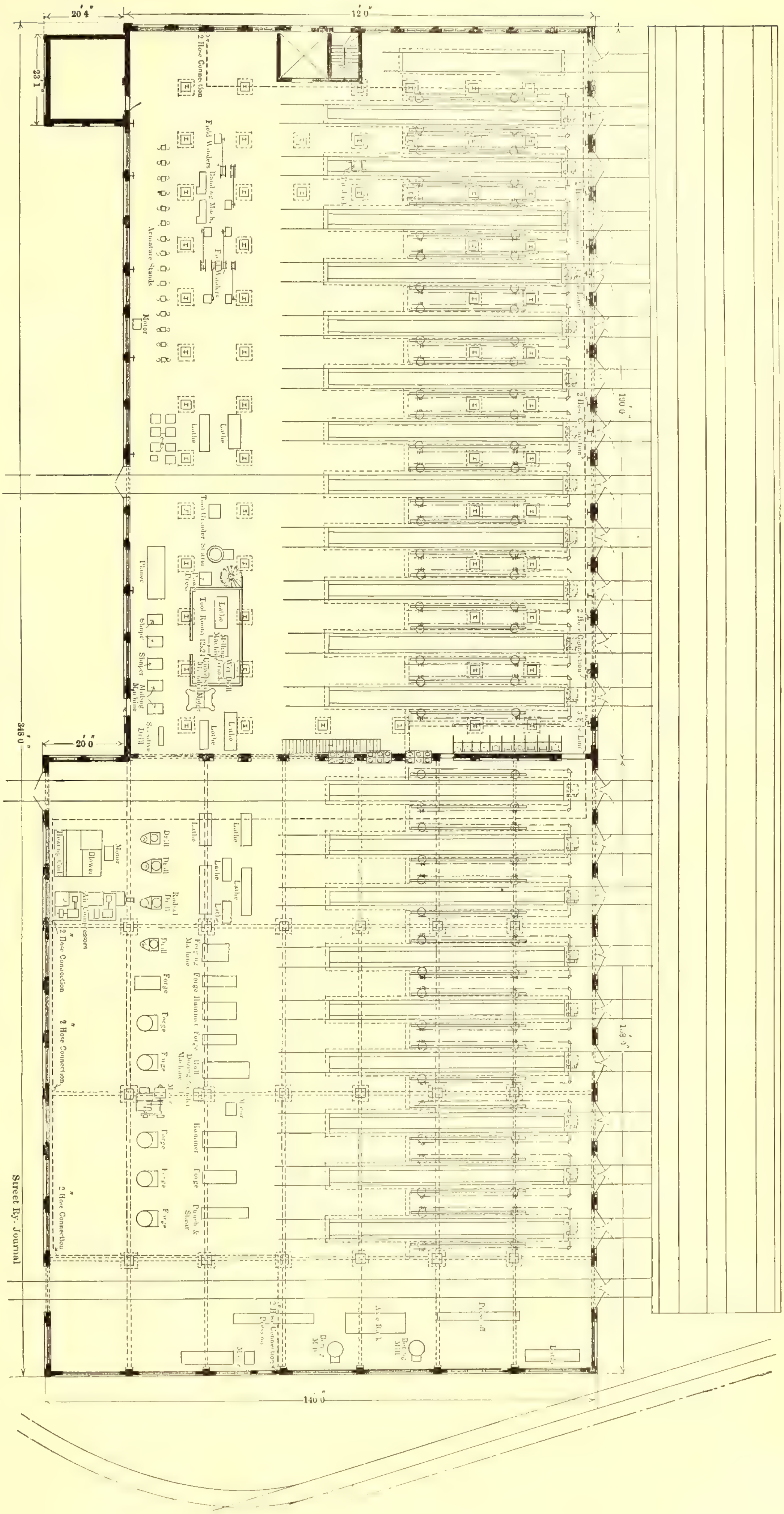
Each hoist has four steel jack screws, which are shown in the diagram on page 342, and are 4 ins. in diameter and 8 ft. long. These screws travel up and down on opposite ends and sides of pits in a case made from a standard 5-in. wrought-iron pipe and filled with lubricating oil, and are installed beneath the floor of the space between pits. The jack screws are operated by cast-steel worm gears that are bushed with threaded brass shells and that rest on a casting with steel balls intervening. The whole forms a step bearing that in turn is bolted to a bed-plate into which is shrunk the casing for the jack screws. The bearing for the cut-steel driving worm is attached to the step bearing of the worm gear. Power for driving the worms is obtained from a Westinghouse No. 3 motor situated in the forward end of the pit, and is transmitted by means of 1 15-16-in. diameter shafts and mitre gearing. The worm shaft will have intermediate bearings about every 5 ft. along the length of the hoist. Reinforced concrete is also used to cover the ends of the pits occupied by the motor, similar to the space between the pits. Each of the jack screws has its upper end slotted to take the 12-in., 30-ft., 31½-lb. I-beam that carries one side of the car. The bottom flanges of the I-beams are coped out so that the web will slip into the slot of the screw shaft. It will be understood by this arrangement that the hoisting mechanism is clear of the pits proper, which are left entirely unencumbered for the workmen. Each pit will also be arranged with a two-way switch and controller. One position of the switch sends a current into the controller for operating car hoist, and the other position makes use of current for running trucks out from under cars and for testing.

At present there are several hoists in use similar to the one described above, except that a sprocket chain is used for transmitting power from the motors instead of the shafts and mitre gears. The shaft driving is superior to the chain drive, inasmuch as the sprocket must cross the pits. In deciding to adopt a suitable hoist, overhead designs were considered, but none was found comparable with the jack screws under the prevailing conditions of single-floor shop. The important features of the hoist adopted are the following: First, it is safe; second, it is positive in its action; third, it is convenient and rapid; fourth, it has a low cost of maintenance; fifth, it takes up

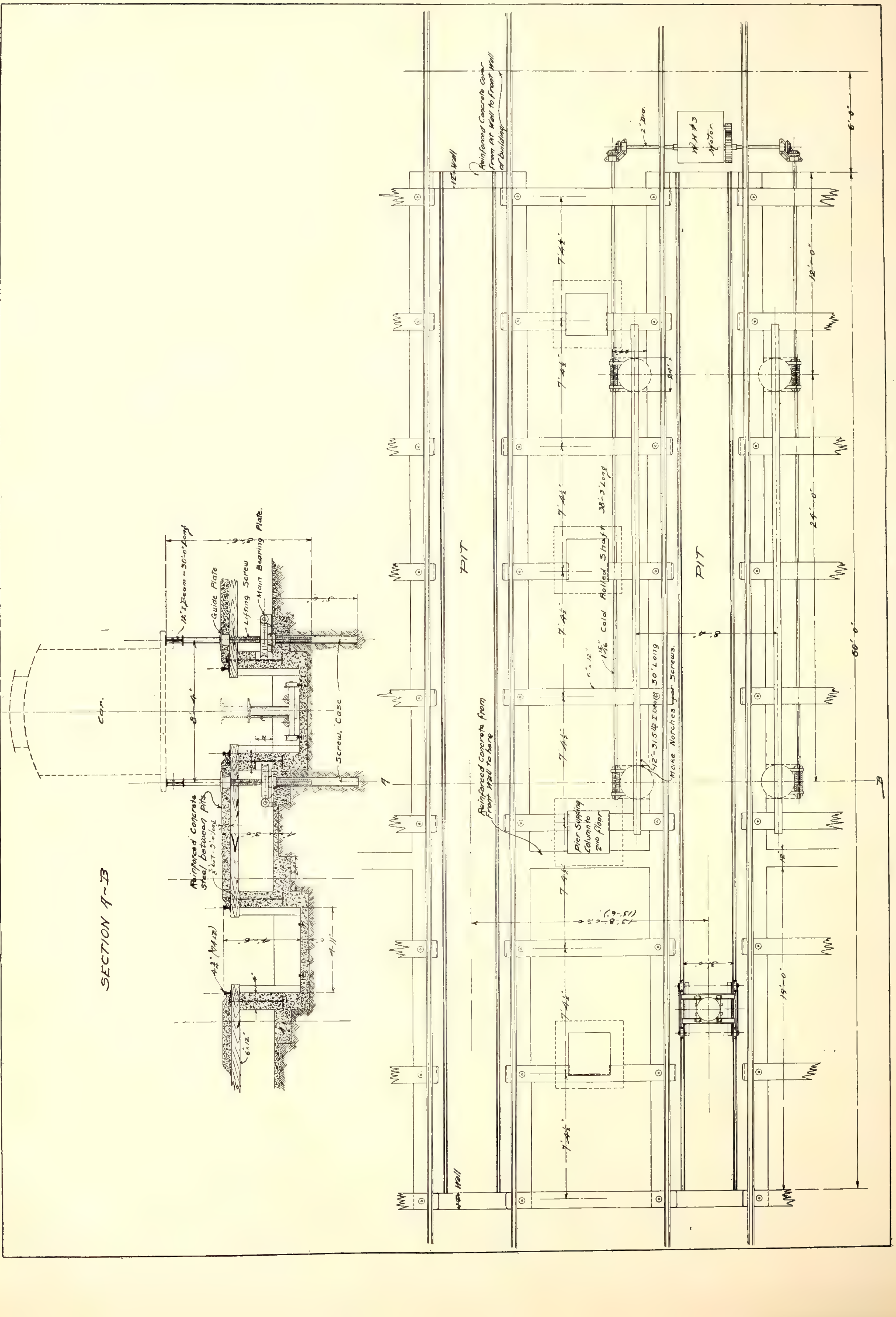
practically no shop space. The Pittsburg Company has the contract to equip the twenty-one pits with the foregoing electric car hoist at a cost of about $15,000. It may be of interest to state that the best figure that could be obtained for hydraulic hoists operating on a similar principle was nearly $40,000.

Each repair pit has a 3-in. T-rail track of 3-ft. gage imbedded in the concrete floor and extending along the whole length. This is installed to accommodate the pneumatic pit jack shown on page 342. The jack is constructed so that it moves transversely on a carriage, and the carriage runs at right angles to the latter direction along the pit track, so that the heavy parts suspended underneath the cars may be placed in position or easily removed. The pit jack can carry its load to one or the other end of the pit and be clear of the hoisted car. From the latter position the repair part may be transferred to the shop floor by means of self-supporting jib cranes that are to be placed at the west end of the space between pits, or the jib cranes may deliver their burden to any surface or overhead traveling device, so that the repair part is put into line for any department of the building. The pneumatic jack has the outside tubing 8 ins. in diameter, and the lift operates through a distance of 30 ins. Air is supplied to the jack by means of a system of ¾-in piping. The American General Engineering Company, of New York, has the order to build twenty-one air jacks according to this design for approximately $4,000.

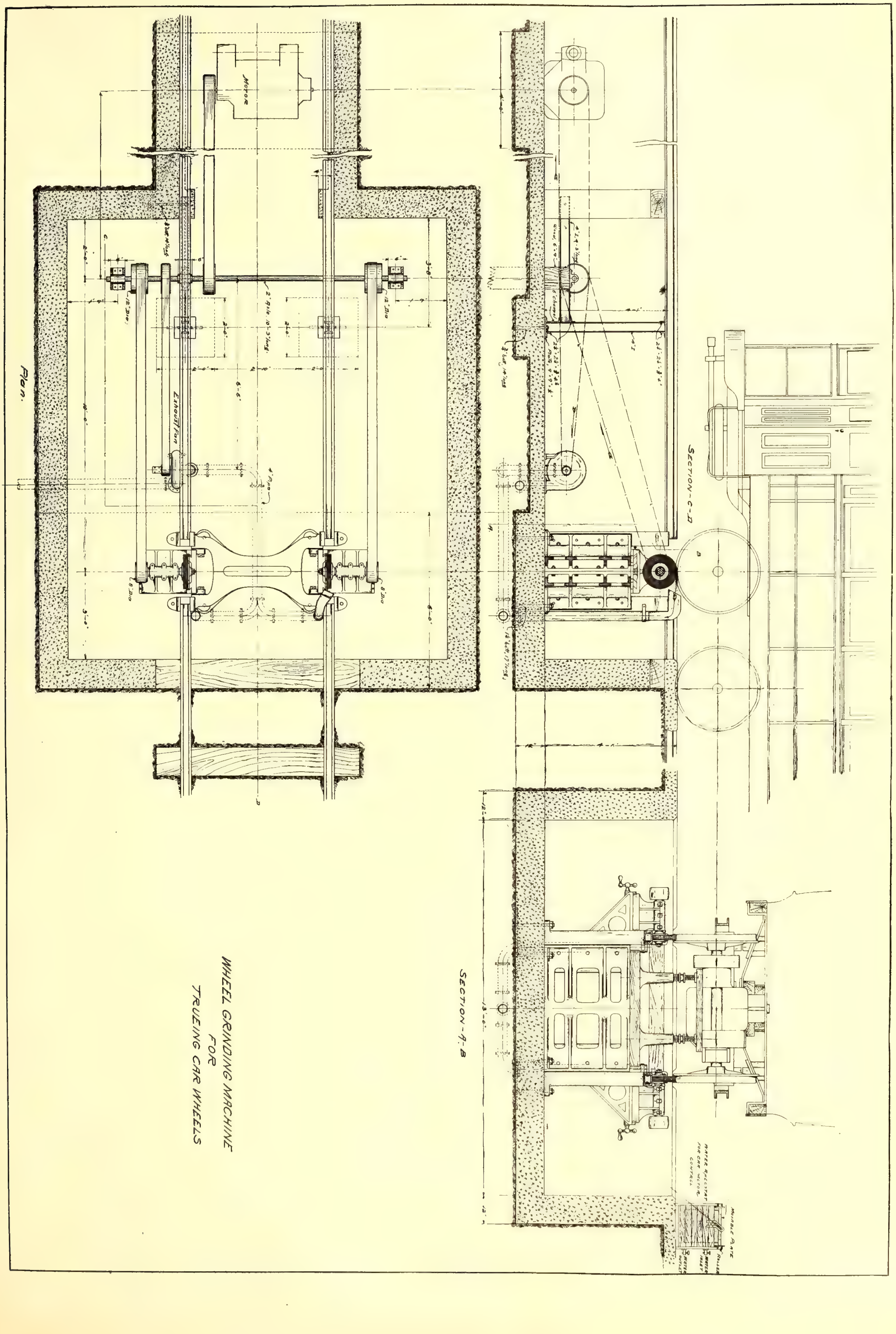
One of the new machine tools of the equipment will be the wheel-grinding machine for the truing of flatted wheels without removing the trucks from the car body,



FLOOR PLAN OF MACHINE SHOP, NEW PLANK ROAD SHOPS



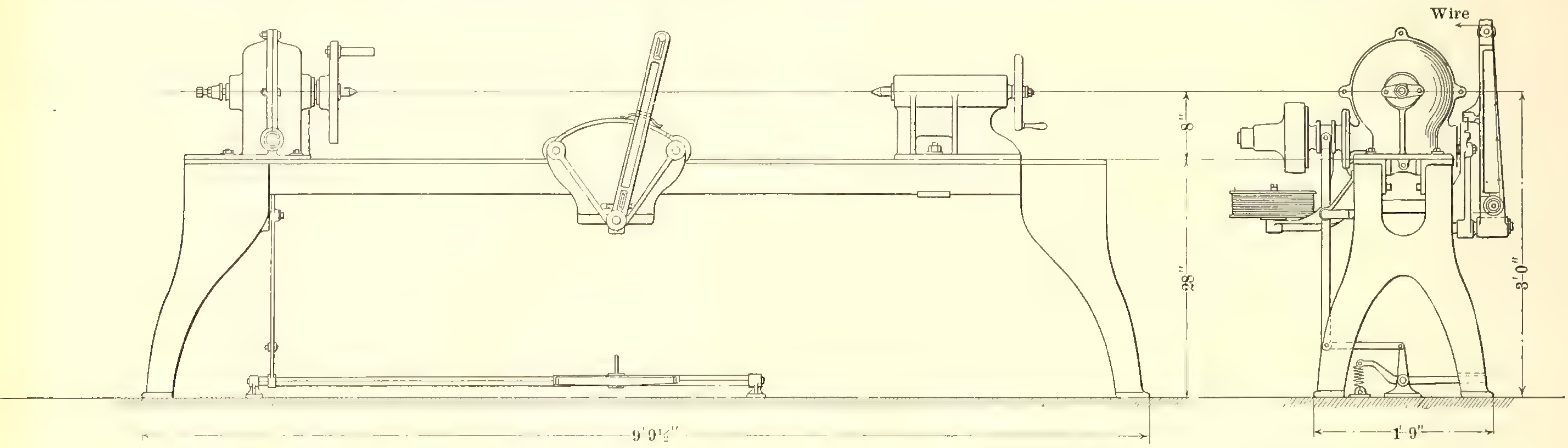
PIT HOIST WITH WORM GEAR FOR RAISING CARS AND HYDRAULIC JACK IN PIT, PLANK ROAD SHOPS

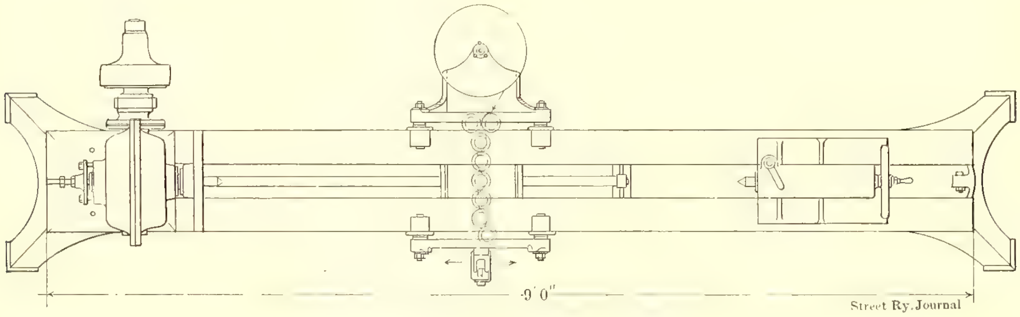

WHEEL GRINDING MACHINE
FOR
TRUEING CAR WHEELS
Plan.
Section-C-D
Section-A-B
Motor
Exhaust Fan

and which is illustrated on page 343. This wheel grinder has recently been patented by the superintendent of rolling equipment of the Public Service Corporation, and is to occupy the extreme north pit of the building. As may be seen from the drawing, a car may be run in over the pit, jacked up and the wheels trued down without any further arranging. Moreover, it is estimated that a pair of wheels may be gotten in shape every twenty minutes—that is, a car coming into the shop with a flat wheel will be turned out again O. K. in that lapse of time. A new wheel grinder is not only to be installed in the main shop, but also in the auxiliary or light overhauling shops, distributed over 550 miles of track. From the illustration it is plain that the longitudinal and vertical slides, giving two movements to the emery wheel on either side, are supported by a single cast-iron frame. This cast-iron frame also affords a firm bearing for the ends of the rails forming the track, as well as rigid and positive positions for the slides. Four foundation bolts fasten the cast-iron frame securely to the concrete in the bottom of the pit. The emery wheels are 14 ins. in diameter with 2-in. face, and are to be driven by two 4-in. belts from a countershaft at a peripheral speed of 5000 ft. per minute. The countershaft is connected by means of a 6-in. belt to a GE 800 motor. Four-inch I-beams are arranged to form a support for the countershaft bearings and to hold up the pit rails. A Buffalo Forge 4-in. exhauster is installed on the floor of the pit to carry away the emery and iron dust, when the machine is operating, through a system of piping, as shown. When a car is brought in to have flats ground down it is first jacked up to clear the wheels and the raised end is held in position by hooking chains on the side frames of the trucks. Then the 500-volt current is introduced into the motors by first passing it through a water rheostat, by which the speed of the flatted wheels can be regulated by varying the distance between the terminal plates. The car wheels rotate in an opposite direction to the wheel grinder. The wheel grinders are manufactured by the Columbia Malleable Iron & Machine Company, of Brooklyn.

THE ELECTRICAL DEPARTMENT

From the plan on page 341, it will be seen that the electric work occupies the space on the northwest side of the building. The intention is to make this equipment as complete as possible. The small addition on the northwest corner comprises the oven and dipping room, the construction of which is to be entirely fireproof. One of the cuts shows the power field winders that are to be used. Six of these machines are already constructed and are working very satisfactory in the old shop. The 1½-in. spindle to which the form is bolted is driven by a worm and gear, which in turn receives its power by engaging a friction cone pulley that is operated by a foot lever. When the foot lever is released, the spindle instantly stops, because the lever spring causes a disengagement of the friction pulley, and also causes the disc of the clutch fastened to the worm shaft to bear against the disc attached to the worm-shaft bearing. The disc face of the clutch is surfaced with leather. The wooden frame of the machine is constructed to form a table with a top 2 ft. x 2 ft., which is very convenient to hold the operator's tools. The worm and gear with the pulley clutch form a desirable method for transferring power and give the necessary positive low speed. One end of the spindle that holds the field form is fitted with a cyclometer or counter, so that the operator may know exactly how many turns he has wound upon the coil at any time without being compelled to trust to memory or stop to estimate.





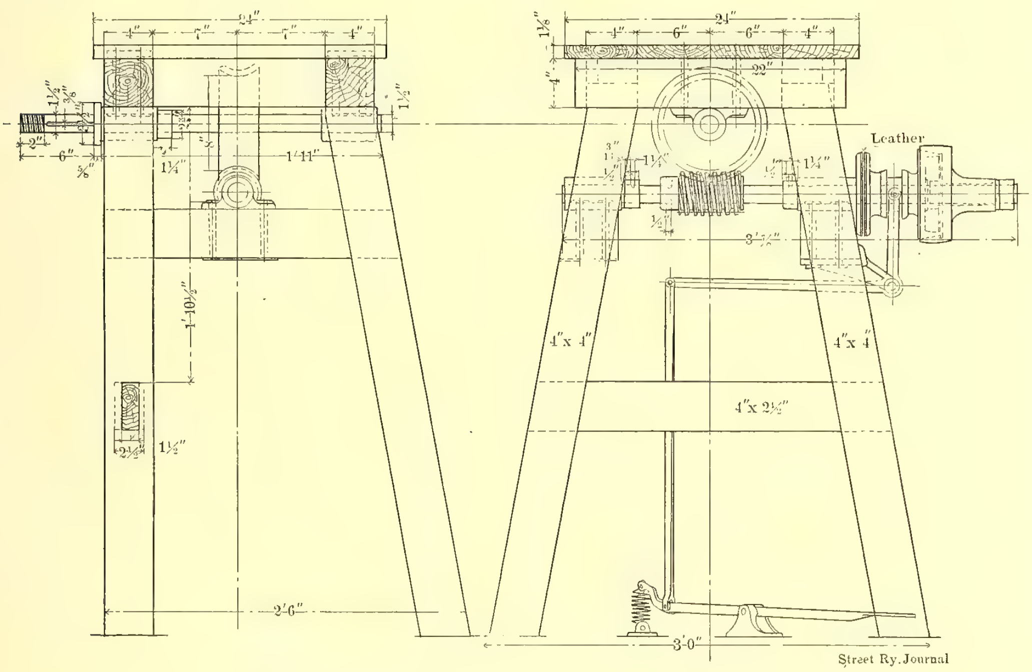
LATHE FOR BANDING ARMATURES

Another illustration shows the patent power armature bander, which is entirely new. Two of these machines are now being assembled at the old shops, and were built by the American General Engineering Company, of New York, according to drawings submitted. The frame of the machine consists of four cast-iron legs and two 4-in. x 4-in. x ½-in. angles placed back to back and 4 ins. apart. The tops of the angles are planed and constitute the runs for the carriage, one side of which is constructed with a spindle to hold a reel of banding wire. When an armature is swung into the machine for banding, the wire is led from the reel alternately over and under 2-in. diameter brass sheaves which are attached to the lower side of the carriage frame, and which, when the machine is in operation, give the required tension to the banding wire. From the tension sheaves the wire is brought to the top of the feeder arm that is pivotally carried to the carriage frame on to the armature. As the armature turns, the feeder arm will automatically deliver the band wire in place. A spring, forged of ⅛-in. x ¾-in. spring steel, regulates the movement of the arm as the latter slides along its radial path over the top of the carriage frame. The power for turning the headstock of the bander is transferred by a worm and gear and through a friction cone clutch pulley similar to that described for the field

winder. The tread that operates the lever for stopping and starting is situated near the center of the machine, so that the operator may always be over his work. A worm gear case affords a receptacle for lubricating oil.

There will be fifteen pair of new armature stands in the new equipment. Each will consist of a cast-iron column flared at the bottom for a base, and with the top of the column terminating in a bearing box for a pair of twin rollers. The stand is arranged with an adjusting jack screw so that its height may be varied to suit the operator, and also has a slot pocket to which a cast-iron shelf is fixed to form a table for the winder's tools.

All the soldering irons will be heated by No. 2 American Gas Furnace Company's soldering iron heaters. A 3-in. gas connection from the city main is to be brought into the building, and 1½-in. branches are run overhead, from which drop connections are taken off for the furnaces near the armature stands. Air will be supplied in conjunction with the gas at the soldering furnace from the compressor lines through a reducing valve. Gas furnaces were installed in the old shop about a year ago, and have proven desirable on account of cleanliness, convenience and efficiency, and are more economical in the end than a crude fuel furnace.



DETAILS OF STAND FOR WINDING FIELD COILS

The general plan on page 341 shows the location of the motor-testing apparatus, just south of the armature stands. Here all the armatures are tested before going out by placing them in test frames and imposing a generator load. This department will also be equipped for making transformer tests on fields and armatures.

The balcony of the machine shop building has a space 28 ft. x 42 ft. reserved for a taping or insulating room. This department is located on the balcony, as the work is to be carried out by girls, and materials can conveniently be transferred to and from the electrical department below by means of a 6-ft. x 6-ft. elevator. Moreover, the elevator landing is convenient to the oven and dipping room.

The oven will be heated by electricity, the heaters being placed in a pit underneath the floor. The dipping room and oven are separated by tin-covered, overlapping sliding doors, and are equipped with armature and coil hangers.

THE MACHINE SHOP

The machine work proper occupies the central portion of the west part of the building, and has been carefully designed according to modern ideas. A number of machine tools that are in use at the Plank Road and West Hoboken shops will be reinstalled, and several new tools are to be added to make this particular department complete. It is worthy of note that a complete installation of independent motor-driven tools was not in favor with the management on account of past experiences. It was found that as the different machines required different sized driving motors, the maintenance of these motors interfered with the progress of the shop work, because, often in cases of break-downs of the motor, the particular part that required renewal was not at hand. It was usually necessary to go to considerable trouble to replace the damaged part, which involved the sacrifice of having a much-needed tool lying idle. Of course, this inconvenience could be obviated by having enough repair parts in stock, but the scheme is expensive as well as impractical with such a variation of sizes as is called for in the machine equipment of a street railway shop. Accordingly, it was decided to operate the machine tools in gangs and with overhead shafting. Each gang of tools is to have an independent 500-volt motor, and inasmuch as each driving motor may be arranged to pull approximately the same load, all the driving motors will be about the same size. The interchangeable repair parts will thus be reduced to a minimum. However, the isolated machine tools are to be independently driven. All the shop motors will be 500 volts, and are to work off the regular railway circuit. Maxwell, Manning & Moore, of New York, have the order for most of the new tools, and some that are already on the ground are: Two 48-in. radial drills, one 4-spindle drill, two 16-in. engine lathes, one V. & O. punching press, two milling machines, one Barnes tool grinder, one special grinder, one cutter and reamer grinder, two metal saw benches and two 2-in. x 24-in. turret lathes.

The tool room is situated near the center of the shop, under the shop superintendent's office, and will be equipped with a Warner & Swasey engine lathe, a No. 2 Hendley milling machine, water tool grinder, complete with 24-in. emery wheel, and one special duplex grinder with surfacing attachment.

FORGE SHOP

The hand forges adopted are No. 8 T Buffalo down-draft forges, complete with down-draft exhaust hoods. These forges will be operated by a 15-hp d. c. motor, driving a 5-in. Buffalo blower and a 48-in. Buffalo exhaust through a system of underground ducts. Besides the Buffalo forges, there will be four Ferguson oil furnaces, furnished by the Railway Materials Company, of Chicago. The latter will be operated for the power hammers, bulldozer and bolt machines. The oil furnaces are very desirable for heavy forging work on account of convenience, ease in regulation, cleanliness and capacity. The Ferguson furnaces are cold blast and require about 8 ozs. at the fire. Besides the Bradley hammers and shears obtained from the old equipments, a new No. 7 Williams & White bulldozer and an Ajax 2-in. heading and forging machine will be installed.

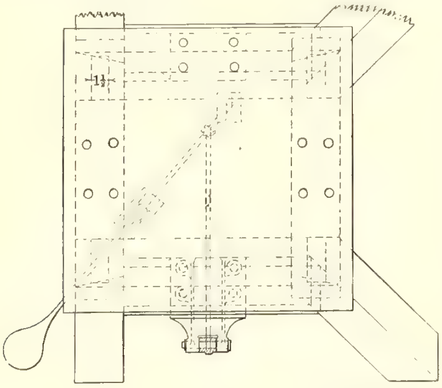
WHEEL DEPARTMENT

A space in the south end of the building, as shown in the illustration, is reserved for wheels and axles, and the inter-

vening space between the south wall and track is to be equipped with straddle tracks for a wheel platform. Generally this department is fitted up with two boring mills, an engine lathe, axle rack, wheel grinder and two Schafer 36-in. 200-ton wheel presses.

COMPRESSED AIR

Compressed air is to be very extensively used throughout the repair work, and it is the intention to run a series of air-pipe lines all around the building from the two air compressors located, as seen in general plan, near the forge shop. From the pipe lines flexible hose connections may be had to supply the air chisels, drills, riveters, hoists, etc. The air tools are to be of the Chicago Pneumatic type. The two new air compressors, complete with two 18-in. x 36-in. air tanks, are ordered from the National Electric Company, of Milwaukee, and are to be of the motor-driven two-stage type, with a capacity of 100 cu. ft. of free air per minute, cylinders 8½ ins. x 8 ins., 150 r. p. m. and 90 lbs. pressure, with electric and water governors.



PLAN OF STAND FOR WINDING FIELDS

ERECTING SHOP AND MILL ROOM

There is no especial departure in the way of equipment for the new mill room, although it was carefully laid out for general convenience in handling material and for the workmen. The equipment for the present will be almost entirely obtained from the old Plank Road and West Hoboken shops. The heavy machines, such as rip saws, car tenoners, four head planers and shapers, will be located on the side of the mill room nearest the erecting shop. Ample room is to be left around the tools, so that workmen are not hampered in handling swinging stock of large dimensions and weight, such as sills, framing, etc. There will be a pattern shop in connection with the mill room, which will be equipped with modern tools.

A power conveyor is to be installed between the mill room and the central boiler house, so that sawdust, shavings and waste stock may be consumed under the boilers.

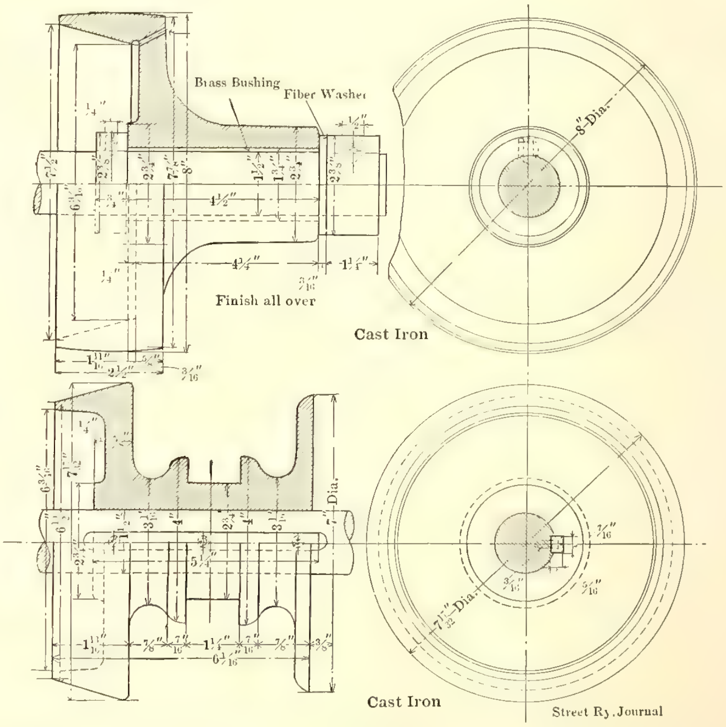
A dry kiln, situated on the south side of the mill room, is just large enough to accommodate a flat car loaded with lumber. The dry kiln has doors on each end, so that a car can be taken in or out by the transfer table between the erecting and machine shop, or by the run-around track that has connections to any part of the yards. The kiln is equipped with steam coils, supported by I-beams under the track. Liberal radiation is provided so that at least a temperature of 125 degs. F. may be obtained. Thermometers are to be built into the side wall of the kiln, so they may be conveniently read from the outside, and there is a careful layout with vents and slides for a close regulation.

PAINT SHOP

The paint shop is fitted up with a car-washing arrangement, using rain water, as was fully described in the previous issue of the STREET RAILWAY JOURNAL. It may be stated that a washstand was put in each of the nine entrance tracks, so that it is impossible to bring a car into the shop for painting without first passing over them. This arrangement aids the assurance of the car being washed down. When the wash house is in a remote corner, as is often the case, there is a tendency of the workmen to avoid this important procedure. The washstand consists of a concrete duct 22 ins. deep and 12 ins. wide, running across the front of the building and under the tracks. It is covered with a perforated cast-iron top and has an overflow connection from the duct into the street sewer, and also a catch basin with an area 4 ft. x 4 ft., so that dirt from the cars will collect in one place. The catch basin may be cleaned out from time to time, thus assuring the concrete duct from filling up with debris. The floor of the building, including the rails, is graded from the front to the duct, which is situated 30 ft. back from the entrance doors. The floor and rails are also graded toward the duct from a line at right angles to the tracks and 30 ft. back of the duct. The edge of the duct is carefully protected by a 2-in. x 2-in. x ¼-in. angle-iron, so that in removing the perforated cast-iron cover the concrete floor will not be chipped away.

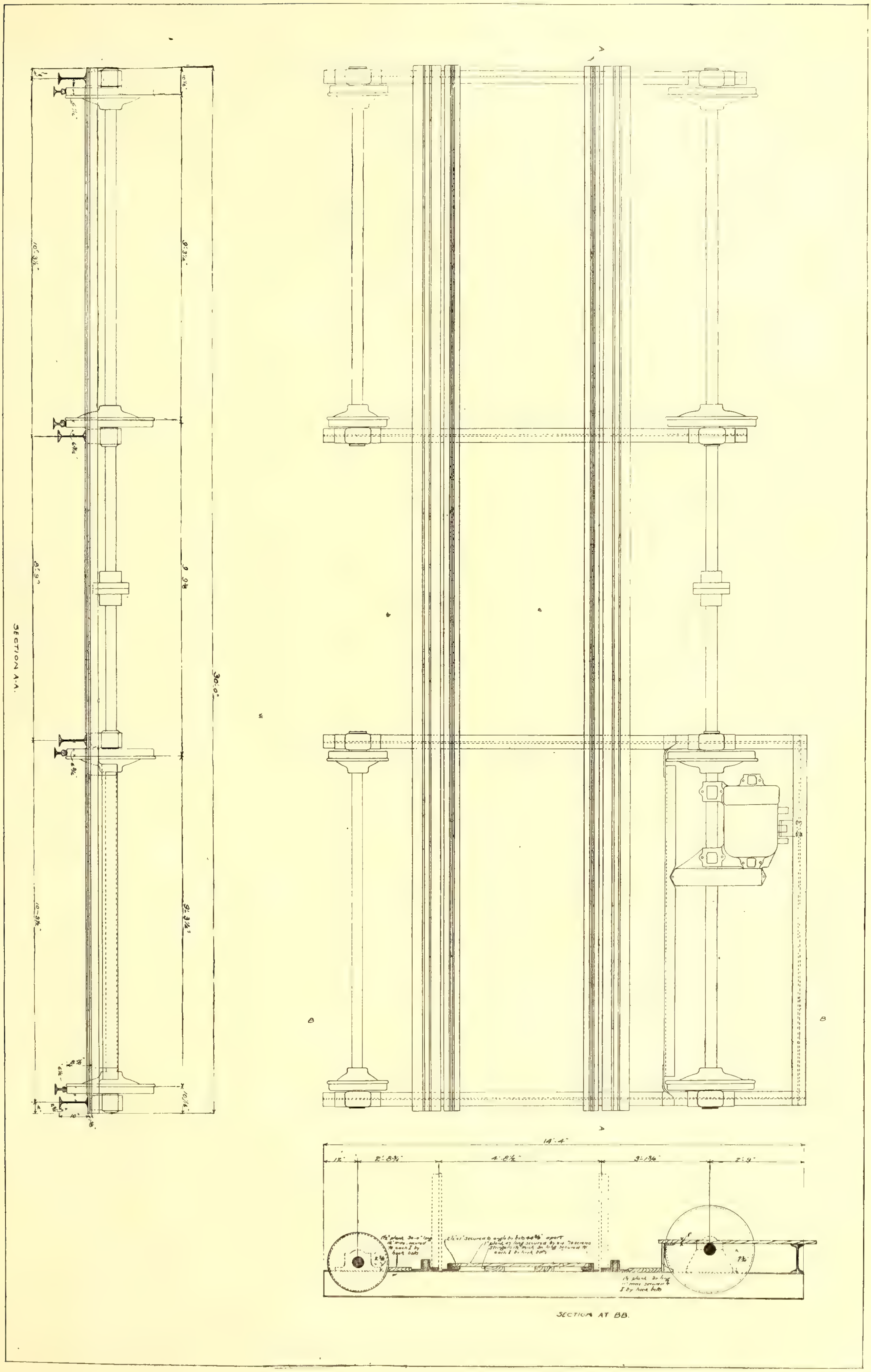
There will be a 2-in. gas connection into the building, with a main and branch pipe carried along the ironwork of the roof; also 1-in. drop connections between every pair of tracks. The latter will be used for supplying gas through a rubber hose to a burner for burning off paint and varnish from the car. An air supply will also be arranged to mix with gas for the burner.

It is a well-known fact that convenient and efficient scaffolding is of prime importance in a paint shop, so several diffrent designs were considered. The scaffold decided upon will be supported by 5½-in. x 3½-in. posts placed along the center of the space between tracks every 16 ft., and supported on the top by the bottom chord of the roof trusses. A 1-in. x 10-in. truss plank scaffold will be arranged to move up and down between the posts, and be operated with a chain and light cast-iron shears, attached to the ends of the planks and the sides of the posts. The ends of the scaffold between each pair of posts will terminate into a neat cast-iron guide that fits snugly one-quarter way around the post.



DETAILS OF CLUTCH AND BEARING FOR FIELD WINDING MACHINE, PLANK ROAD SHOPS

The finishing room was designed of ample size for handling sash, doors and small parts that are stripped from the car body. Here will be located a zinc-lined washing vat and sash racks run at right angles to the tracks. Between each pair of sash racks a table will be provided with revolving frames, so that the sash may be laid upon a frame and turned in any position convenient to the workman. The paint storeroom is constructed entirely independent of the shop proper, and of non-

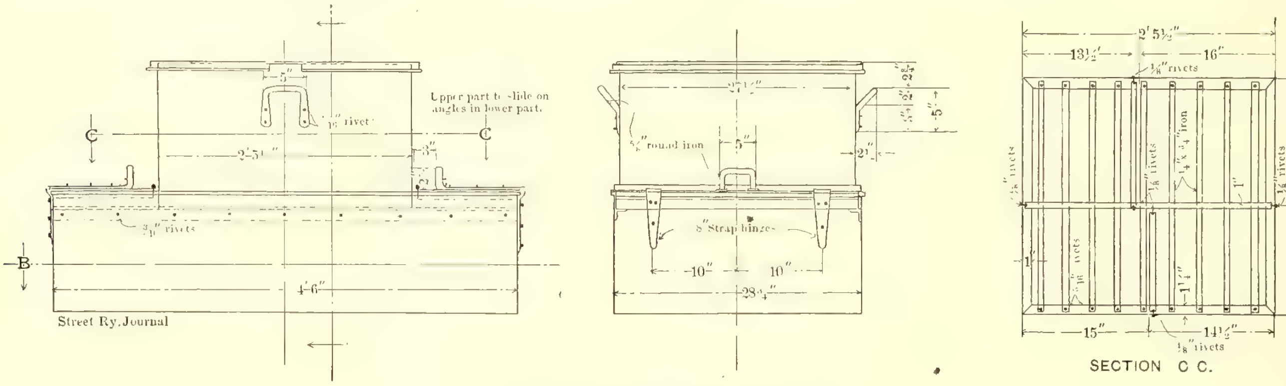


TRANSFER TABLE, PLANK ROAD SHOPS

combustible material. An ample amount of north light was carefully provided for so that all the colors could be satisfactorily mixed.

SHOP ACCOMMODATIONS

An important feature of the repair shops will be the excellent accommodations for the men. The lavatory, wash basins and lockers are to be of the best. The plumbing is all open work, with nickel-plated piping and slate stalls, and the entire outfit of this line is very acceptable. There will be in all 400 lockers, which will be installed in the shop buildings, and are to be furnished by Merritt & Company, of New York. The lockers will be 18 ins. deep by 12 ins. wide and 6 ft. high, with the bottom of the lockers 6 ins. from the floor. The legs will be a continuation of the angle-iron corners, and will set in neat cast-iron shoes. The sides, backs and tops of the lockers are to be solid steel, and the doors, bottoms and shelves will be expanded metal with ⅛-in. mesh. Each locker is to be fitted with five clothes hooks and a shelf 12 ins. from the top, and the door is to be equipped with three malleable-iron hinges, a three-way latch, and be arranged so they may be fastened with a Yale lock or a padlock. Especially designed lockers will be placed between the tracks in the truck shop. These are a combination clothes locker, tool and waste box. One of the illustration shows the oil filter and waste tank adopted for the truck shop.



TANK FOR DRAINING WASTE

Time clocks are to be placed in every department, and electric gongs connecting to a clock in the timekeeper's office will announce the opening and closing of the working hours.

A dining room and kitchen are to be equipped on the west side of the balcony, so that employees may obtain their meals at the works.

A reading room 42 ft. x 28 ft. is also to be constructed on the west side balcony that will be supplied with mechanical and technical papers and magazines and other current literature.

The headquarters of the superintendent of rolling equipment, with clerks' offices and drafting room, is located on the northeast balcony. From these offices there are to be private telephones and gongs to all the different buildings and departments. Here also will be the emergency gong connection for the auxiliary fire-alarm system.

THE AUXILIARY SHOP EQUIPMENT

It may be of interest to mention the standard equipment of the new auxiliary overhauling shops that are to be operated in connection with the Plank Road shop. There are five of these to be equipped about the system, and are located at Montgomery Street, Jersey City; Market Street, Paterson; South Orange Avenue, Newark; Milltown and Westfield.

The Montgomery Street shop is about completed, and has five tracks with pits 100 ft. long. A low pit transfer table travels across the front of the shop, and is shown in detail in one of the illustrations. A wheel grinder, especially designed and already described, is to be installed in one of the pit tracks. There will be five jib cranes with air hoists, designed to lift 6000 lbs., and erected between tracks near the ends of pits, and intended to lift the repair parts taken from beneath the car to the shop floor. Each pit is also to have a portable air jack, as described in the main shop equipment. A new air compressor and storage tank, similar to the ones already described, is also provided. The space in the rear of the shop is reserved for the machine tools, which consist of an engine lathe, a drill press, emery wheel, shaper and grindstone. There is also a Buffalo hand forge. Jib cranes with chain blocks are installed near the machine tools for convenience in handling material.

A. B. DU PONT'S REPORT ON A CHICAGO MUNICIPAL STREET RAILWAY SYSTEM

A. B. Du Pont, who was recently employed by Mayor Dunne, of Chicago, as a special expert adviser in traction matters, has submitted to the Mayor a report on the probable cost and earnings of a system of municipal street railways comprising 264 miles of track on streets where the city officers claim franchises have expired, and in a few cases on streets not now occupied by tracks.

The following extracts give the more important features:

The system is to be so designed as to be readily extended as the franchises expire on contiguous streets, so as to embrace the entire city.

In the operation of these railways the lines running approximately north and south, in the North Side and the South Sides, respectively, and east of Halsted Street, should be connected together and operated as through routes through Wabash Avenue.

The diagonal lines running approximately southwest from the central portion of the city should be connected to the diagonal lines, and to lines that are established approximately diagonal, in a generally northwest direction from the central portion of the city, and operated as through routes through Dearborn Street.

The lines on the West Side that run east and west should not at present be extended east of Dearborn Street.

Such an arrangement of routes would avoid grade crossings and do away as much as possible with congestion in the heart of the city. I would recommend such a system of routeing until such time as proper underground terminals would be furnished for the through routes above referred to; in which event these West Side lines could be properly operated to Wabash or Michigan Avenue. All other lines should be operated as cross-town routes, and transfer passengers to the routes above mentioned.

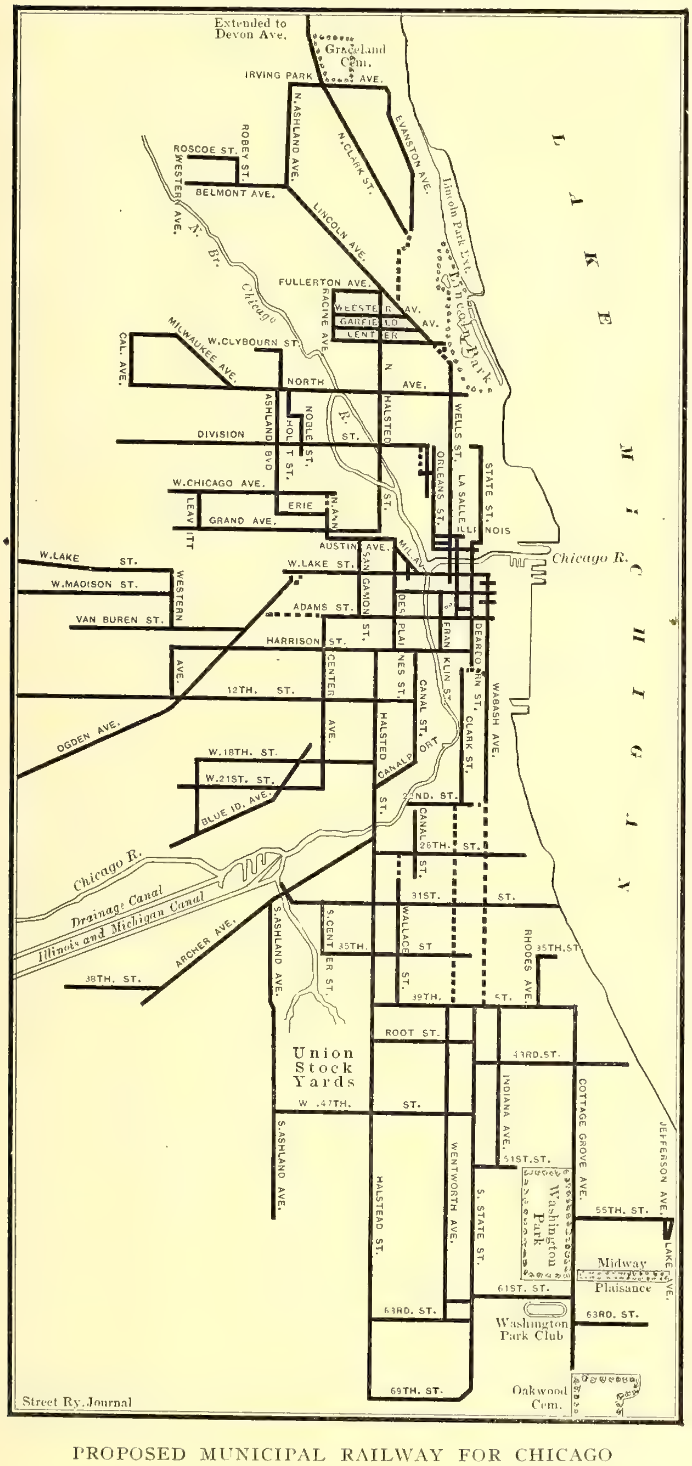
Transfers should be made at all intersecting points from any one route to any other route, not, however, including a transfer to such a route that would enable a passenger to return for one fare to approximately the point he started from. And for the sake of transfer, Dearborn Street, and Wabash Avenue in the central portion of the city should be considered intersecting points with all east and west lines that only reached Dearborn Street.

This system of railways should also be required to issue and receive transfers from the other street railways in Chicago, or, better still, on all lines that are continuations of the lines of the designed railway it should exchange its cars with the cars of the old railway at the connecting point, so that the passengers shall have a through ride to their destination, and only the motorman and conductor transfer. The condition of the present street railway companies after the construction of the proposed line will make it

necessary for them to exchange transfers to profitably conduct their business.

The fact that there exists an immediate necessity for the improvement of the street railway situation and the complete solution of the problem necessitates the construction of general terminal subways, which should not be done until the rights of the city and the street car companies are settled as to the streets now occupied by them.

Temporarily, and until such time as general terminal subways



PROPOSED MUNICIPAL RAILWAY FOR CHICAGO

are built, I recommend that the overhead trolley system be extended to include the center of the city, thereby saving the excessive waste that would be entailed by the premature construction of the electric conduit system. In case there should be any delay in getting possession of any connection at the time needed, a subway can be constructed to make such connection, and can be so designed as to be a part of a permanent subway system.

The cost of construction of the 264 miles of track above indicated will not exceed $25,000,000. Such a sum, besides constructing the railway complete, will provide ample power and cars to take care of the riding public.

I am not prepared at the present time to estimate the cost of subway construction in Chicago, but if it is desired in my final report, I can, after an investigation of conditions below the surface of the streets, prepare a detailed report and submit plans and specifications.

After careful comparison of the earning capacity of the designed system and remaining parts of the Chicago City Railway and the Union Traction Company at 5-cent fares and the transfers above indicated, I am of the opinion that should the designed system be put in operation for the year 1908, its gross earnings will not be less than $12,000,000.

Of course the above estimate is on the supposition that the city will not allow any invasion of the territory of the designed system.

The cost of operation, including maintenance and depreciation, but not including taxes, for the first five years of the designed railway should not exceed 55 per cent of the gross earnings.

After that time, owing to the track and equipment becoming older, this cost would probably equal 60 per cent of the gross earnings.

I estimate the financial results from the operation of the designed system with 5-cent fares and transfers as indicated, as follows:

FOR THE YEAR 1908

Gross earnings	$12,000,000.00
Operating expenses, including maintenance and depreciation, but not taxes	6,000,000.00
Net earnings from operation, 45 per cent	5,400,000.00
Interest on cost, 5 per cent on $25,000,000	1,250,000.00
Surplus	4,150,000.00

FOR THE YEAR 1913

Gross earnings on annual increase of 5 per cent of earnings of 1908		15,315,378.75
Operating expenses, including maintenance and depreciation, but not taxes, 60 per cent		9,189,227.25
Net earnings		6,126,151.50
Interest on first cost, $25,000,000, 5 per cent	$1,250,000.00	
Interest on $3,000,000 additional cost to provide for increase in traffic at 5 per cent	150,000.00	
Total charge		1,400,000.00
Total surplus		4,726,151.50

I am advised by counsel that there is very little doubt of the right of the city to construct a line on North and South Clark Streets, on North State Street, and on Milwaukee Avenue.

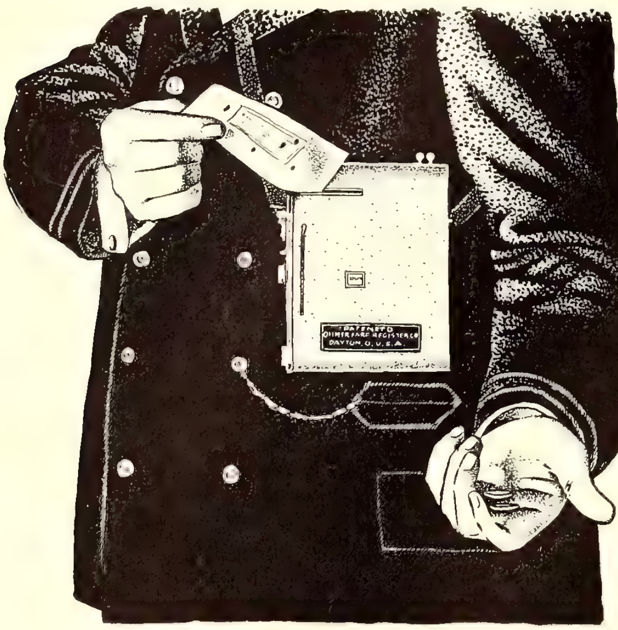
If these streets are available it would add about fourteen miles to the system, as herein set out, and would make a further cost of $1,600,000. This addition of mileage in these streets would increase the earnings $1,000,000 per year, with the same percentage of profits as herein indicated.

DETROIT UNITED TO GIVE PRIZES FOR SHORT STORIES BY CHILDREN

The Detroit United Railway announces the opening of a short story contest to the children regularly enrolled in the schools of Wayne, Oakland, Macomb, St. Clair and Genesee Counties, through which the lines of the company pass. The contest will be open a sufficient length of time, about nine weeks, to give every boy and girl a chance to become settled in their year's school work and give proper time to their best possible composition. There are to be three prizes, the first of $25, the second of $15 and the third of $10. The theme of the story is to be confined to some incident, experience or anecdote descriptive of travel on the electric cars, either Detroit city or interurban lines. No story must be more than 2500 words or less than 1500 words in length. The composition must be absolutely original. The contest will close at 6 p. m. Saturday, Nov. 4, 1905. All compositions must have been mailed or delivered to John H. Fry, 12 Woodward Avenue, Detroit, before that hour. A committee, consisting of three of Detroit's most eminent writers, authors or newspaper men, will pass upon the manuscripts submitted, and select those which in their opinion show the greatest literary excellence, originality and style. This committee will be announced later. It is planned to publish the work of the first prize winner, and possibly all three winners, in the daily newspapers. It is the aim to arouse school children's interest in literature.

THE OHMERGRAPH TRANSFER-ISSUING MACHINE

The general demand and necessary adoption of the transfer system has grown beyond all calculation. The growth has been so widespread and to such enormous proportions that it has to be reckoned with by every street railway manager in the country. The value of a transfer and its necessity are too well known for comment, and the abuses following its introduction



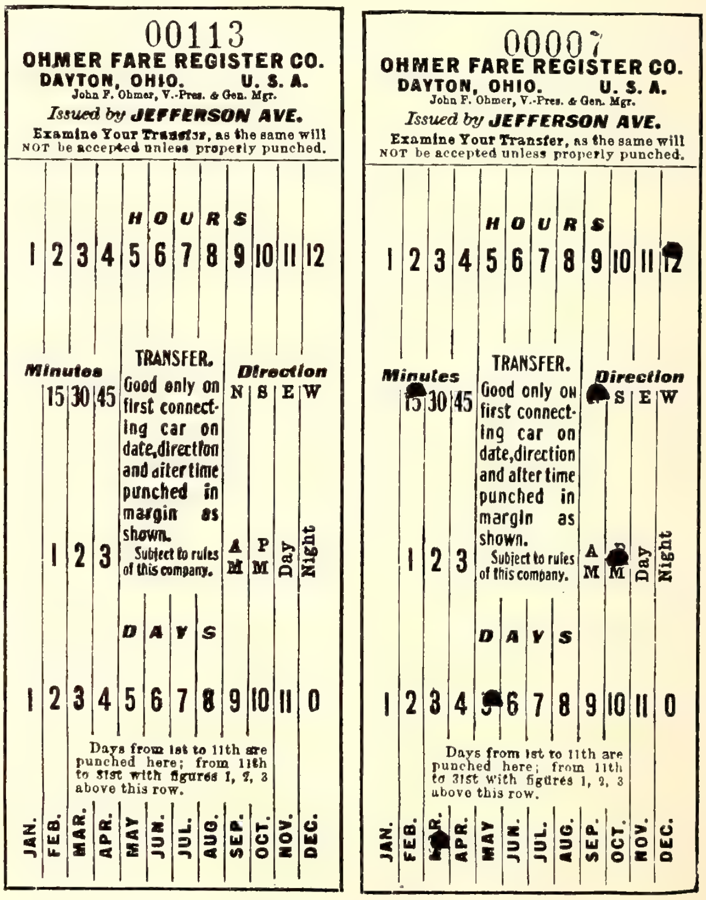
TAKING A TRANSFER TICKET FROM MACHINE

have more than kept pace with its good features. These abuses are so generally practiced that managers are continuously conferring with one another, and the subject is discussed at every meeting of railway associations. The transfer seems to be supreme, and the conclusions are always practically no conclusions at all; the problem has continued beyond solution. At the time of its issue the transfer should be accurately punched to fix the date, the time by hours and by fractions of hours, but when the traffic is more or less congested, it is impossible for the conductor to collect his fares and issue transfers with the proper limitations. He must either collect his cash fares and issue transfers with the limitations punched as best he can, or properly punch the transfers at the expense of not getting some of the cash fares.

John F. Ohmer, vice-president and general manager of the Ohmer Fare Register Company, of Dayton, Ohio, has invented a device to solve this most perplexing problem. It is a small machine which is called the "Ohmergraph." This machine is worn on the side or chest of the conductor, and is so light that its weight is scarcely perceptible. It will perforate the month, the day, the direction, the hour, the minute (by fractions of an hour), and it issues and records each transfer in less time than the conductor could place his hand in his pocket for a pad of transfers. The machine is enclosed within an aluminum case, and contains transfers put up in rolls of 200 and 300 each. The transfers are consecutively numbered in the usual way and checked out to the conductor by the consecutive numbers, and also by the register record. The operation requires one hand only of the conductor, and the transfer is properly punched, issued and recorded in one operation by the movement of a single lever.

Two of the illustrations show transfers before and after issue. It will be observed that the matter is printed transversely across the paper and can be read without turning. The first perforation is shown in the top column at 12; the next under minutes at 15; the next, on the same transverse parallel, punches out the direction, "N;" the next perforation, "P. M." Under the word "Days" are figures from 1 to 11, and then a cipher. It will be observed that 5 is punched for the fifth day, and the last perforation on the transfer, as shown, indicates March. The figures 1, 2 and 3 on the third transverse column are used for indicating the days in excess of the 11th. For the 12th day, for instance, the figure 1 would be punched with the figure 2 directly below the 1. On the 22d day of the month the next figure 2 would be perforated, and on the 30th the next figure 3 and the cipher in the next column below would be perforated. It is impossible to punch and issue transfers without recording them in the machine. From a sanitary standpoint the innovation should be highly commendable and popular with the public, as there is no chance to contaminate the transfer with dirty money, tobacco, etc., carried by the average conductor.

The transfers will be printed in different colors, denoting special lines or streets from which they are issued. An audible indication (bell ring) is the accompaniment to each transfer issued, and the number of bell rings must indicate the number issued. Under these circumstances the conductor would not dare to issue surreptitiously more transfers than are legitimately required by passengers. The perforators for the month and day are concealed and are not accessible to the conductor. The punches controlling the hours, the minutes and the direc-



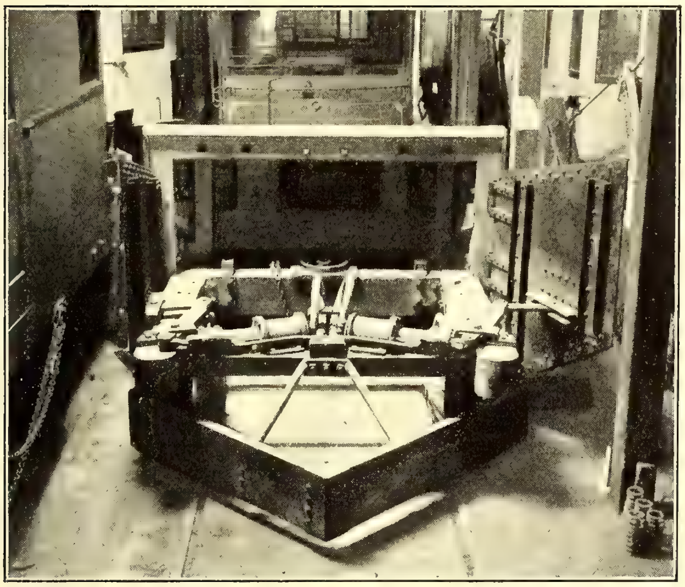
SPECIMEN TRANSFERS BEFORE AND AFTER ISSUE

tion are available to the conductor, and can be set in an instant to the required time. In operation it will only be necessary for him to move the hour punch once an hour, the minute punch once in fifteen minutes and the direction punch simultaneously with the issuing of the transfer.

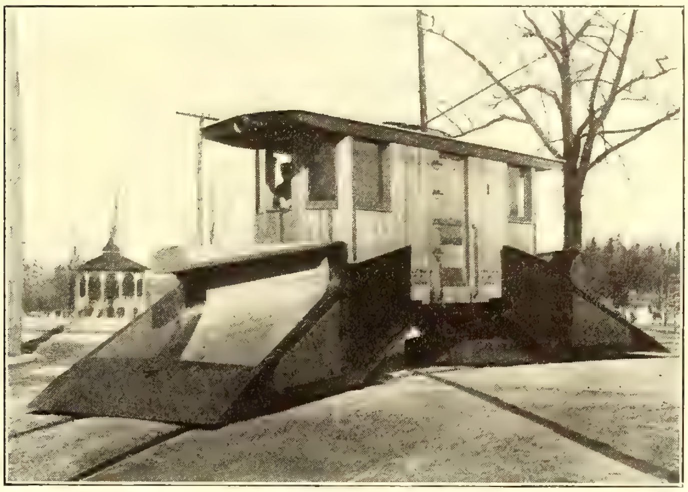
Mr. Ohmer's company has for the past eighteen months been preparing to manufacture the Ohmergraph on a large scale. The first machines will be ready to exhibit at the forthcoming American Street Railway convention, which assembles in Philadelphia this month.

NOVEL SNOW-PLOW

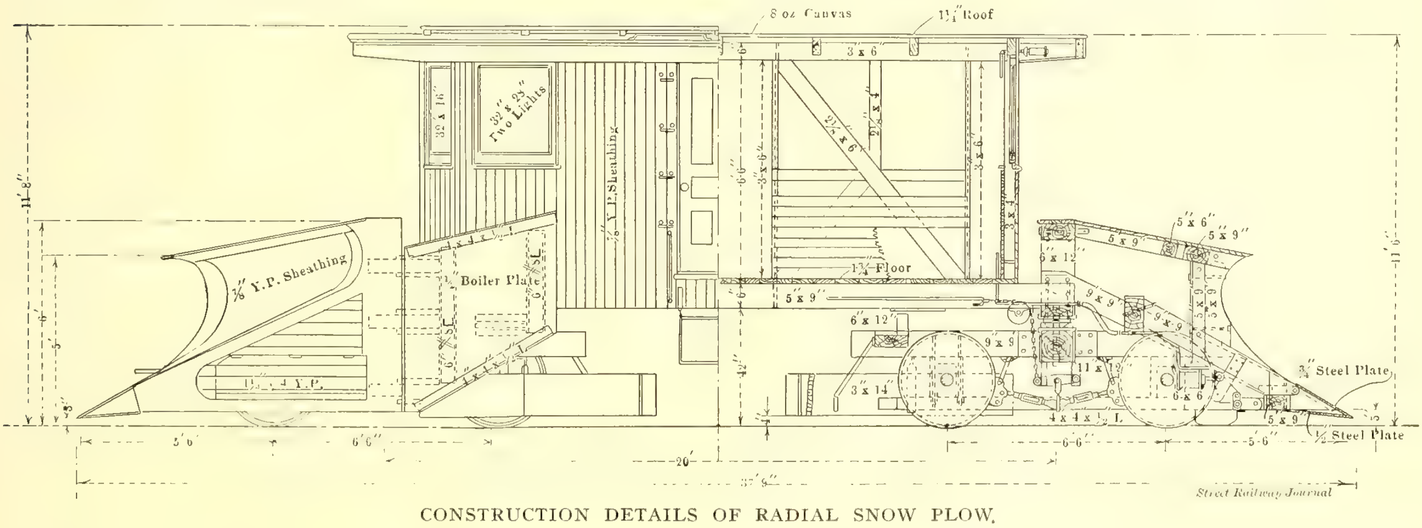
The accompanying illustrations show a novel type of snow-plow which has been in use for the past two winters on the lines of the Worcester Consolidated Street Railway and for one winter on the Boston & Worcester Street Railway. As will be seen, one feature of the device is the use of a square or shovel-nose plow, consisting of an incline built straight across the track from but a few inches above the rail in front, and extending far back, at an angle of 30 degs., above and to the rear of supporting wheels, and a moldboard, either divided in the middle or extending entirely across the incline, and located some distance back from its front edge.



FRONT VIEW OF SNOW PLOW, SHOWING PNEUMATIC CYLINDERS FOR OPERATING THE WINGS



RADIAL SNOW PLOW COMPLETE



CONSTRUCTION DETAILS OF RADIAL SNOW PLOW.

To adapt this style of plow to electric railways having many curves of short radius and frequent sudden changes of grade is the feature upon which the inventor, W. E. Wilder, of Worcester, has been granted a patent. The plow portion, instead of being mounted on the usual car body, is carried on and forms a part of the truck. It also substantially covers the end of the body, which terminates practically at its point of support on the trucks, thereby allowing the plows to turn with the trucks and clear the rails, even on curves of 25-ft. radius.

The framing of the body is yellow pine, and the plow is oak. The sheathing all over is yellow pine, and is finished in the natural wood. Each end of the plow is supplied with a "Huff" two-way locomotive air sander and a 3-in. chime whistle, while a 12-in. gong is located up under each hood. On the plow used on the Worcester Consolidated, the equipment consisted of four GE 67 motors with K-6 controllers, while that used by the Boston & Worcester was equipped with four GE 57 motors with K-14 controllers. This plow, however, is designed to take motors as heavy as 125 hp. The wings are of boiler plate and are controlled pneumatically.

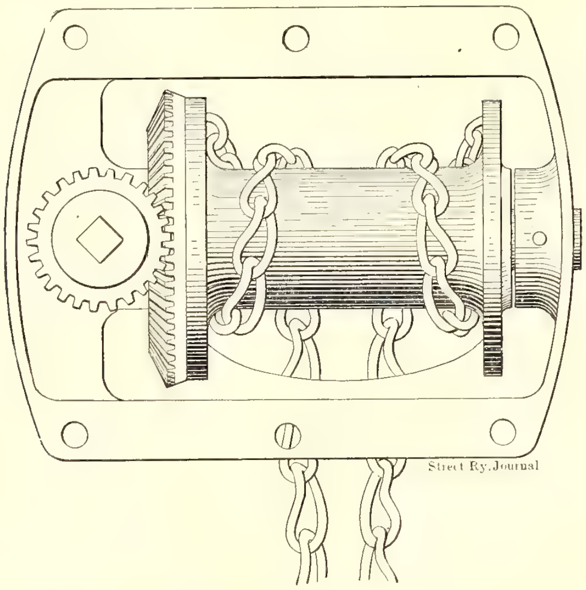
On the Worcester Consolidated the inventor states that the plow made an excellent record. With its light equipment it maintained a speed of over 8 m.p.h. for miles through snow that averaged from 1 ft. to 3 ft. in depth, frequently taking side-hill drifts 3 ft. to 5 ft. on the high side. At a speed of from 15 m.p.h. to 20 m.p.h., the snow would be thrown from 20 ft. to 30 ft. from the track and over fences and stone walls. In fighting snow it has worked continuously for twenty-four hours at a stretch, yet never was stalled, derailed or disabled.

Two men are all that are needed to operate the plow, though eight have ridden in it without discomfort. The body is sheathed inside and out, and the windows have double lights, preventing frost from forming on them, and making the plow warm and comfortable.

The first place that the interchange of tickets between the electric and steam lines of the New York Central Railroad is to take place will be at Syracuse during the week of the New York State Fair, Sept. 11 to 16. The Syracuse Rapid Transit Company has no line to the fair grounds, but the West Shore Railroad has a station on the grounds. An arrangement has been made whereby the street car conductors can sell tickets in any part of the city direct to the fair grounds and return. The West Shore conductors will give transfers to the Rapid Transit lines.

SAFETY CAR BRAKE

For the last six months the Union Railway Company, of New York, has been trying out in every-day service a new quick-action safety car brake made by the Traction Equipment Company, of Brooklyn, N. Y. The principal details of this brake, for which many advantages are claimed, are shown in the accompanying cut. The horizontal drum is an entirely new feature, which prevents locking of the chains. Two chains are used, and these are secured on each side of drum by staples



DOUBLE-CHAIN CAR BRAKE

riveted through the drum head. This divides the strain on the links and makes the chain less liable to break. If one chain should break, the other would still remain in operation to perform its functions. The drum takes up the slack chains quickly. The gear wheels have a tendency to bring a car to a full stop without any perceptible jar. The pinion shaft has a square hole in it to receive the brake staff, thus making it impossible for it to slip.

This brake is designed for service on electric and steam railroads, and for equipments from single-truck cars up to the heaviest rolling stock. While possessing all the advantages claimed, this brake is not more expensive than other brakes now on the market.

AUTOMOTONEERS IN CHICAGO

A number of the Garton-Daniels Company's "Automotoneers" for restricting the too rapid advancement of the controller handle have been put in service on cars in Chicago. As this device has only recently been installed in large numbers, considerable interest attaches to the results obtained with it. The conditions under which it has been tried in Chicago have not been such as to make possible as good comparative tests as might be desired, but some idea can be obtained as to what it accomplishes.

The Chicago Union Traction Company has had thirty cars equipped with "Automotoneers" since January, 1905. This is a full equipment for the Evanston line, which is a suburban line running from the terminus of the North Clark Street cable line to Evanston. This is a suburban run, not requiring the number of stops per mile that occur in downtown city service. It is not therefore the kind of a line on which the advantages of such an apparatus as the "Automotoneer" should be most apparent. The records of the company include special daily reports on the subject from Jan. 22, when the "Automotoneers" were put in service, for a period of ninety days. The chief interest in these reports lies in the reduction in the number of motor troubles reported after the "Automotoneers" had been in service a month. During the month of February there was no noticeable reduction in the number of cars turned in for motor and controller troubles. This was as might be expected, as the results of previous abuse of motors without the "Automotoneers" would continue to make themselves felt over considerable time. In March, however, a change in the number of motor defects began to be noticed. From March 1 to 15, 1904, 23 cases of motor trouble were reported. For the same period of 1905 there were only 9 cases. Motor troubles on this line for the year 1904 averaged 40 per month. For the month of March, 1905, there were 16 cases. From March 31 to April 21, 1905, there were 9 cases. The weather was exceptionally good in 1905, but even taking this into account, the conclusion was reached that the "Automotoneers" were saving at least 50 per cent of the motor troubles. The cars were the same in number and equipment as the year before, being equipped with GE 52 motors and weighing about 22 tons. The equipments are eight years old, and it might be expected that the number of motor and controller defects would, if anything, increase from year to year. The results for the period for which the records were kept were very favorable to the use of the "Automotoneers" for preventing misuse of motors.

The Calumet Electric Street Railway Company has "Automotoneers" ordered and in its shops for the entire equipment of its road. Its most important cars have been already equipped. The South Chicago City Railway Company also has many of its cars equipped. The Twenty-Sixth Street line of the Chicago City Railway has been thus equipped for some time.

MORE SEMI-CONVERTIBLE CARS FOR NASHVILLE

The Nashville Railway & Light Company has purchased from the J. G. Brill Company twenty-three cars having the "grooveless post" semi-convertible window system. Ten of the cars are 22 ft. 7 ins. over the bodies, and the other thirteen measure 30 ft. 6 ins., eight of the latter being intended for trailer service. About two years ago a shipment was made the railway company of twenty-five cars of the same dimensions as these, and altogether sixty semi-convertible cars, which are all mounted on Brill trucks, have been furnished by this builder. The order for the cars was placed through the engineering firm of Ford, Bacon & Davis, who, within the last month, have also ordered thirty-five of the "grooveless post" semi-convertible cars for Memphis.

The single-truck cars are seated for thirty-two passengers and the double-truck cars for forty-four passengers, the seats being of rattan and transversely placed. The absence of wall window pockets by reason of the roof pocket storage of windows permits the use of an unusually low window sill. From the top of the floor to the top of the window sill is but 25 ins., giving a large window opening and adding much to the comfort of the cars in warm weather. The height named is the builder's standard for the window sill of this car. As the window sill is rather low to be reached by the elbow of a seated adult passenger, neat arm rests are provided. Seven-bar guard rails are an excellent feature in connection with the window sills.

The interiors of the cars are richly finished in cherry, with bird's-eye maple ceilings, undecorated. The vestibules are also finished in cherry. The seats are 34 ins. long and the aisles are 23½ ins. wide. The platform knees are reinforced with angle iron and protected and strengthened at the ends with angle-iron bumpers. No. 27-G short-base double-trucks with 4-ft. wheel base and 33-in. wheels and No. 21-E single-trucks with 7-ft. 6-in. wheel base and 33-in. wheels are used. Both types have solid forged side frames. The weight of a single-

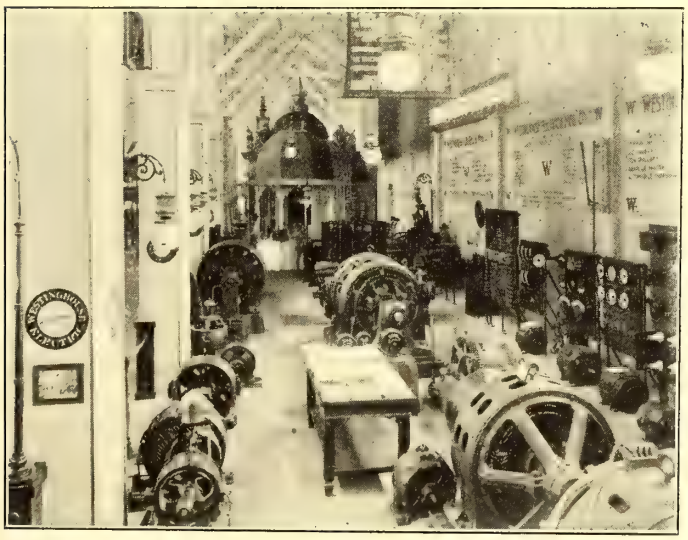
truck car without the electrical equipment is 18,620 lbs., and of a double-truck car, including all of the equipment, 44,940 lbs.

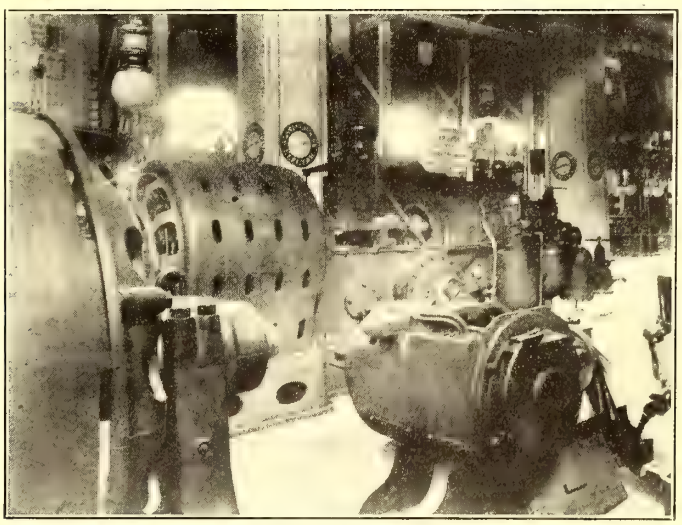
The general dimensions of the cars are as follows: Double-truck motor and trailer cars are 30 ft. 6 ins. over the end panels, and 40 ft. 6 ins. over the crown pieces and vestibules. The platforms are 5 ft. The width over the sills is 7 ft. 8 ins. The side sills are 4¾ ins. x 7¾ ins., and the end sills, 5¼ ins. x 6⅞ ins.; the thickness of the corner posts is 4½ ins. x 5½ ins. in one piece; the thickness of the side posts is 3¼ ins. The single-truck cars are 22 ft. 7 ins. over the end panels and 31 ft. 7 ins. over the crown pieces; platforms are 4 ft. 6 ins.; width over sills, 7 ft. 8 ins.; height of the window sill from the top of the car floor, 2 ft. 1 in.; side sills, 4¼ ins. x 6 ins., and the end sills, 3½ ins. x 6⅝ ins.; thickness of the corner posts, 4½ ins. x 5½ ins., made in one piece, and the thickness of the side posts, 2¾ ins.

DOUBLE-TRUCK CAR FOR NASHVILLE RAILWAY & LIGHT COMPANY

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY AT THE LEWIS AND CLARK EXPOSITION

In the STREET RAILWAY JOURNAL of Aug. 12 some facts were given about the more important exhibits at the Lewis and Clark Exposition. Further details have just come to hand of the Westinghouse electrical exhibit, and these are presented herewith. In the building devoted to machinery, electricity and transportation, the Westinghouse Electric & Manufacturing Company occupies 1500 sq. ft. of floor space. Starting in at the main entrance to the exhibit, the visitor's attention is attracted by the most prominent and most interesting feature of


D.C. AND A.C. GENERATORS AND MOTORS IN FOREGROUND, 600-HP TURBO-GENERATOR ON LEFT AT REAR

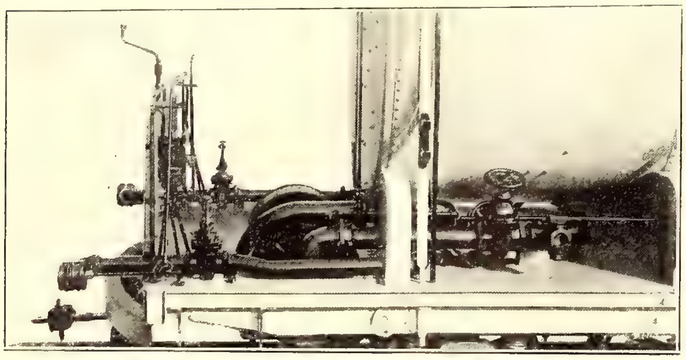

600-HP STEAM TURBO-GENERATOR SET—TURBINE OPENED FOR INSPECTION

the display, a 400-kw Westinghouse-Parsons turbo-generator unit. To the left is a showcase containing all the standard types of portable instruments, and just behind this is an electrically-operated distant-control automatic oil circuit breaker, designed to open a 200-amp. 33,000-volt circuit. Down the aisle is seen a No. 92 50-hp direct-current and a No. 107 75-hp alternating-current single-phase series railway motor and a switch group of the multiple-control system. To the right is a group of type S motors, including a vertical type machine, a 25-kw rotary converter and a 2-kw type S generator, direct connected to an Ohmen high-speed engine manufactured by the Ohmen Engine Works, of San Francisco, Cal. Across the aisle is a motor-generator set consisting of a 150-hp induction motor and a 100-kw direct-current engine-type generator, and in immediate succession are a group of type R direct-current motors, 1-6 hp to 1 hp; a 120-kw revolving-field self-contained a. c. generator, and a 100-hp type HF induction motor. At the extreme rear the Sanitary Devices Manufacturing Company displays, in conjunction with this exhibit, an automatic dust-removing plant driven by a type S motor.

In the rear section are also some distinctive types of Westinghouse transformers, including a 110-kw air-blast transformer, a number of type OD, type N, manhole type. Five OD transformers, ranging from 7½ kw to 25 kw, are mounted on the wall. On turning to the left and walking toward the main entrance, may be seen a group of induction motors, types H and CCL for constant-speed work, and types F and C for variable-speed service. A line of special motors, both a. c. and d. c., for crane service is also shown. Standard switchboard instruments, comprising voltmeters, wattmeters, ammeters, power-factor meters, etc., are arranged on display boards against the wall. In the controller section are found an oil-immersed auto-starter for use with the CCL motors, a rheostatic controller for the type HF motor, an elevator controller used with type F motors, an automatic pump controller, and finally a three-wire double-voltage controller for use with direct-current motor in machine-tool drive. Near the center of the exhibit is a rope hoist manufactured by the Denver Electric Company, to which is connected a No. 103 A type F induction motor. Various classes of fuses artistically arranged on a board, a double-throw oil switch, a static interrupter, choke coil and lightning arresters complete the display.

NEW CENTRIFUGAL SPRINKLING CAR

One of the most important inventions of the year in electric railway equipment is a recent invention of the J. G. Brill Company, known as the Brill centrifugal sprinkling car. Instead of using air pressure in the tank or in an auxiliary tank, the pressure is obtained by using a centrifugal pump operated by a direct-connected motor, both of which are located on the platform at one end of the car. The apparatus takes up comparatively little room and supplies enough pressure to sprinkle 50 ft. on either side of the car. About two years ago the Brill Company designed and built a double-truck gravity sprinkling car for the Bergen Turnpike Company, of New Jersey, which,

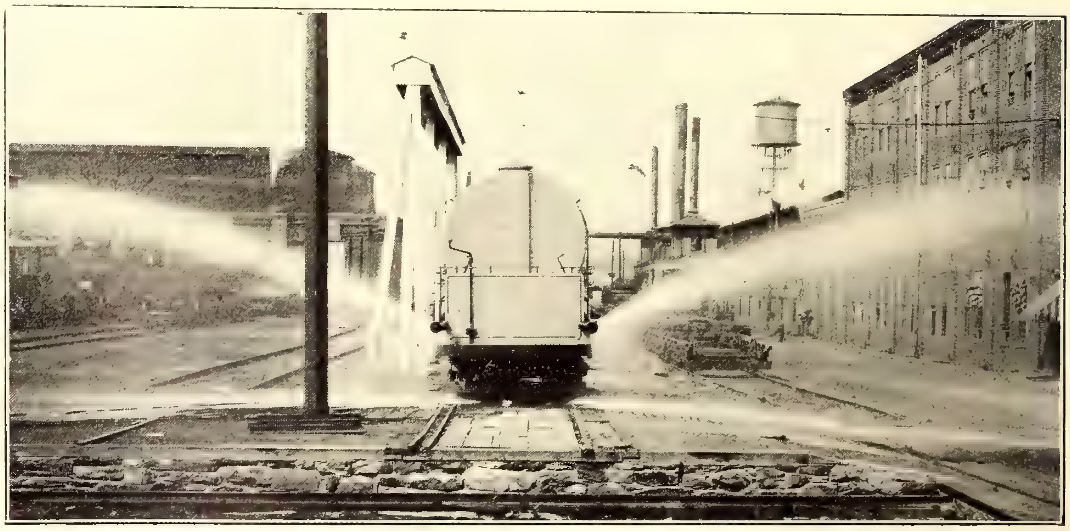


PIPING CONNECTION UNDER TANK

instead of being filled in the usual way, was furnished with a centrifugal suction pump operated by a motor. By means of this centrifugal pump the car was filled from a lake near the track and so got around the necessity of using hydrants, the water tax being excessive. This type was a complete success, and the company has built several cars with filling pumps. It suggested the use of a centrifugal pump for expelling the water, and not being entirely satisfied with the power sprinkler which the company has been building for a number of years, experiments have been carried forward for more than a year, and the new centrifugal sprinkler is the result. One of the drawbacks associated with the compressed-air sprinklers is the necessity for expensive tanks, as the pressure requires double riveting and special bracing, while in the new form only the weight of the water has to be taken into account. Where auxiliary tanks are used, valuable space is occupied and the expense of riveting to provide for high pressure is considerable. An important advantage of the centrifugal over other power sprinklers is that there are no wearing surfaces other than the shaft of the centrifugal pump; therefore, there is no possibility of the machinery becoming heated, no check valves, inlet valves, crank shafts, nor piston rods, are employed. In the centrifugal sprinkler, when the valves are all closed, provision is made by means of an automatic by-pass, for preventing back pressure on the motor at such a time when all four sprinkling heads might be quickly closed.

With a constant and uniform pressure produced by the centrifugal pump, and with sprinkling heads at both ends of the car which keep the amount and range of water always under control, it appears that a power sprinkler thoroughly practical from every standpoint has at last been devised. One of the illustrations, showing the centrifugal sprinkling car in operation, is made from an unmanipulated photograph, and shows a uniform spray of water projected upon the ground from a point inside the rail to a point at right angles 50 ft. from the rail. It will be seen in this illustration that the light line produced by the water falling upon the ground has the same appearance from the track to the edge of the picture, proving that the spray falls in a uniform amount over the entire surface. This is accomplished by the builder's special form of sprinkling attachment, consisting of a head vertically slotted for half its circumference and having inside a cylindrical chamber with a corresponding slot. The cylinder is moved forward and back, and revolved by a handle on the platform. Gate valves are also provided, as there are sprinkling heads at both ends. They are not absolutely necessary, because the sprinkling heads completely cut off the water, but it is an added convenience to have them.

The piping is very neatly arranged. There is but one opening in the bottom of the tank, and from that point a large pipe leads to the centrifugal pump on the platform and returns through the centrifugal pump to a pipe which leads to both sides of the car and direct to the sprinkling heads at the four corners. By attaching a suction hose under the centrifugal pump, water may be drawn by the pump into the tank, may easily be lifted vertically 20 ft., and may be drawn from quite a distance, so that if there is a lake or stream anywhere along the lines it is a simple matter to run a hose or lay a main from the track to the water and connect with a short hose to the pump. This enables a company to be independent of hydrants or expensive elevated tanks and their pumping equipment. Valves are provided in the piping and an inlet furnished so that the tank may be filled in the usual way from a hydrant or may be filled through a manhole.



VIEW SHOWING THE CENTRIFUGAL SPRINKLING CAR SPRAYING WATER FOR A DISTANCE OF 50 FT. ON EACH SIDE

The car shown has been delivered to the Lehigh Valley Traction Company, which operates over 200 miles of track in Allentown, Pa., and the vicinity. The length of the car over the end sills is 16 ft., and the width over the sills is 6 ft. 10 ins. The size of the tank is 6 ft. 6 ins. x 10 ft. The length from the tank over the end sills at either end is 3 ft. The side sills are 4¾ ins. x 10 ins., and the end sills are 7 ins. x 7 ins. The weight of the car body with the tank and the equipment is 9500 lbs., and including trucks, but without truck motors, 14,500 lbs. The car is mounted on the builder's No. 7 trucks with 33-in. wheels and 7-ft. wheel base.

LEGAL DEPARTMENT*

ACCIDENTS AT WINDOWS

The rule prevailing in the United States is that it is negligence as matter of law, precluding a recovery for damages for injury, for a passenger in a steam railway car, intentionally or inadvertently, to protrude his arm, hand, elbow or other part of his body through a window, while the car is in motion. (V. American and English Encyclopedia of Law, 683.) It is true that some American courts have held that such an act does not, per se, constitute contributory negligence, but the decided weight of authority and the better opinion support the rule above stated. Somewhat illogically, according to the judgment of the writer, the tendency of authority is in the opposite direction as regards passengers in street railway cars. There are not as many decisions dealing with street railway passengers as with travelers on steam railroads, but such cases as have been reported seem to favor the view that whether or not a street railway passenger is negligent in allowing part of his person to protrude from a window is a question of fact under the actual circumstances of the case to be submitted to the jury. In Miller vs. St. Louis R. Co. (5 Mo. App., 471) it is said: "It does not necessarily follow, however, because the exposure of the person from the window of an ordinary railroad carriage moved by steam is negligence, that the same exposure from the window of a street car is so. The motive power is much more under control in one case than in the other, whether we speak of the carriage in which the passenger is or of anything likely to approach it from a parallel track, and the speed is less."

On various occasions legitimate distinctions as to the measure of care and liability between steam railroad and street railway companies have been pointed out in this place. It is, however, difficult to perceive any proper basis for a distinction in the considerations above quoted. It scarcely would be contended that because street cars are run at a comparatively low rate of speed those operating them are chargeable with the duty before passing obstructions or other cars to make an inspection for protruding arms and elbows and give warning to withdraw them. Nevertheless, a discrimination between the two forms of conveyances has been drawn and, according to the present state of the law, must be reckoned with.

The advisability is therefore suggested, especially as to cars running on routes where protruding arms and elbows are particularly liable to contact with outside objects, of providing bars or screens. Indeed, the duty of furnishing such safeguards has been laid down in a few adjudicated cases even as to steam railroad cars. A recent street railway case betokens a judicial disposition to deal reasonably with the question of a company's liability if it has taken fair precautions to avoid harm to passengers.

In Christensen vs. Metropolitan Street Railway, decided by the United States Circuit Court of Appeals, Eighth Circuit, in April, 1905 (137 Fed., 708), it was held that screens with large meshes fastened across the lower half of the windows of a street car on the side next to the poles supporting the trolley wires are a sufficient protection against the accidental injury of passengers from such poles, and a sufficient warning of danger to absolve the railway company from the charge of negligence in that regard. It was actually decided that a passenger in a street car who, on account of a sudden illness, extended her head through a window above a screen which covered the lower half of the window, and was injured by striking against a trolley pole beside the track—she being obliged in order so to reach the window to stand upon the seat—was chargeable with contributory negligence as matter of law. The court remarked:

"While the plaintiff's sudden illness undoubtedly placed her in a very uncomfortable and distressing position, yet that fact would not authorize her to disregard unmistakable warnings of danger. She must have known that the heavy screens which barred the windows were placed there for no other purpose than to prevent passengers from extending their arms or heads out of the windows, as the meshes in the screen were too large to serve any other purpose. To disregard this plain warning was, we think, such contributory negligence upon her part as will necessarily preclude a recovery in this case."

* Conducted by Wilbur Larremore, of the New York Bar, 32 Nassau Street, New York, to whom all correspondence concerning this department should be addressed.

CHARTERS, FRANCHISES AND ORDINANCES

GEORGIA.—Taxation of Street Railways—Equal Protection of the Laws—Contracts—Impairment of Obligation.

1. A street railway company is not denied the equal protection of the laws by a municipal tax on its business at a rate of $100 per mile or fraction of a mile of its trackage in the city streets because a steam railway, making an extra charge for local deliveries of freight brought over its road from outside the city, is not subjected to this tax.

2. No exemption from the municipal taxation of the business of a street railway company results from provisions in its agreement with the municipality preserving its easements for railway purposes in land to be conveyed by it to the city, and granting it the right to lay down, construct, maintain and operate its railway through certain streets, subject to the control and regulation of the Mayor and Aldermen.—(Savannah, Thunderbolt & Isle of Hope Railway, of Savannah, Ga., Plff. in Err., vs. Mayor and Aldermen of the City of Savannah, 25 Sup. Ct. Rep., 690.)

INDIANA.—Railroads—Crossings—Construction of Safety Devices—Constitutional Law—Presentation of Constitutional Questions.

1. Under act March 3, 1903, p. 125, c. 59, requiring street railroads desiring to cross railroad tracks to maintain and operate a system of interlocking works and derailing apparatus within six months after it commences to use the crossing, and authorizing the road desiring to make the crossing to enjoy the use of the same at once by paying the amount of the award into court, and presenting a summary method for hearing and settling objections, the six months within which the interlocking works must be constructed commences to run at the time that the street railway begins to use the crossing, and is not postponed until the final termination of litigation as to damages to be paid by the street railroad for constructing the crossing.

2. A street railroad which, in crossing the tracks of a railroad, has made no attempt to comply with act March 3, 1903, p. 125, c. 59, requiring the construction of interlocking works with a derailing apparatus, cannot, in litigation with the railroad over its failure to comply with the statute, raise the question of the constitutionality of that portion of the statute requiring the works to be constructed to the satisfaction of the State Auditor.—(Chicago I. & L. Ry. Co. vs. Indianapolis & N. W. Traction Co., 74 N. W. Rep., 513.)

KENTUCKY.—Railroads—Right of Way Agreements—Erection of Station Houses—Breach—Damages—Instructions—View—Misconduct of Jury.

1. In an action against a railroad to recover damages for breach of an agreement to maintain a station near plaintiffs' land, in consideration of which plaintiffs conveyed to defendant a right of way through their land, a charge defining the measure of damages as such sum as would represent the difference in what would have been a fair market value of the residue of plaintiffs' land after the conveyance of the right of way if the station had been established and the fair market value of such residue without the station was proper and sufficient, without further telling the jury not to take into consideration the value of the strip of land deeded to defendant.

2. In an action against a railroad for breach of an agreement to maintain a station near plaintiff's land in consideration of a conveyance of a right of way through such land, the damages claimed were based on the value of the land for suburban residential purposes, and its value for agricultural purposes was not in issue. A view was awarded, and, while on the premises, there was some conversation between a juror and a stranger as to the quantity of hay grown on the place, and the jury, or some of them, walked over the tract, stepping off the distances. Held, that the misconduct of the jury was immaterial.—(Louisville, A. & P. V. Electric Ry. Co. vs. Whipps et ux., 87 S. W. Rep., 298.)

MASSACHUSETTS.—Street Railroads—Location—Restrictions—Statutes—Construction—Powers of Town—Streets—Repair—Reconstruction.

1. A restriction as to street repairs contained in the original location of a street railway company's line by a town is not af-

fected by St. 1898, p. 742, c. 578, s. 11, providing that street railroads shall be subject to a mileage tax corresponding to the amount formerly paid for the repair of streets, and that such railroads should not be required to keep any portion of the streets and highways in repair, but should remain subject to all legal obligations imposed in original locations granted by a city or town, etc.

2. Under Pub. St. 1882, c. 113, s. 7, authorizing selectmen of a town to grant a street railway location under such restrictions as they deem the interests of the public may require, the selectmen of a town, in granting a location, were authorized to require the railway company to keep that portion of the streets included between its tracks, and for 18 ins. outside thereof, at all times flush with the top of the track, and keep the same in repair, to the satisfaction of the selectmen, though such restriction was more onerous than the general law (Pub. St. 1882, c. 113, s. 32) limiting a street railroad company's obligation to repair the paving, upper planking, or other surface material of the portions of the streets, etc., occupied by its tracks, and, in case of unpaved streets, for a distance of 18 ins. on either side of the portion so occupied.

3. Under Pub. St. 1882, c. 113, s. 7, authorizing selectmen of a town to grant a street railway location under such restrictions as they deem the interests of the public may require, the town was authorized to impose a restriction in a grant of location requiring the railroad to reconstruct its track and roadbed by laying such different material therefor as the selectmen, after a public hearing, may judge that public safety and convenience require, etc.

4. Such restriction was not rescinded by St. 1898, p. 743, c. 578, s. 13, providing that all locations previously granted or in use are ratified and confirmed as if accepted under the provisions of such section, the first clause of which ratified the validity of all restrictions which could have been made thereunder.

5. Where a street railroad location contained a restriction requiring the railroad company to reconstruct its track, etc., with different material, as required by the Board of Selectmen, the railroad company could not refuse to comply with an order requiring it to take up 50-lb. T-rails specified in the location, and lay down 90-lb. girder rails in place thereof, because both were of the same material.—(Dunbar et al. vs. Old Colony St. Ry. Co., 74 N. E. Rep., 353.)

MASSACHUSETTS.—Street Railroads—Restrictions—Fares—Street Lighting—Statutes.

1. Under Pub. St. 1882, c. 113, s. 43 (Rev. Laws, c. 112, s. 69), providing that a street railway company may establish the rates of fare subject to its charter, and the statutes (St. 1898, p. 743, c. 578, s. 13), providing that the selectmen of a town, in a location to a street railroad company, may impose such conditions as the public interest may require, does not authorize them to impose a limitation on the rates of fare.

2. That an electric street railroad company was forbidden to use its electricity for lighting purposes by Rev. Laws, c. 121, ss. 24, 26, and c. 122, s. 1, did not preclude it from using electricity for lighting as an incident to its business, or constitute an excuse for its failure to comply with an order of the selectmen of a town requiring it to maintain 100 electric lights, of 25 cp each, for 5 miles, along a street on which it operated its line.—(Cunningham et al. vs. Boston & W. St. Ry. Co., 74 N. E. Rep., 355.)

MISSISSIPPI.—Carriers—Passengers—Separation of Races—Evasion of Statute—Ejection of Passenger—Justification—Punitive Damages.

1. Signs 8 ins. x 12 ins. in size, having painted thereon the words "White" and "Colored," respectively, and supported on the backs of seats in streets cars, are not "adjustable screens" within the meaning of Laws 1904, p. 140, c. 99, requiring the separation of the white and colored races on street cars, but permitting the use for that purpose of adjustable screens, to be moved about as the needs of the traffic may require.

2. A street railway company which evades Laws 1904, c. 99, p. 140, requiring the separation of the white and colored races on street cars, by merely posting small signs to mark the limits of the space allotted to the respective races, cannot invoke the provision of the law authorizing the conductor to move the partition or screen separating the races according to the needs of the traffic, and to put all passengers who refuse to accommodate themselves to such adjustment off the cars as a justification for his act in ejecting a passenger.

3. Punitive damages may be awarded to a female passenger who was rudely ejected from a street car by the conductor, and compelled to walk some distance in the mud, because of her refusal to comply with an unwarranted demand of the conductor that she change her seat in the car.—(Southern Light & Traction Co. vs. Compton, 38 S. Rep., 629.)

NEW YORK.—Street Railroads—Transfers—Recovery of Penalties.

1. Laws 1890, p. 1106, c. 565, s. 78, as amended by Laws 1892, p. 1398, c. 676, provides that any railroad corporation may contract with any other for the use of their respective roads, and if such contract shall be a lease, certain formalities are to be observed in its execution. Section 104 (p. 1114) provides for transfers from one road to another upon payment of a single fare. Held, that the latter section applies to surface lines leased by one or more corporations to another, and operated by the lessee, so as to render the lessee liable where transfers are tendered and refused for the penalties provided for their refusal.

2. The penalties provided for on refusal of transfer on payment of a single fare from one to another of leased surface railroads, under Laws 1890, p. 1082, c. 565, as amended by Laws 1892, pp. 1398, 1406, c. 676, ss. 78, 104, are not cumulative, and the bringing of an action for one penalty is a waiver of all previous penalties incurred.—(Griffin vs. Interurban St. Ry. Co., Scudder vs. Same, 72 N. E. Rep., 513.)

NEW YORK.—Street Railroads—Extension of Line—Franchise—Expiration—Statutes.

Railroad Law (Laws 1890, p. 1084, c. 565), s. 5, provides that, if any domestic railroad corporation fails to begin the construction of its road within five years after the certificate of incorporation is filed, its corporate existence and powers shall cease; and section 99, art. 4, p. 1112, which article is entitled "Street Surface Railroads," provides that in case such corporation shall commence the construction of its road, or any extension thereof, within one year after the consent of the local authorities and property owners, and shall not complete the same within three years, its rights may be forfeited. Held, that where a street railroad company was granted a franchise to construct an extension, but it failed to commence such construction within five years, its rights were lost, ipso facto, under Railroad Law, s. 5, the same being self-executing.—(In re Brooklyn, Q. C. & S. R. Co., 94 N. Y. Suppl., 113.)

NEW YORK.—

1. The contract arrangement for the payment to a municipality of a license fee on each street car, modified as to the amount of such fees under the authority of a statute accepted by the street railway company, stating that such fees should be taken "in full satisfaction for the use of the streets or avenues," does not exempt the company from the tax imposed, under N. Y. Laws 1899, c. 712, on its franchise.

2. A street railway company cannot claim to have been denied due process of law in the valuation of its franchise for the purpose of the special franchise tax imposed by N. Y. Laws 1899, c. 712, on the theory that it was ascertained by speculation and guesswork, where such valuation is required to be made by the State Board of Tax Commissioners, to which the owner of the franchise is required to furnish a written report, and notice and hearing are accorded such owner, and a review of the assessment by certiorari is afforded.—(People of the State of New York ex rel. Brooklyn City Railroad Company, Plff. in Err., vs. State Board of Tax Commissioners, 25 Sup. Ct. Rep., 713.)

OHIO.—Street Railroads—Franchises—Limitations—Municipal Corporation—Powers—Contract Rights—Surrender—Unlimited Franchises—Judgments—Estoppel—Res Judicata—Consolidation of Lines—Effect—Extension of Franchise by Implication—Ordinance—Title—Permission to Extend Tracks—Effect—Determination of Franchise—Statutes—Construction—Extensions—Authority of Municipality—Double-Tracking Line—Validity.

1. A municipal corporation entitled to grant a street railway franchise had power to limit the grant as to time, prior to the passage of act Ohio May 14, 1878 (75 Ohio Laws, p. 360), providing that no grant or renewal of a grant shall be valid for a greater period than twenty-five years, though prior to the passage of such act there was no statute authorizing the municipal corporation to limit such grants.

2. Where a street railway company, having an alleged unlimited franchise to operate a line on a certain street, granted prior to the adoption of 75 Ohio Laws, p. 360, limiting such grants to twenty-five years, accepted the terms of a subsequent ordinance authorizing it to extend its line on such street, and to equip and operate such extension and all of its tracks on such street for a period of twenty-five years, the acceptance of such ordinance operated as a surrender of its alleged unlimited franchise as to such street.

3. Where a street railway company was compelled by action of the public to defend itself in court against a present claim of misuser of its franchise, mere reasons presented by it in argument in such action, though inconsistent with its subsequent

claim as to the continuance of its franchise, did not amount either to an estoppel or establish a claim of res judicata.

4. Neither the consolidation of street railway lines into one company and one system, nor transfer obligations imposed by an ordinance authorizing the laying of an additional line on another street, operated to prolong the life of any prior franchise.

5. Where none of the titles of several city ordinances granting street railway extensions contained any intimation of a purpose to deal with the subject of the life of the original grant, though the "subject" of the ordinance was required to be "clearly expressed in its title," an extension of the main franchise could not be implied therefrom.

6. Ordinance granting a street railway company permission to extend tracks and operate them "in connection with the main line" for a period which endures longer than the right to operate the main line did not operate as extending the main line franchise, regardless of whether such extensions were capable of independent operation.

7. Where a street railway company operating lines on various streets, under franchises which expired at different times, accepted an ordinance authorizing the substitution of electricity for horse power on its G. Street branch, and providing that the right to operate such branch should continue during the term of the company's then present grant for the operation of the tracks on such branch, the ordinance fixed a uniform period for termination of the franchise of the G. Street line over its entire length, as extended under a prior ordinance, and therefore abrogated any prior contract for the operation of an extension of the G. Street branch for a period longer than the expiration of the G. Street franchise.

8. Rev. St. Ohio, ss. 2501, 2502, provide for the granting of original street railway franchises, after advertisement on public bids, to the corporation which will agree to carry passengers at the lowest possible rates of fare, and shall have previously obtained the written consent of a majority of the property holders on the several streets along the proposed route, provided that no street railway grant, or renewal of a grant, shall be valid for a longer period than twenty-five years. Section 2505 authorizes the City Council to grant any street railway corporation power "to extend its track," subject to the provisions of sections 3437-3443, none of which, however, relates to the establshment of a route or a renewal of a grant, and did not require such extensions to be on competitive bidding, etc. Held, that an extension granted under such sections is not a "new route," having an independent life, but depends for its existence on the original line, and expires with the franchise thereof.

9. Where a City Council established a street railway route, and granted a franchise for the operation of the road, as provided by Rev. St. Ohio, ss. 2501, 2502, the City Council had no power, by merely giving the corporation the right to double track its lines, to confer power on the railroad company to operate the second track for a period beyond the term of the franchise of the line double tracked.—(Cleveland Electric Ry. Co. vs. City of Cleveland et al., 137 Fed. Rep., 111.)

PENNSYLVANIA.—Railroads—Property Tax—License.

Where a city of the second-class imposed a tax of 25 cents per foot for each foot of track laid or operated by a street railway within the city, except such tracks as were in the yards or buildings of the company, it was a property tax, and not a license tax, within act March 7, 1901 (P. L. 40), art. 19, s. 3, pars. 4, 22), though the ordinance designated the tax as a license tax.—(Pittsburg Rys. Co. vs. City of Pittsburg et al., 60 Atl. Rep., 1077.)

WEST VIRGINIA.—Eminent Domain—Railroads—Crossing Other Road—Jurisdiction—Character of Crossing—Statutes—Construction—Bill—Multifariousness—Pleading—Costs.

1. The acquisition of a crossing by one railroad over another involves a taking of private property for public use.

2. Section 11 of chapter 52 of the Code of 1899 does not confer upon courts of equity jurisdiction to condemn the property of one railroad, turnpike or canal company for the purpose of a crossing by another railroad, turnpike or canal company.

3. By said section such courts are empowered to determine the exact places at which, and the manner in which, such crossings may be made, when the parties are unable to agree; but the right to cross must be obtained by proper proceedings under chapter 42 of said code, when it cannot be secured by consent and agreement of parties.

4. The place and character of the crossing to be decreed, when the parties fail to agree, are determined by the situation of the parties, the public interests, the topography of the place, the connections to be made, the expense of making the crossing, and all the material facts and circumstances affecting the public and the rights of the parties immediately concerned, and not upon the choice and will of the parties desiring it. Hence the court may decree a crossing other than the one described in the bill.

5. Railroad crossings at grade are neither prohibited nor discriminated against by the statute. On the contrary, they are expressly authorized, and, when the parties fail to agree, the court may order such crossing to be made, as, under all the circumstances, is fair, just and reasonable, viewed from the standpoint of the parties interested, and promotive of the public welfare.

6. The clause in section 11 of chapter 52 of the code reading as follows, "Provided its work be so constructed as not to impede the passage or transportation of persons or property along the same," neither contemplates nor prohibits such impediments as are merely incidental to a properly constructed crossing at grade.

7. Wherever a crossing is necessary in the construction of a railroad, the law allows it, and confers the right to obtain it; but this power is to be exercised, in the absence of an agreement by the parties, under such conditions and limitations as to the place and mode of crossing as a court of equity may justly impose, in view of the interests of the parties and the public.

8. In the construction of a statute, its spirit, rather than its letter, is the guiding star, but contradiction and repugnance must be avoided when it is possible to do so. The statute must be construed as a whole, and every word in it made effective, if possible.

9. A clearly expressed intention in one part of a statute does not yield to a doubtful construction of another portion of it; and when the general intention of the Legislature is clear, and the spirit and purpose of the statute are manifest, a mere implication or inference of a contrary particular or special intent, arising out of language of doubtful meaning, must yield to the general intent.

10. Where the language of a statute is ambiguous or the meaning doubtful, the surrounding circumstances, the history of the times, and the defect or mischief which the statute was intended to remedy, may be resorted to in seeking its true meaning and purpose.

11. An undeviating course of legislation in a certain direction through a long period of time, in an effort to systematize and perfect the law relating to a given subject, strongly emphasizes the express language embodying the final declaration of legislative will.

12. All former statutes on the same subject, whether repealed or unrepealed, may be considered in construing provisions that remain in force.

13. Uniting a purely legal demand with an equitable demand, in a bill seeking the enforcement of the latter, does not render the bill multifarious.

14. In such case the allegations respecting the legal demand may be treated as surplusage and ignored.

15. The extent to which facts must be set out in a bill depends upon the nature of the principal facts to be established. When a general term used has a double meaning, and, standing alone, may import either a mere fact or a conclusion of law, it must be accompanied by a statement of such additional facts as constitute ground for the legal conclusion which the plaintiff undertakes to establish; else the rule that pleadings must be certain to a common intent is violated.

16. Bills filed under section 11 of chapter 52 of the Code of 1899 are governed by the ordinary rules of equity pleading applicable to bills in general, and a bill so filed is sufficient if it so states the plaintiff's case as to inform the defendant of what he is called upon to meet.

17. When, in a suit under section 11 of chapter 52 of the Code of 1899, the court decrees a crossing substantially different from the one demanded of the defendant before the institution of the suit, a decree for costs against the plaintiff is proper.—(Wellsburg & S. L. R. Co. vs. Panhandle Traction Co. et al., 48 S. W. Rep., 746.)

LIABILITY FOR NEGLIGENCE

ALABAMA.—Street Railroads—Injury to Person Crossing Tracks—Contributory Negligence.

1. At street crossings pedestrians and operators of street cars have equal rights of passage, but each is presumed to know of the danger incident to the crossing by the former of the car tracks, and upon each is incumbent the duty of exercising such care to avoid injury as a reasonably prudent person would use under the circumstances.

2. It is the duty of a pedestrian, before crossing tracks on which street cars are being operated to look and listen for approaching cars, from which he is not absolved by the fact that a car had but recently passed, and where he could have seen an approaching car by which he was struck and injured, but failed to look, he is chargeable with contributory negligence, which precludes his re-

covery for the injury, notwithstanding the negligence of those operating the car, unless their negligence was willful or wanton.

3. Where plaintiff, upon alighting from a street car at a street crossing, passed around behind it, and upon a parallel track, without looking to see whether there was a car approaching thereon, and was struck and injured by a car going in the opposite direction, the question of his contributory negligence is not affected by the fact that the rules of the company required the car to stop on meeting another, which had stopped to take on or discharge passengers, and also to sound the bell at crossings, which was not done; it not appearing that such rules were customarily observed, or that plaintiff relied upon or knew of them.—(Birmingham Ry., Light & Power Co. vs. Oldham., 37 S. Rep., 452.)

ARKANSAS.—Carriers—Street Railroads—Injury to Passenger—Time to Alight—Premature Start—Care Required—Instructions.

In an action against a street railroad for injuries to a passenger, plaintiff claimed that the car suddenly moved forward while he was alighting, and there was testimony that the car was moving at the time plaintiff alighted. The court charged that if the conductor knew of plaintiff's negligent conduct, and could, by the exercise of proper care, have prevented the injury caused thereby, and did not do so, the contributory negligence of plaintiff would be no bar to his recovery, notwithstanding the jury might find that the conductor did not and could not have had any reason to anticipate that an injury would probably be caused. Held, that the instruction was calculated to mislead, since, if the car was moving so slowly that the conductor, by reasonable foresight, could not have anticipated that plaintiff would be injured, it was not the conductor's duty to make an effort to avoid such consequence.—(Little Rock Traction & Electric Co. vs. Kimbro, 87 S. W. Rep., 614.)

ARKANSAS.—Carriers—Street Railroads—Passengers—Ejection—Exemplary Damages.

Where a street railway conductor improperly refused to accept plaintiff's transfer because it was too late, and required plaintiff to pay another fare or leave the car, but in doing so the conductor acted in obedience to the rules of the company, as he understood them, and was guilty of no unnecessary rudeness, plaintiff was not entitled to recover exemplary damages.—(Little Rock Traction & Electric Co. vs. Winn, 87 S. W. Rep., 1025.)

CONNECTICUT.— Negligence—Instructions—Damages—Proof—Evidence of Cost of Article.

1. In an action for injuries from a leakage of electricity from defendant electric company's wires into a street where plaintiff was driving, the court read to the jury defendant's request to the effect that there was no contractual relation between the parties, and that defendant was not an insurer of the plaintiff's safety, and then refused to so charge—such expressed disapproval being accompanied by instructions contained in plaintiff's requests which in effect made defendant an insurer—and elsewhere in plaintiff's requests other measures of defendant's duty were given. Held, that such instructions were prejudicially erroneous as to defendant.

2. Where, in an action for injuries, the jury were once told in a charge that the subject of plaintiff's contributory negligence was not in issue, and elsewhere they were correctly told otherwise, it was prejudicial error as to defendant.

3. Where,in an action for injuries to a horse, plaintiff testified as to his worth before and after the injuries, defendant, on cross-examination, should have been permitted to ask what plaintiff paid for the horse.

4. In an action for injuries to a horse, the admission of evidence as to the price paid for the animal, on the issue of damages, is to be determined by considerations involving the exercise of a sound discretion, under all the circumstances.—(Rosenstein vs. Fair Haven & W. R. Co., 60 Atl. Rep., 1061.)

DELAWARE.—Street Railways—Collision with Team at Crossing—Negligence and Contributory Negligence.

A street railway company is liable for collision with a team at a crossing if its employees in charge of the car fail to exercise ordinary care, considering the circumstances of the place and occasion, and this is the proximate cause of the accident, and the person in charge of the team does not, by failure to exercise such care, contribute to the accident.—(Boudwin vs. Wilmington City Ry. Co., 60 Atl. Rep., 865.)

DELAWARE.—Street Railroads—Negligence—Duty of Car Operatives—Care Required—Running Into Funeral Procession.

1. A street car is not required to stop at street intersections for a funeral procession to pass, nor to give a funeral procession the right of way.

2. The fact that by courtesy street railroads have given funeral processions the right of way does not relieve one driving a vehicle in a funeral procession from using reasonable care and precaution to avoid collision with a street car.

3. In an action for injuries to plaintiff, who was driving a vehicle in a funeral procession, owing to a collision between his vehicle and a street car, it appearing that it had been the uniform practice of defendant to give funeral processions the right of way, which was known to plaintiff, such custom might be taken into account by the jury in estimating the degree of diligence required of plaintiff.

4. In approaching a crossing where there is a steep down grade, it is the duty of a motorman to make the descent at reasonable speed, so as not to put the car beyond his control.

5. Where a street railway approaches a crossing at a point where the rails are wet and slippery, or where the view of the railway from the crossing street is obstructed, greater care is required of the car operatives than where such conditions do not exist.

6. In an action against a street railroad company for injuries sustained in a collision between plaintiff's vehicle and a car, the burden of proving defendant's negligence is on plaintiff.

7. Where there was negligence on the part of the motorman of a street car, but the negligence of plaintiff contributed to the collision between plaintiff's vehicle and the car, or was the proximate cause thereof, the railway was not liable for the injuries.—(Foulk vs. Wilmington City Ry. Co., 60 Atl. Rep., 973.)

DELAWARE.—Street Railroads—Trespassers—Children—Negligence—Care Required.

1. In an action for injuries, the burden of proving negligence is on plaintiff.

2. Whether negligence exists in a particular case is a question of fact for the jury.

3. What constitutes negligence is a question of law for the court.

4. In an action against a street railroad company for the death of a child, on the ground that defendant's motorman ordered him to jump off a car when it was in motion, whereby he was frightened, and either fell or jumped from the car, the jury were to determine whether defendant exercised due care, such as a reasonably prudent person would have done under the circumstances.

5. The term "ordinary care and diligence," applied to the management of electric cars in motion, means all the care, prudence and discretion which the circumstances of the place and occasion require.

6. In an action for the death of a child, if deceased, notwithstanding his tender years, contributed to the accident, so that his conduct was the proximate cause thereof, no recovery can be had.

7. The ordinary care of an infant is that degree of care which children of the same age, of ordinary care and prudence, are accustomed to exercise under like circumstances.

8. Where a child of tender years gets on the platform of a street car, and remains there unobserved by the servants of the company, and the child then jumps off or falls off without any negligence on the part of the servants, the company is not liable.

9. A street railroad company is not bound to so guard its cars as to prevent trespassing children from getting on or off while the car is in motion.

10. Where an infant trespasser on a street car was seen in a perilous position by the operatives, who could have prevented injury to him, caused by his jumping or falling off, but they made no effort to do so, there was such a lack of care as to constitute gross negligence.

11. Where the motorman of a street car saw a 5-year-old trespasser in a dangerous position on the front platform while the car was in motion, and by order or threat of the motorman the infant was frightened, so that he jumped or fell from the car, whereby he was injured, the company was liable.—(Goldstein vs. People's Ry. Co., 60 Atl. Rep., 975.

ILLINOIS.—Street Railroads—Injury to Passengers—Instructions—Contributory Negligence—Question for Jury—Trial—Limiting Instructions—Prejudicial Error.

1. The error, in an order limiting the number of instructions to be requested or given, which does not deprive a party of any proper instruction, is not reversible error

2. Where, in an action against a street railway company for injuries sustained by a passenger while alighting from a car, the issues were whether the passenger was injured because of the sudden starting of the car or because of his contributory negligence, and the court instructed that the burden of proof was not on the company to show how the passenger fell, and, if it was not shown that he fell by reason of the negligence in starting the car, as charged in the declaration, he could not recover, and the court also correctly submitted the defense of contributory negligence, it was error not to refuse to charge that the negligence alleged was that

the company suddenly started the car while the passenger was in the act of alighting, after the car had come to a stop.

3. Whether a passenger is guilty of contributory negligence in attempting to board or alight from a moving car is a question of fact for the jury, in view of all the circumstances.—(Chicago Union Traction Company vs. Olsen, 71 N. E. Rep., 985.)

ILLINOIS.—Street Railroads — Pedestrians — Injuries—Negligence—Contributory Negligence—Question for Jury—Direction of Verdict—Instructions—Modification—Special Interrogatories—Submission to Counsel—Prejudice.

1. The question of contributory negligence becomes a question of law for the court only when the undisputed evidence in so conclusive that the court could arrive at no other conclusion than that the injury was the result of plaintiff's negligence.

2. In an action for injuries caused by a street car striking a timber being carried by plaintiff and his companion, evidence considered, and held, that the question of plaintiff's contributory negligence was for the jury.

3. Plaintiff was injured by a street car striking a timber which plaintiff and his companion were carrying in the street. In an action against the railway company for such injuries the court charged that, if ordinary care on plaintiff's part required him to look and ascertain whether or not a car was approaching before he took such a position that the timber could come in the course of the car, and if plaintiff could "or would," by the exercise of ordinary care, have looked to see whether a car was approaching, and if he did not so look, and was injured because of his failure to look and ascertain whether or not a car was so approaching, and if "he did not exercise ordinary care for his own safety just before and at the time of the accident complained of, and was injured by reason thereof," he could not recover. Held, that the insertion of the words quoted in the instruction as requested was not erroneous, as charging that, though ordinary care required plaintiff to look, and he could, but omitted to do so, still such conduct did not amount to a failure to exercise ordinary care.

4. An instruction defining circumstantial evidence as such as gives rise to a reasonable inference in the minds of the jury, based on proof of the truthfulness of the facts alleged and sought to be proved, provided such circumstances, together with all the other evidence bearing on such facts, constitute a preponderance of the evidence, was not misleading.

5. An instruction that plaintiff was not bound to prove "his case" beyond a reasonable doubt, but only by a preponderance of the evidence, and that, if the evidence bearing on "plaintiff's case" preponderates in his favor, it will be sufficient, was not objectionable in that it used the term "plaintiff's case" and "his case" instead of referring to the allegations in the declaration.

6. An instruction that if plaintiff's evidence preponderates in his favor, although but slightly, the verdict must be for him, was not reversible error.

7. Where special interrogatories submitted by the court to the jury fully covered the issues of negligence and contributory negligence, defendant was not prejudiced by the failure of the court to submit them to counsel for examination before submitting them to the jury.—(Chicago City Ry. Co. vs. Nelson, 74 N. E. Rep., 458.)

ILLINOIS.—Carriers—Street Railroads—Injuries to Passengers—Electric Equipment—Explosion—Panic—Prima Facie Case Res Ipsa Loquitur—Instructions—Appeal—Right to Allege Error—Questions Not Raised at Trial.

1. In an action for injuries the judgment of the Appellate Court is conclusive on the question as to whether the verdict is supported by the weight of the evidence.

2. Plaintiff, while a passenger in defendant's street car, was startled by an explosion in the controller, which caused a panic. When the explosion occurred, the passengers, including plaintiff, rushed from the rear door, and plaintiff was pushed and fell to the pavement, sustaining serious injuries. Held, that the circumstances of the accident were sufficient prima facie evidence of negligence on the part of the carrier under the doctrine of res ipsa loquitur.

3. An objection on the ground of variance between the issues and proof cannot be reviewed where the question was not raised in the trial court.

4. Where, in an action for injuries to a passenger, the declaration averred that the injury was the result of an explosion in the electric equipment of the street car; that such explosion created a panic among the passengers, causing plaintiff and the other passengers to rush to the rear door, and in the excitment plaintiff was pushed from the car to the pavement and received the injury—it was not objectionable after verdict, on the ground that it did not allege that plaintiff was injured by the explosion, or in endeavoring to escape from danger apprehended by her therefrom.

5. Where plaintiff and other passengers on a street car were thrown into a panic by an explosion in the controller box, and plaintiff was injured in attempting to escape from the car, an instruction that if a person, without fault on her part, is confronted with apparent sudden danger, the obligation resting on her to exercise ordinary care for her safety does not require her to act with the same deliberation and foresight which may be required under ordinary circumstances, was properly given.

6. Where the court charged that plaintiff was required to prove that she was pushed or thrown from defendant's car and injured, as alleged, or she could not recover, it was not error to refuse to charge that plaintiff could not recover unless the jury believed from a preponderance of the evidence that plaintiff was in fact pushed and thrown from the car to the street, as charged in the declaration.—(Chicago Union Traction Co. vs. Newmiller, 74 N. E. Rep., 410.)

ILLINOIS.—Street Railroads—Injuries to Pedestrians—Derailment—Negligence—Issues and Proof—Evidence.

1. Where plaintiff sets out in his declaration in an action for injuries the negligent acts of the defendant relied on as a basis for a recovery, he cannot recover by reason of negligent acts not alleged, though proved to have caused the injury.

2. In an action for injuries to a pedestrian by being struck by a derailed street car, evidence held to justify a finding that the derailment was caused by defendant's negligence in leaving a switch open at a curve.—(Chicago City Ry. Co. vs. Bruley, 74 N. E. Rep., 441.)

ILLINOIS.—Street Railroads—Injuries to Pedestrians—Wrongful Death—Willful Injury—Actions—Special Interrogatories—Submission—Notice to Counsel—Instructions.

1. Where plaintiff's intestate, a boy 5 years old, was killed by coming in contact with a street car at the side as he was crossing the street behind another car going in the opposite direction, it was improper for the court to submit special interrogatories as to whether the child ran into the side of the car, or whether the car ran into and struck the child, as such interrogatories were both immaterial, and related only to evidentiary facts.

2. Where, in an action for death resulting from a street car collision with intestate at a crossing, the court charged that there was no evidence to support two counts of the declaration besides the count charging a willful and wanton injury, it was improper for the court to submit special interrogatories requesting findings as to whether defendant was guilty of wantonness or recklessness in driving the car in question, and whether it was guilty of negligence charged "in the declaration, or some count thereof."

3. It is improper for the court to submit special interrogatories to the jury without notice to counsel, and an opportunity given them to argue the same.

4. In an action for death caused by a collision between plaintiff's intestate and defendant's street car, an instruction on willful injury that it was not necessary for plaintiff to prove that defendant intended to drive the car upon deceased, in order to sustain an allegation of willfulness—but failing to charge what was necessary in order to sustain such allegation, was erroneous.—(Chicago City Ry. Co. vs. Jordan, 74 N. E. Rep., 452.)

ILLINOIS.—Carriers—Injuries to Passengers—Damages—Witnesses—Cross-Examination—Curing Error—Instructions.

1. Where, in an action for injuries, each of three instructions given at defendant's request, advised the jury that plaintiff could only recover such damages as were the result of the accident complained of, a former instruction on the question of damages was not prejudicially erroneous for failure to confine the jury to such damages.

2. Where the evidence on the issue of damages in an action for injuries was very conflicting, and it was doubtful whether plaintiff's present physical condition, which was emphasized in the presence of the jury by an ocular demonstration, was the result of the accident complained of, an instruction permitting the jury, in estimating plaintiff's damages, to take into consideration plaintiff's present physical condition, as shown by the evidence, was error

3. Where the extent of plaintiff's injuries, as claimed by her, was strenuously denied, plaintiff's denial, on cross-examination, that she helped take care of her mistress, who was the keeper of a boarding house, during an illness, did not so cover a subsequent interrogatory as to whether she did not carry her mistress' meals to her from the basement as to preclude defendant from being entitled to an answer thereto.

4. Error of the court in sustaining an objection to such question was not cured by subsequent testimony given by a witness who was in defendant's employ that plaintiff did perform the service inquired about for her mistress under the circumstances specified.—(Chicago Union Traction Co. vs. Miller, 72 N. E. Rep., 25.)

ILLINOIS.—Negligence—Release of Person Liable—Fraud—Raising Question of Fraud—Evidence—Question for Jury—Injuries—Hearsay Evidence—Impeaching Witness.

1. Where one signing a release is induced to do so by a fraudulent representation, but understands what he is signing, in order to make an attack on the release resort must be had to equity.

2. Where one signing a release is deceived into signing it by the belief that he is signing something else, he may attack the instrument in an action at law.

3. Where, in an action for personal injuries, there was evidence that plaintiff signed a release under the belief that he was signing a receipt for something else, the question whether the release was obtained unfairly was for the jury.

4. In an action for injuries where one defense was that prior to the accident plaintiff had met with other accidents, which had caused many of the ailments attributed to the accident in question, it was error to permit plaintiff to introduce the testimony of witnesses as to what they had heard about prior injuries to plaintiff.

5. Where evidence was introduced by plaintiff over objection, and defendant thereafter introduced evidence of the same character, he was not thereby precluded from questioning the correctness of the ruling on plaintiff's evidence.

6. In an action against a street railway for injuries sustained by having been struck by one of defendant's cars, it was error to admit on behalf of plaintiff's evidence showing that a policeman arrested the motorman and conductor several hours after the accident.

7. A party had no right on cross-examination of a witness to examine him as to his relations with his wife, and as to whether he supported his family.—(Chicago City Ry. Co. vs. Uhter, 72 N. E. Rep., 195.)

ILLINOIS.—Street Railroads—Persons on Track—Collisions—Death—Willful Injury—Witnesses—Interest—Competency—Instructions.

1. Since a judgment against a street railway company for death caused by the alleged negligence of a motorman in an action to which the motorman was not a party would not be evidence against the motorman in a suit by the railway company to recover over against him, such motorman was not interested in the suit against the railway company so as to be an incompetent witness for the defendant therein within Laws 1867, p. 183, removing the disqualification of witnesses on account of interest in the event, except (section 2) that a party interested shall not be allowed to testify of his own motion or on his own behalf as against the administrator of a deceased person, etc.

2. Where, in an action for death of a traveler on a highway in a collision with a street car, every witness to the occurrence testified to the sudden application of the brakes by the motorman before collisin, and there was no evidence of any intention or purpose not to discharge any duty incumbent on defendant with reference to the accident, an instruction withdrawing from the jury an issue of willful and wanton injury was proper.

3. Where, in an action for death of a traveler in a collision with a street car, there was no evidence of a willful injury, a requested instruction to find for plaintiff, though deceased was guilty of negligence contributing to the accident, if the evidence showed that the motorman managed the car in a wanton and reckless manner, was properly refused.

4. In an action for death, an instruction authorizing recovery for mere negligence on the part of defendant's servant, notwithstanding contributory negligence of deceased, was properly refused.—(Feitl vs. Chicago City Ry. Co., 71 N. E. Rep., 991.)

ILLINOIS.—Carriers—Injuries to Passengers—Mental Condition Non-Expert Opinions—Trial—Misconduct of Counsel.

1. Where, in an action for injuries to a passenger, it was claimed that his brain was injured, it was competent to show his mental status before the injury, and also continuously from and after the injury to the time of the trial.

2. Where an injury to a passenger was alleged to have resulted in loss of reason, non-expert witnesses who had known plaintiff before and after the accident, and who had testified to instances of action on plaintiff's part, occurring after the accident, tending to show a diseased mind, were competent to give their opinion as to his mental condition.

3. An action for injuries having been previously tried, on a subsequent trial defendant's counsel objected to an answer, whereupon a colloquy occurred between the court and counsel, and, with reference to the remarks made, the court said, "I hoped we would get along without them and be satisfied," whereupon plaintiff's counsel remarked, "I was satisfied at the end of the other trial." Counsel for defendant thereupon objected, and the court said, "Yes, it is improper," notwithstanding which ruling, defendant's counsel took an exception. Held that, since the verdict in favor of the plaintiff was amply sustained in other respects, the reference made by plaintiff's counsel to the previous trial was not reversible error.—(Chicago Union Traction Co. vs. Lawrence, 71 N. E. Rep., 1024.)

ILLINOIS.—Street Railroads—Injuries to Passengers—Action—Instructions—Contributory Negligence.

1. It is improper for the trial court to limit the number of tendered instructions.

2. Marking a tendered instruction "not received," instead of "refused," is not material where the instruction should not have been given.

3. In an action against a street car company for injury to a passenger, where the action was based on negligence in suddenly starting the car as plaintiff was about to alight, its proper to refuse a tendered instruction relating to negligence in failing to properly stop the car.

4. As it is not, as a matter of law, contributory negligence for a street car passenger to fail to take hold of the rail or bar of the car while riding on the platform preparatory to alighting, it was proper to refuse an instruction, in an action for injury in being thrown off by the sudden starting of the car, that such failure of a passenger would be contributory negligence.

5. In an action by a passenger on a street car for injuries received, where the instructions required the jury to find that plaintiff could not recover unless she was in the exercise of due care for her own safety, and that the giving of notice in some way to the conductor that she desired to alight was involved in her exercise of due care, it sufficiently presented to the mind of the the jury the question of notice to the conductor.

6. An instruction requiring the jury to notice and consider the extent to which any one of the instructions given might be qualified by other instructions is not erroneous, as submitting to the jury a question of law.

7. Instructions to the jury must be regarded as a continued series, and it must be clear that the jury have drawn an improper inference from a single instruction before the judgment will be reversed.—(Chicago Union Traction Co. vs. Hanthorn, 71 N. E. Rep., 1022.)

ILLINOIS.—Street Railroads—Injury to Pedestrian—Contributory Negligence—Question for Jury—Finding of Appellate Court—Conclusiveness—Peremptory Instruction—Waiver of Ruling.

1. A defendant does not waive his right to have reviewed the action of the trial court in refusing a peremptory instruction because it is offered at the close of all the evidence, or because after its refusal he requests instructions as to the law of the case.

2. Where there is any evidence to establish a fact as found by the Appellate Court, the finding is binding on the Supreme Court.

3. In an action against a street railway company for the death of a pedestrian struck by a car, a witness testified that he saw dedecedent walking on the street; that just as he reached the carline the witness heard the gong of a street car, and instantly the car, going at the rate of 12 or 15 miles an hour, struck decedent down; that the witness went to the car, which had stopped, and found decedent dead under the car. The proof tended to show that decedent had almost cleared the track when he was struck, and that no warning of the approach of the car was given. Held, that the question of the decedent's contributory negligence was for the jury.—(Chicago Union Traction Co. vs. O'Donnell, 71 N. E. Rep., 1015.)

INDIANA.—Street Railroads—Vehicles—Collisions—Injuries to Travelers—Imputed Negligence—Contributory Negligence—Questions for Jury—General Verdict—Special Interrogatories Conflict — Witnesses — Credibility — Instructions — Appeal —Review.

1. In determining whether special findings are in irreconcilable conflict with the general verdict, all reasonable presumptions and intendments must be indulged in favor of the verdict, and nothing can be presumed in favor of the special findings or answers to interrogatories.

2. Where plaintiff was injured by a street car striking a vehicle in which she was riding with her husband, special findings of isolated facts to the effect that plaintiff, while passing along the street prior to the accident, did not look to discover the approach of the car; that she made no effort to ascertain the location of the car; that she heard it approaching, and gave her husband some warning that they were in danger, etc.—were insufficient to overthrow a general verdict in favor of plaintiff, as showing that she was guilty of contributory negligence as a matter of law.

3. In an action for injuries to plaintiff in a collision between a street car and a vehicle in which she was riding, evidence held to require submission of plaintiff's alleged contributory negligence to the jury.

4. The preponderance of the evidence does not depend on the number of witnesses, but means the greater weight of the evidence.

5. The use of the words "shall" and "should," in an instruction that, if the jury shall find from the preponderance of all the evidence that plaintiff acted as a person of ordinary prudence under all the circumstances, they should find her free from contributory negligence, did not render such instruction erroneous.

6. Where the jury had been instructed that they should consider all the circumstances and surroundings at the time of the injury in determining whether plaintiff was guilty of negligence which contributed to her injury, and were fully and correctly charged as to imputed negligence, an instruction that, on the question of plaintiff's contributory negligence, the jury should consider not only her own acts and conduct, but all other circumstances surrounding the accident, and determine from these whether plaintiff was free from contributory negligence, and if she was herself free from such negligence, and was merely a passive guest of her husband, without any authority to control his conduct or movements in driving and managing the horse and vehicle in which she was riding at the time, his negligence, if any, could not be imputed to her, was not objectionable as invading the province of the jury, and misleading them to believe that in considering plaintiff's contributory negligence they were not to consider the negligence of her husband.

7. Where, at the time plaintiff was injured, she did not in any manner undertake to exercise reasonable care for her safety through the agency of her husband, who was driving anl managing the vehicle in which plaintiff was riding at the time, the negligence of the husband in failing to look out for an approaching street car, etc., by which plaintiff was injured, could not be imputed to her.

8. An instruction that the jury were the exclusive judges of the credibility of the witnesses, and that it was their duty to reconcile, so far as they could, conflicting evidence, etc., was not objectionable as confining the jury to the consideration of the interest and character of such witnesses whose evidence was conflicting.

9. Failure of the court to charge with sufficient fullness on particular issues is unobjectionable, where no further instructions were requested.—(Indianapolis St. Ry. Co. vs. Johnson, 72 N. E. Rep., 571.)

INDIANA.—Carriers—Street Railroads—Injuries to Passengers—Premature Starting.

1. A complaint alleged that plaintiff was thrown with such force to a brick pavement that he was rendered unconscious for six hours; that his head was cut open, and the muscles of his back strained, so that he was and would always be unable to do any manual labor; that in falling he struck his elbows on the pavement so that the flesh was torn away and the bones exposed to view, and plaintiff was then and there rendered a permanent cripple. Held that the complaint was sufficiently specific as to the injuries sustained.

2. A complaint alleging that defendant's street car stopped at a regular stopping place, when plaintiff and other passengers began to leave the car by the rear platform; that the conductor could have seen, and did see, the position of such passengers until they stepped off the car; and that, as plaintiff was in the act of stepping from the lower step, the car was suddenly started with a violent jerk, and that the conductor, without regard to plaintiff's dangerous position, negligently signaled the car to be so started—sufficiently charged negligence on the part of the conductor.

3. Where a street car has stopped for the purpose of permitting passengers to alight, it is the duty of the conductor to know that passengers have alighted before starting the car.—(Union Traction Co. of Indiana vs. Siceloff.—(72 N. E. Rep., 266.)

INDIANA.—Remand After Change of Venue—Review—Personal Injuries — Jurisdiction — Instructions — Evidence — Inconsistent Findings.

1. The ruling on a motion to remand a cause to the court from which the venue had been changed should be questioned by making it a reason for a new trial rather than by separate assignment of error.

2. That the court has no jurisdiction to try the case cannot be raised by demurrer where want of jurisdiction does not appear on the face of the complaint.

3. In an action for personal injuries from alleged negligence it was proper to instruct that "care is required to be in proportion to the danger to be avoided and the fatal consequences that might result from the neglect."

4. In an action for injuries to a person on the track of an electric street railway, an instruction that the motorman must use diligence to avoid danger to a person on the track, and that the car must be stopped, if there is time to stop it, where the person is in a dangerous position, and if there was time, in the exercise of ordinary care, for a motorman to have stopped the car after seeing, or after he was bound to see, with ordinary care, the dangerous position of the person on the track, and failed to check the speed of the car, then the defendant was guilty of negligence, is not objectionable in not properly stating the theory of "the last clear chance."

5. The distance within which a street car in motion may be stopped by the use of the brake is a question on which an expert witness may properly give an opinion.

6. In an action for injuries by collision with a street car, findings that the motorman sounded his gong when the horse first went on the track, and that up to that time there was no indication of danger, and that the motorman was in proper position, and paying attention, and should first have known that the buggy would not get off the track when the car was 40 ft. from it, and the car could have been stopped with the utmost care within 35 ft., are not inconsistent with general verdict for plaintiff.—(Indianapolis St. Ry. Co. vs. Seerley, 72 N. E. Rep., 169.)

INDIANA.—Master and Servant—Injuries to Servant—Omission to Sand Tracks—Assumption of Risk—Proximate Cause—Pleading.

1. In an action against a street railroad for injuries to a motorman, a complaint alleging that defendant was in the habit of roughing the rails on a grade by sanding them, but on a certain date negligently failed to do so, or to take any means or precaution to prevent the cars from slipping, sufficiently averred defendant's dereliction of duty, without further stating what other means could have been used to make the track safe.

2. The omission of a street railroad to roughen or sand its track at a place where a steep grade makes sanding necessary in order to make the track safe for the operation of cars is negligence.

3. The negligent omission of a street railroad to sand its track, in consequence of which a car became unmanageable, and collided with another car, injuring a motorman, was the proximate cause of such injury.

4. A motorman on a street car assumes the usual and ordinary risks incident to his employment, so far as such risks are known to him, or could be known by the exercise of ordinary and reasonable care.

5. Where a street railroad had recognized its duty to make the track safe for the operation of cars by roughing or sanding the same, a motorman who knew this fact had a right to rely upon the performance of such duty by the railroad, in the absence of knowledge that the custom of sanding the track had been changed, and at a time when, by reason of darkness, he could not see whether the track was sanded or not.—(Union Traction Co. of Indiana vs. Buckland, 72 N. E. Rep., 158.)

INDIANA.—Appeal—Sufficiency of Evidence—New Trial—Impeaching Evidence—Instructions—Presumption.

1. Evidence tending to prove the essential facts in a case is sufficient to sustain the verdict.

2. As affecting the credibility of the president of a corporation, who testified that he did not notify a director of a special meeting at which the note sued on was authorized, a statement of his at the meeting as to the reason the director was not present, inconsistent with his testimony that he did not notify the director, is admissible.

3. It will be presumed that the jury regarded the instruction that they should consider certain evidence for no other purpose than as affecting the credibility of a witness.

4. A new trial will not be granted on appeal unless it appears that substantial justice has not been done.—(Indianapolis, G. & F. R. Co. vs. Hubbard et al., 74 N. E. Rep., 535.)

IOWA.—Street Railways—Negligence—Injuries to Passenger Alighting from Car—Contributory Negligence—Recovery by Husband for Injury to Wife—Measure of Damages—Present and Future Services—Assignment of Husband's right of Action—Burden of Proof—Evidence—Res Gestæ—Instructions—Error.

1. Where plaintiff, a passenger on a street car, in alighting fell by reason of defendant's negligence in failing to let down a folding step, evidence that immediately after plaintiff fell she exclaimed "Yes; let down the step after I fall!" was admissible; the declaration being relevant to evidence that the step was let down after plaintiff fell.

2. A street railway is bound to use extraordinary care and precaution to protect its passengers from injury.

3. In an action against a street railway by a passenger for personal injuries, there was no inconsistency between an instruction that defendant was held to the exercise of extraordinary care and caution to prevent injury to plaintiff, and that plaintiff was bound to exercise only ordinary care and caution, and an instruction that if plaintiff was not guilty of contributory negligence, and was injured by reason of defendant's negligence, she was entitled to recover.

4. In an action against a street railway by a passenger for personal injuries, an instruction that if the plaintiff failed to use ordi-

nary care, and such failure contributed to the injury, defendant was not liable, and that, as to the issue of plaintiff's contributory negligence, the burden of proof was on her to establish by a preponderance of the evidence that she was in the exercise of ordinary care and caution, was not misleading as to the burden with reference to contributory negligence.

5. While, in personal injury actions, present worth, rather than the aggregate of future damage, should be estimated, yet, where no specific instruction as to present worth is asked, the jury may be directed as to the general basis on which the right to recover is founded, and allowed to fix such sum as, in their judgment, is reasonable.

6. A husband can recover for injuries to his wife such compensation as the jury deem a money equivalent for the loss of such services, assistance, companionship and society as he has been deprived of by the injury.

7. If a wife, after receiving personal injuries, should be able to earn money in an independent business, such earnings would be no set-off to the damages which her husband might have recovered, or which she may recover under an assignment from him of his right of action, for damages for deprivation of her services, and for expenses incurred for medical attendance, etc.

8. In an action for personal injuries, plaintiff could recover, under an assignment to her by her husband of his right of action for damages for deprivation of her services, only the value of the services of which he had been or in the future might be deprived by reason of the injury.—(Hutcheis vs. Cedar Rapids & M. C. Ry. Co., 103 N. W. Rep., 779.)

MASSACHUSETTS.—Streets—Use by Teams—Impeding Traffic—Negligence—Questions for Jury.

1. Whether the driver of a team was negligent in leaving his horse standing, with his trace unfastened, so near to passing street cars that a passenger standing on the running board of a car was crushed between the horse and the car, held a question for the jury.

2. The right of a merchant to leave his team standing in the street while merchandise is being unloaded therefrom must be exercised with due regard to the rights of others lawfully using the street.—(McCormack vs. Boston Elevated Ry. Co., Same vs. Standard Oil Co., 74 N. E. Rep., 599.)

MASSACHUSETTS.—Carriers—Street Railroads—Injuries to Passengers—Space Between Cars—Negligence.

It was not negligence for an elevated railroad company to permit an open space in the passageway between the platforms of its cars, made necessary by sharp curves in its line, and to impliedly invite passengers to use such passageway at stations in going between the cars without informing them in words of the existence of such open space.—(Falkins vs. Boston Elevated Ry. Co., 74 N. E. Rep., 338.)

MICHIGAN.—Master and Servant—Injuries to Servant—Street Railroads—Construction—Collisions—Duties of Servant—Vice-Principal—Negligence—Contributory Negligence—Assumed Risk.

1. The general superintendent and manager of an electric railway was a vice-principal, and not a fellow-servant, of an employee engaged in the work of construction.

2. In an action for injuries to an employee, while riding on an electric railway construction train, caused by a collision with other loaded cars left on a spur track, evidence held to authorize a finding that defendant's general superintendent was negligent in placing such loaded cars on the spur track, and in failing to give notice of the fact to those in charge of the train on which plaintiff was riding.

3. Where an employee of an electric railway company elected to ride on the outside of a house car at the close of the work, in order to watch the tools, with the acquiescence of defendant's assistant superintendent, and was injured in a collision between the train on which he was riding and loaded gravel cars negligently left on a spur track, he was not guilty of contributory negligence, as a matter of law, because of the position he assumed, the danger of collision being not one he was required to anticipate.

4. Plaintiff, an employee of an electric railway company, took a position on the outside of a house car prior to his being transported to his destination at night, and, on being cautioned by the assistant superintendent to go inside, replied that he had taken his position to watch the tools and see that none fell off, and that he had a good seat, whereupon the road master replied, "All right, then," and plaintiff remained in such position. Held to justify an inference that plaintiff was directed to stay where he was and there perform a duty for defendant.

5. Where, in an action for injuries to an employee, while riding on an electric railway construction train, by a collision, it appeared that the shock of the collision was much greater than that ordinarily resulting from cars coming together on the siding, plaintiff did not assume the risk as a matter of law.—(Milbourne vs. Arnold Electric Power & Station Co., 103 N. W. Rep., 821.)

MICHIGAN.—Street Railroads—Negligence—Construction of Track—Rails Above Street Surface—Overturning of Vehicle—Personal Injuries—Evidence—Admissibility—Sufficiency—Instruction.

1. In an action for injuries to plaintiff from the overturning of his cutter in striking the rails of the defendant's track, which were alleged to have been negligently left above the surface of the street, where the sole question was the condition of the street, and whether its condition was negligence, evidence of prior accidents of a similar character at the same place was inadmissible.

2. An instruction that if the jury believed that any witness for defendant testified under a fear of losing his employment, or a desire to avoid censure, or fear of offending, or a desire to please his employer, such fact might be considered in determining the weight to be given to his testimony, was erroneous, when not coupled with any caution that the jury would not be justified in drawing unfair inferences simply because the witnesses were employees, and there was nothing in the testimony itself or in the manner of the witnesses to justify the conclusion that the testimony was tainted in the manner suggested by the instruction.

3. Where none of the witnesses for the plaintiff who testified as to the condition of defendant's track where the accident occurred had made such an examination as entitled their testimony to much weight, but, on the contrary, eight for the defendant testified to a careful examination, and that it was in good condition—two of them being officers of the village in which the accident occurred—a verdict for plaintiff was contrary to the clear weight of the evidence.—(Gregory vs. Detroit United Ry. Co., 101 N. W. Rep., 546.)

MISSOURI.—Master and Servant—Injuries to Servant—Defective Appliances—Assumed Risk—Statement Against Interest—Weight—Instructions—Curing Error.

1. In an action for injuries to a street car conductor caused by a defective step, an instruction that plaintiff must show "that he did not know of the broken and unsafe condition" of the step, and that the same was not obvious to plaintiff in the exercise of reasonable care, was erroneous, as plaintiff did not assume the risk of the defect, though he had knowledge thereof, unless it was so obviously dangerous that ordinary prudence would have distated that he refuse to use it.

2. Such error was not cured by a subsequent disconnected instruction correctly declaring the law, the instructions being conflicting and misleading.

3. An instruction that any statements made by plaintiff either during the trial or elsewhere, which were against his interest, were to be taken and treated by the jury as "absolutely true," was erroneous, such statements not being conclusive of the facts alleged to have been admitted.—(Shepherd vs. St. Louis Transit Co., 87 S. W. Rep., 1007.)

MISSOURI.—Jury—Verdict by Nine—Conflicting Evidence—Question to Physician—Street Cars—Stopping to Discharge Passenger—Instructions—Remarks of Counsel.

1. No right under the United States Constitution is violated by the Missouri constitutional amendment authorizing a verdict in a civil case by three-fourths of the jury.

2. A verdict on conflicting evidence can be set aside on appeal only where it appears to have been the result of prejudice and passion.

3. To obtain from the physician who attended plaintiff his opinion, based on his own knowledge of the case, whether the symptoms of pain in the head from which plaintiff testified she still suffered were probably caused by the injury received in the accident in question, is the fair purpose of the question: "In view of what you had seen when you first visited her, and in view of the fact that you continued to treat her, and that she has remained under your care to the present day, and in view of the fact that she now claims she is still suffering from pains in her head, I will ask you, in your opinion as a physician, would those pains that she claims to suffer be caused, or be likely to be caused, by the injury to her head for which you treated her?"

4. Though an ordinance required defendant street railway company to stop its cars on the far crossing, yet, cars having frequently, to plaintiff's knowledge, been stopped at the place of the accident before reaching the far crossing, to receive or discharge passengers, and she having signaled the car to stop to let her off, she had a right to suppose, on its stopping before it reached the far crossing, that it stopped to let her off, so that, there being no suggestion that it stopped for any other purpose, defendant can-

not complain that the jury were authorized to find that it was stopped for such purpose.

5. It is not error to refuse an instruction in effect a repetition of instructions given.

6. The remarks of plaintiff's counsel that he was tricked by defendant not calling to the stand one subpœnaed by it, and that a certain witness was a perjurer and a villain, though not justified by the record and improper, are not ground for reversal.—(Franklin vs. St. Louis & M. R. R. Co., 87 S. W. Rep., 930.)

MISSOURI.—Street Railroads—Use of Tracks—Collisions With Teams—Death—Actions—Release by Person Injured.

1. The fact that an injured person was, prior to his injuries, afflicted with the disease of which he subsequently died, and that his injuries merely hastened his death, does not preclude a recovery by the persons entitled thereto for his death.

2. The driver of a wagon is not a trespasser, nor guilty of negligence, in driving on a street railroad track, but is merely bound to use reasonable care to avoid interfering and colliding with the cars.

3. Conceding that one driving a wagon on a railroad track should have driven away from the track on hearing the gong of a car approaching from the rear, yet the fact that he disregarded his duty in that regard did not authorize the motorman of the car to run the wagon down and knock it off the track.

4. A husband or father, who suffers injuries through the negligence of another, cannot, by executing a release, deprive his widow or children, in case he dies from such injuries, of the right of recovery given them by Rev. St. 1899, secs. 2864, 2865.—(Strode vs. St. Louis Transit Co., 87 S. W. Rep., 976.)

MISSOURI.—Carriers—Street Cars—Passengers—Assault by Conductor—Termination of Relation—Actions—Instructions—Verdict—Conflicting Evidence—Appeal.

1. Defendant's street car conductor committed an unprovoked assault on plaintiff, who was an old man, as he was endeavoring to alight, and pushed or threw him from the car. Plaintiff's umbrella remained on the platform, and when he attempted to get it the conductor kicked him in the groin, whereupon plaintiff hit the conductor with the umbrella, and the latter then followed plaintiff to the street and beat him. Held, that the assault was continuous, and that the relation of carrier and passenger had not entirely ceased when plaintiff was kicked.

2. Where, in an action for injuries to a passenger, no witness was impeached by evidence of his bad character for truth and veracity or by inconsistent statements, it was not reversible error for the court to refuse to charge that, if the jury believed any witness had knowingly testified falsely to any material fact in issue, the whole or any part of the testimony of such witness might be disregarded, the jury having been fully charged that they were the sole judges of the credibility of the witnesses, and the proper rule for determining the weight to be given to their testimony.

3. In an action for injuries to a passenger it was not error for the court to strike the words "and no other cause" from an instruction that the burden was on plaintiff to establish that his alleged injuries were the direct and natural result of the assault by defendant's conductor, and of no other cause, etc.

4. In an action for injuries to a passenger on a street car, caused by an assault by the conductor, a requested instruction, ignoring evidence given by the conductor that after he was struck by plaintiff with an umbrella he followed plaintiff into the street, and continued the assault on him when he was retreating from the car, was properly refused.

5. An instruction assuming facts not in evidence is properly refused.

6. A verdict based on conflicting evidence will not be interfered with on appeal, though it may appear that the preponderance of the evidence is against it.—(Flynn vs. St. Louis Transit Co., 87 S. W. Rep., 560.)

MISSOURI.—Negligence—Injuries to Children—Turntables—Capacity—Age—Instructions.

1. Where, in an action for injuries to a child while playing on defendant's turntable, there was evidence that when defendant abandoned the turntable it was securely fastened, and was unfastened when plaintiff was playing thereon, an instruction purporting to cover the whole case, and directing a verdict for plaintiff if the matters submitted were believed, which omitted any hypothesis of defendant's negligence, or of its knowledge that the table was unfastened or being revolved by children at play, or that by ordinary care it could have known such condition, was erroneous.

2. In an action for injuries to a child while playing on defendant's turntable, it was proper to submit plaintiff's age and capacity on the issue of the care exercised by him.—(Edwards vs. Metropolitan St. Ry. Co., 87 S. W. Rep., 587.)

NEBRASKA.—Street Railroads—Collision With Team—Negligence—Evidence.

1. If the driver of a vehicle who arrives at a street intersection and who sees an approaching car is justified in believing that there will be sufficient time for him to cross the track before the car, if run at its usual and ordinary rate of speed, will reach the point of crossing, he cannot be said as a matter of law to be guilty of negligence in attempting to cross, and the question is a question of fact for the jury, to be determined from all the evidence before it.

2. The exclusion of testimony to show that the car might have been seen at a greater distance is not erroneous, since the question was not whether the plaintiff might not have seen the car at a greater distance, but whether he was guilty of negligence in attempting to cross with the car at the distance it actually was when he saw it.—(Omaha St. Ry. Co. vs. Mathiesen, 103 N. E. Rep., 666.)

NEW JERSEY.—Carriers—Street Railroads—Injuries to Passengers—Time to Alight—Contributory Negligence—Actions—Pleading—Issues and Proof—Evidence—Moral Character—Effect—Limitation—Negligence.

1. In an action for injuries to a passenger on a street railway car while attempting to alight, evidence held to require submission of plaintiff's contributory negligence to the jury.

2. In an action for injuries to a passenger by the premature starting of a street car as she was attempting to alight, an allegation that it then and there became and was the duty of the defendant to use due care that the plaintiff should be safely conveyed on her journey, was sufficient to present the question of defendant's negligence in not properly supervising the car and in looking after passengers at the point where plaintiff attempted to alight, to see whether any of them wanted to alight or not, and whether defendant's employees did everything that reasonable prudence required of them at the time, etc.

3. Where, in an action for injuries to a passenger on a street car, defendant, in rebuttal, introduced evidence showing a physical condition since the accident different from that described by plaintiff at the trial, some of which tended to asperse plaintiff's moral character, it was not error for the court to charge that the evidence relating to plaintiff's moral conduct could not be used to impeach her testimony as a witness.

4. Where a street car approached a railroad crossing protected by a derailing switch there was no negligence in the mere fact that the conductor of the street car left it and went ahead to operate the switch.—(Camden & S. Ry. Co. vs. Rice, 137 Fed. Rep., 326.)

NEW YORK.—Street Railways—Defect Between Tracks—Injury to Pedestrian—Negligence—Contributory Negligence.

1. Merely because there was a large knothole in a board constituting part of the temporary crossing where a street railway company had the street torn up between its tracks, whereby a pedestrian was injured, does not show that it was negligent; it not being shown that it put the board there, or that it had knowledge of the defect, or that the board had been there long enough to give it notice.

2. A pedestrian injured by stepping into a knothole in a board in a temporary crossing, where a street railway company had the street between its tracks torn up, must, to show freedom from contributory negligence, show that she took precautions to observe the condition of the temporary crossing, of which she had knowledge.—(Keating vs. Metropolitan St. Ry. Co., 94 N. Y. Suppl., 117.)

NEW YORK.—Carriers—Injuries to Passengers—Evidence of Injury—Sufficiency—Damages—Personal Injuries—Pleading—Evidence—Excessive Verdict.

1. In an action against a street railroad for injuries to a passenger resulting from a collision, evidence held sufficient to authorize a finding that plaintiff was physically injured, and not merely frightened, by the collision.

2. Proof of uterine trouble, consisting of irregularity of menses, is admissible under an allegation of severe injury to the person, as the result of which plaintiff was made "sick, sore and disabled," notwithstanding subsequent specific allegations of a severe shock to the nervous system, headaches and dizziness.

3. In an action for injuries to a passenger caused by a collision, there was evidence that, while there were no bruises or outside indications of injuries, plaintiff had suffered severe pain in her spine, had become nervous, sick and dizzy, and had disclosed symptoms of internal injuries. There was also evidence

of uterine trouble, consisting of irregularities of menses. Held, that a verdict for $500 was not excessive.—(Lofink vs. Interborough Rapid Transit Co., 94 N. Y. Suppl., 150.)

NEW YORK.—Damages—Pleading—Personal Injuries—Allegations of Specific Injury—Carriers—Injuries to Passengers—Violation of Statute.

1. In an action for injuries, the admission of evidence that plaintiff suffered from gastritis was erroneous, where no facts were stated in the complaint from which it could be inferred that plaintiff had been thus affected, but it was alleged therein that she had sustained a wound of the thigh, extending to the periosteum, dividing the nerves and blood vessels of the same, so that she suffered loss of sensation and impeded circulation, was unable to use her leg as before, and sustained a severe shock to her nervous system.

2. A violation of Laws 1890, c. 565, s. 138, providing that no train on an elevated railroad shall be permitted to start until every passenger on the platform desiring to board or enter the cars shall have actually boarded or entered the same, does not create a presumption of negligence against the railroad, but is merely evidence to be considered with other facts on the question of negligence.—(Brown vs. Manhattan Ry. Co., 94 N. Y. Suppl., 190.)

NEW YORK.—Carriers—Injury to Passenger—Cause of Accident—Burden of Proof—Negligence—Jury Question—Instructions—Conflict—Error—Theory—Trial—Appeal.

1. The burden is on a street railroad company, in an action by a passenger for injuries resulting from the falling of the poles or wires on the car, to show the cause of the accident.

2. In an action for injuries to a passenger on one of defendant's open trolley cars, it appeared that the span wire broke from some unexplained cause while the car was going very fast; that the trolley pole and wire fell on the car, and, in the unusual commotion which ensued, plaintiff was either thrown or jumped in fright from the car, though in her complaint she alleged that she was thrown from the car. The evidence was conflicting, and would support either theory. The defendant offered no testimony as to why the pole or wire fell. Held, that the alleged negligence of the defendant was properly submitted to the jury.

3. The court instructed that, if the car became so violent that plaintiff was thrown out involuntarily, then she could recover, but that if there was no commotion or violence, and the car immediately stopped, and then, without any reason, she voluntarily got off, she could recover nothing. On requests for further rulings, the court charged that even if, though voluntarily, she was induced by the disorder to get off, then it would be attributable to the company, and also that the plaintiff must recover, if at all, on the theory that she was thrown from the car, "within the law as the court had laid it down." Held, that the charges were in such irreconcilable conflict as to require a reversal.

4. The fact that the complaint alleged that plaintiff was thrown from the car would not defeat her right to recover on the theory of involuntary motion, unless the sufficiency of the complaint to sustain the recovery be first disposed of in the trial court.—(Stern vs. Westchester Electric Ry. Co., 90 N. Y. Suppl., 870.)

TENNESSEE.—Master and Servant—Personal Injuries—Negligence—Telephone Poles Dangerously Near Railroad Track.

A street railroad company is not chargeable with negligence in permitting telephone poles to be erected on land not owned or controlled by it so near the track as to be dangerous to employees operating cars.—(Chattanooga Electric Ry. Co. vs. Moore, 82 S. W. Rep., 478.)

TEXAS—Street Railroads—Injuries to Travelers—Defective Track — Evidence — Relevancy — Instructions — Appeal — Assignments of Error—Prejudice.

1. Where, in an action for injuries, a physician had previously testified that his attendance on plaintiff had cost plaintiff nothing, and the court's charge on damages excluded any allowance for such an item, the fact that the court inadvertently permitted the witness' evidence that his services were reasonably worth $150 to stand, over objection, on the promise of plaintiff's counsel to show its relevancy, which he failed to do, did not constitute reversible error.

2. An assignment of error not followed by a proposition cannot be considered on appeal.

3. It is not error to refuse a request to charge, substantially covered by the charge given.

4. Where, in an action for injuries to a hack driver while crossing defendant's railway track, the petition alleged that defendant's rail was negligently permitted to extend and remain above the ground, and that defendant negligently allowed the earth to be washed and removed from such rail, plaintiff's evidence with reference to a hole in defendant's roadbed at that place was relevant.—(El Paso Electric Ry. Co. vs. Davis, 83 S. W. Rep., 718.)

TEXAS.—Carriers—Street Railways—Failures to Stop—Questions of Fact—Instructions—Weight of Evidence.

1. Where a petition sought both actual and exemplary damages, and the charge authorized a verdict for both kinds of damages, and the verdict did not state for which kind of damages it was given, and there was no evidence justifying exemplary damages, the judgment on the verdict would be reversed.

2. Whether an intending passenger was "compelled" to walk between stops on a street railway line because of the failure of a car to stop for him was a question of fact, and a charge that the jury might take into account the fact that such passenger "was compelled" to walk was on the weight of the evidence.

3. Whether an intending passenger was subjected to discomfort, inconvenience, and expense in walking between stops because of the failure of a street car to stop for him was a question of fact.—(Northern Texas Traction Co. vs. Hooper, 80 S. W. Rep., 113.)

TEXAS.—Carriers—Injuries to Passengers—Alighting from Street Cars—Negligence—Contributory Negligence—Measure of Care Required—Instructions—Questions for Jury—Appeal—Assignments of Error—Propositions.

1. An appellate court cannot weigh testimony to pass on conflicting evidence or determine issues of fact, but its province in that behalf is limited to a determination of whether there is evidence reasonably sufficient to support the findings of the jury.

2. It is the duty of a street railway company and its employees to use such high degree of care and foresight in the protection of passengers and in guarding against possible dangers as would be used by very cautious and competent persons under like circumstances, although such a company is not an insurer of the safety of its passengers.

3. A charge that street railway companies are not to be regarded as insurers of the safety of their passengers was, if meaningless, not prejudicial to the company, in view of the remainder of the charge on the degree of care that such companies are required to use.

4. A proposition which is not cognate to the assignment of error under which it is placed, and which states no point that can arise from it, but presents and raises a distinct question arising from the action of the court upon separate matter, cannot be considered.

5. Where the charge of the court covered every material issue raised in the pleadings and evidence, the failure to fully state the issues in the preliminary part of the charge was not a ground for reversal where no special instruction was requested for the correction of the omission.—(El Paso Electric Ry. Co. vs. Harry, 83 S. W. Rep., 735.)

TEXAS.—Personal Injuries—Sufficiency of Petition—Parol Evidence.

1. A petition in an action for injuries to plaintiff's wife is sufficiently definite where it alleges a collision of defendant's cars, and that plaintiff's wife suffered a miscarriage as a result of "the jolt, jar and shock" by such collision.

2. Where an accident occurred in June, which caused plaintiff's wife to miscarry the following day, a second miscarriage the following November, resulting from the same injury, is not too remote for a recovery in the same action.

3. Though a small money consideration be expressed in a written release of a cause of action, parol evidence is admissible to show that the real consideration was a verbal promise by defendant of future employment of plaintiff.

4. Where the court divides the issues in relation to a release pleaded as a defense, charging that if, when the release was signed, plaintiff had been promised employment by defendant, to find for plaintiff, otherwise to find for defendant, with instructions as to the form of the verdict, and then gave another charge on the question of damages, so that two general verdicts were rendered, defendant, though the practice was irregular, suffered no injury thereby.—(Rapid Transit Ry. Co. vs. Smith, 82 S. W. Rep., 788.)

VERMONT.—Street Railroads—Injury to Passenger—Theory of Trial—Inconsistent Instructions.

Where, in an action for injuries to a passenger when alighting from defendant's street car, plaintiff's declaration and evidence showed that after the car had come to a full stop it was suddenly started, whereby plaintiff was injured, and in argument plaintiff's counsel expressly disclaimed any claim or right of recovery on any other ground, plaintiff could not complain that the court, in submitting the case to the jury, refused to charge on any theory on which a recovery might be had other than the car had come to a full stop.—(Fogarty vs. Rutland St. Ry. Co., 60 Atl. Rep., 801.)

LONDON LETTER

(From Our Regular Correspondent.)

The bill of the Administrative County of London and District Electric Power Company, which has been before the House of Lords and the House of Commons and generally in the public eye for the past two or three months, has finally been "squelched," for this year at any rate. It will be remembered that this is the bill which has been brought forward by its promoters for the establishment of three enormous turbo-generating stations in the County of London, situated at various points on the River Thames, the purpose of the company being to supply electricity in bulk especially for the furnishing of power. The bill, of course, met the determined opposition of all the existing companies and municipalities operating their own power stations, but notwithstanding that opposition it passed the House of Lords' committee and also passed the second reading in the House of Commons. It has been before the House of Commons' committee, of which Sir James Kitson has been president for the past few weeks, and volumes of testimony, both pro and con, have been taken from the leading experts in Great Britain. There has been recently a general feeling that the bill would not be allowed to go through this year, and many of those who voted for the second reading undoubtedly would not have voted for the third reading. The bill, however, never got so far through committee that it came up for a third reading, and at the last moment an attempt was made to have it postponed in the state in which it was so as to avoid the enormous expense next session. Even this has failed, so that when the promoters bring it up next year the whole preliminary work will have to be thrashed out again at the same enormous expense. There is no doubt that the promotion of this bill will stimulate the existing companies and municipalities to seek for a greater power load and to reduce the price of current to a much more reasonable figure. Many of the companies during the fight made arrangements with the promoters of the company by which the latter agreed not to interfere with the regular lighting business, but would simply furnish the existing companies with current in bulk at a less rate than that at which they could themselves produce it. Many arrangements of this kind were made, but as we have stated, the bill has not gone through, and all of this work has now become void. Notwithstanding the need for cheaper current in London there is a strong feeling against granting to this company such a huge monopoly as that for which application was made, and it is perhaps just as well that for this year at least the bill has not gone through, as it will give those really interested in the supply of electricity for London more time to consider fully the best method of future procedure.

The London County Council is still proceeding with its various schemes to electrify tramways in various portions of London, and also in bringing fresh bills before Parliament for such rights as are still necessary. It has been decided to apply again to Parliament for powers to construct an electric tramway from the Marble Arch, along the Edgware Road to Cricklewood, where the Council has previously met with very serious rebuffs. Now that the omnibus companies have placed a number of motor omnibuses on this road it is to be feared that the tramway scheme will receive even more serious opposition than previously. The construction of the subway between Southampton Row and the Strand is proceeding apace, and much of it is now completed. The construction of the electric tramways from the present terminus at Theobalds Road to the Angel is now practically completed, and this is the system of electric tramways which will be first connected to the subway. The highways committee has asked the Council to approve a sum of nearly £60,000 to cover the necessary expenditure for the equipment of this line in addition to the sum that was necessary for its construction. The bill for the construction of tramways over Blackfriars and Westminster Bridges was rejected by the House of Lords at the last moment, and the highways committee has recommended that this bill be brought forward again next year, when it is hoped it will meet with a better fate. In the meantime, important contracts will be let in the immediate future for the construction of the electric system in the southern portion of London, about which we have already given particulars. As is well known also, negotiations have been pending for some time with the London County Council for the securing by the North Metropolitan Tramways Company of the lease of its northern tramways, which does not expire until June, 1910. It is now distinctly stated that an offer has been made to the North Metropolitan Company by which the Council will take over this lease, commencing from the first of April next. Provided that the claim is ratified by the shareholders it is calculated that from the money to be received from the London County Council the shareholders of the North Metropolitan Tramways Company would get a return of from £4 to £5 per share.

Owing to the introduction of electric traction, the District Railway has for sale fifty-four locomotives and 368 coaches. The engines weigh about 47 tons each. One coach is fitted with electric light, and the rest with oil gas, and they measure 26 ft. x 8 ft. 6 ins. They are to be sold by private treaty, not under the hammer.

A very representative exhibition, embracing all branches of electricity, is to be held at Olympia during September and October. The exhibition is under the direct patronage of the Institution of Electrical Engineers, and Sir William H. Preece, F. R. S., is the president of the committee, which includes a number of gentlemen well known in the electrical world. We understand that the space at Olympia has nearly all been taken up.

At a special meeting of Largs (Scotland) Town Council a proposal was submitted for the construction of a tramway between Largs and Wemyss Bay. The want of facilities other than those provided by the steamboats have long been felt, and several schemes for connecting the two places by rail have been proposed in past years since shortly after the opening of the Wemyss Bay Railway, but none of them ever took practical shape. It now seems possible, owing to the development of tramway enterprise, to provide that desired communication. In the details submitted for the consideration of the Council an estimate was given that the journey from Glasgow and Largs via Wemyss Bay and the proposed tramway, could be accomplished in seventy minutes. The tramway will also provide much needed facilities for people residing in North Ayrshire, generally reaching Rothesay, Dunoon and other places on the opposite shore of the Clyde, so that the proposed line is expected to act as a feeder to both railway companies. The members of the Town Council were unanimously in favor of the scheme, and expressed a hope that the tramway whould also be extended to the southern boundary of the burgh.

A few weeks ago the Middlesex County Council opened its new electric tramway from the Highgate Archway to Whetstone. Now the London County Council has commenced the construction of its link to the Archway Tavern, so as to connect this new line with the main system of London tramways. When this work is completed, it will be possible to travel by tram from the city—either the Moorgate Street or Holborn terminus—to Whetstone with one change only, a distance of 10 miles.

The competition of the electric trams with the steam railways is so keen that Mr. Cosmo Bonsor, at the Southeastern Railway meeting recently, said that in the course of the half year the railway had carried nearly a million and a half fewer passengers than in the corresponding six months of last year.

West Ham has completed its great tram scheme, and by it another important chain of lines has been added to the electrical systems, which are fast linking up the metropolitan area. The value of the system is felt not alone in West Ham itself. At a cost of close upon £300,000 the Town Council has now become possessed of a network of systems which practically control the traffic from Aldgate to Romford—nearly 14 miles. With the exception of Leyton, all the surrounding authorities have now their systems in full work. Walthamstow on the northeast, and East Ham and Ilford on the far east, are all running, and it only needs the London County Council to set about its East London section in order to allow the passengers to travel right through from Aldgate to the Romford boundary by tramcar.

An inquiry was recently held in the Londonderry Literary Institute, Seaham Harbor, before Col. G. F. O. Boughey, R. E., C. S. I., and Henry Allan Steward, of the Light Railway Commission, as to the expediency of granting the application made to them by the Ryhope, Seaham, Murton & South Hetton Tramways Company for a provisional order to lay tramways in the districts mentioned. The promoters of this light railway are called the S. M. H. Syndicate, and are composed almost entirely of shareholders in the Sunderland & District Electric Tramways Company.

Motor omnibuses are becoming more and more common in the streets of London, and a lively fight is now going on between one or two of the new companies, which were organized for the purpose of running motor omnibuses, and the old London omnibus companies, which have been using horse-drawn omnibuses for years. the latter, however, are now wakening up to the situation and are themselves putting on large numbers of motor omnibuses and have many more on order. For the past month or two one of the best known motor omnibus, called the "Vanguard," has been running successfully from the Law Courts in the Strand to Criklewood by means of Charink Cross Road, Tottenham Court Road, Edgware Road, Maida Vale, etc. This route has been changed so far as the southern portion of it is concerned, and these 'buses now continue their career along Waterloo Bridge to the Elephant and Castle. The London General Omnibus Company has also started a service of motor omnibuses to compete with this new service over exactly the same route, completing their southern journey, however, at the Law Courts. Next year, therefore, will see keen

competition between the various omnibus companies, who have each probably a hundred motor omnibuses on order, and it is extremely probable that in the course of the next year or two the old horse omnibuses will practically have disappeared from the streets of London. These motor omnibuses are now well patronized, as they save at least 20 to 30 per cent of the time occupied on a journey, and so far as can be judged at present, they are being operated successfully and with economy. The tale of the tires is, however, not yet completely told, though it is confidently expected that the enormous expense of tires will not be prohibitory to success.

The bill promoted by the Birmingham Corporation for the construction of its new tram lines has now passed all the Parliamentary stages, and though it has not as yet received the royal assent it has for all practical purposes gone through this session successfully. The city of Birmingham now stands committed to an expenditure of over a million pounds on the electrification of its tramways, so that in the course of a year or two Birmingham will be in a position to compare favorably with other cities of its size. It has been the last large city in England to get thoroughly settled down to an electrification scheme of its tramways system, which for years have been a sore spot in the eyes of all electrical engineers, the old-fashioned steam cars and cable cars being still in use. A considerable portion of the amount, probably a fifth or more, will have to be spent in street widening, as many of the streets in Birmingham are extremely narrow and tortuous, but at least £600,000 will be spent for electrification equipment, including the erection of a large generating plant, sub-stations, car houses, underground cables, overhead construction, etc.

The North-East London railway bill, which has already passed the House of Commons, has now successfully passed the committee stage of the House of Lords, and it has now been decided that the bill may proceed. The railway is to run from the city, where there will be three stations, to Waltham Abbey. From the Monument to Hackney Road it will be in the tube tunnels, and for the rest of the distance it will be just an ordinary electrically-equipped railway on the surface. The Parliamentary estimate of the cost of the scheme was about three millions and a half sterling, and, in order to carry it out, a company is to be incorporated with a capital of £4,000,000.

Last month we had the pleasure of recording a test of the Raworth regenerative system at Birmingham, and this month we have the pleasure of reporting a very interesting test of the Johnson-Lundell regenerative system of tramway control, which was furnished to members of the press during the past month at the works of the Johnson-Lundell Electric Traction Company, Ltd., at Southall, a few miles outside of London. This system has been more or less before the public for some years, but as yet, outside of one or two experimental cars, no actual system of tramways has been equipped with it. The company has, however, been persevering in its efforts and now claims to have perfected a system by which it can demonstrate a great saving of current. At its works in Southall, the company has equipped a line in an adjoining field, and on this line has a rough car, which is used for experimental purposes, which is fully equipped with the system and fitted with measuring instruments to show the regenerative effect. The Johnson-Lundell system differs very considerable from that invented by Mr. Raworth. Without going into details at present, we may say that everything passed off most successfully at the trial, the car being under perfect control at all times, and even when going at full speed being brought gently to rest by the regenerative system. The platform controller has the ordinary appearance of the usual controller, but in the handle is a button which, upon being depressed by the thumb of the driver, operates another controller underneath the car by electromagnets, which alters the field winding from simple to compound, so that the motors begin to regenerate. The car can thus be brought to a speed of about 2 miles an hour, when a mechanical brake acts automatically and brings the car to a standstill. It is estimated by the Johnson-Lundell Company that a saving of from 40 to 55 per cent can be effected, and though there are necessarily some extra complications involved by the use of the regenerative system, the company claims that, even should the regenerative devices get out of order, the ordinary operation of the car would not be affected.

The Durham County Council is seriously considering the practicability of a county scheme of electric tram service. The Electricity Supply Committee has reported that the population of the county during the past ten years has grown to the extent of about a hundred thousand, and it appears to the committee that access to the rural districts ought to be more practicable by means of electric tramways, as the ordinary steam train service of the county does not in any way afford adequate communication. It is probable, therefore, that in the next session a bill will be brought forward for some tramway scheme for county service. A. C. S.

PARIS LETTER

[*From Our Regular Correspondent.*]

The question of the reorganization of transport in Paris drags its weary course, without apparently arriving at any definite results. The last propositions of the special committee appointed to examine the question have been discounted, if not completely ignored, by the Municipal Council, and further reports are to be gotten out by the committee. The matter, however, is at all events recognized to be a very serious one, and it would appear that the present year will not have made way for 1906 before a solution is found for the present deadlock. One sign of this lies in the fact that the concession for the steam tramway running from the Louvre to Versailles will not be renewed by the authorities for another ten years, as previously arranged, but only for the period of six months, which is considered ample time for the new traction regime to come into force. At present, however, all discussion is adjourned until the end of October. The main difficulty to be cleared from this fertile field of discussion is that of obtaining or imposing an accord between the General Omnibus Company and the various tramway lines at present operating a more or less frequent service in the various zones of Paris. It is recognized on all hands that the omnibus routes are unnecessary, and will become more and more a burden to the operating company as the Metropolitan Railway approaches completion. The receipts of the Omnibus Company are constantly decreasing, and, even with a modified method of adjusting fares and routes, it is estimated that the horse omnibus traffic will never permit of anything but a deficit to the company.

The Omnibus Company, however, is not exactly at a standstill. It is experimenting with certain steam and gasoline omnibuses, and at certain non-official trials organized by the French Automobile Club, several presentable specimens of motor omnibuses took part in the tests, and with good results. Among other types was one furnished with a gasoline-electric combination, consisting of a Richard-Brasier 24-hp motor, coupled to generator, with geared motors operating the rear wheels of the omnibus, which has a total weight of 7600 lbs. The Gardner-Serpollet Company, which has perfected a very practical type of steam car, is in a good position to furnish this kind of omnibus.

Two prolongations of the Paris deep level tube railway have been authorized: one from the Central Ouest Railway station of St. Lazare and extending to Porte St. Ouen, and the other from the Montparnasse Railway Station to the Porte Versailles. The form of this railway will therefore be that of an irregular "Z," the main stroke of the "Z" running north and south through the city.

Line 4 of the Paris Metropolitan Railway has now definitely been put in hand. The most interesting portion of this line is undoubtedly the passage beneath the Seine, of which some 60 m will be built not far below the river bed. The manner of tunneling this part will be that known as the Poetsch freezing process. Around the center of the mass of earth to be removed are driven long, double tubes, spaced according to the nature of the soil. In these tubes is circulated a freezing liquid, refrigerated by a special plant installed on the work. After several weeks of circulation in this manner, a frozen zone is formed around the tubes, so as to form a wall enclosing the tunnel. This excludes the water and quicksand, so that work can be prosecuted inside the frozen area by the methods usually used in rock excavation. This work, constituting the seventh section of line 4 of the Metropolitan Railway, will cost over two million dollars, and a delay of eighteen months is accorded to the contractor for the completion of the work.

The Paris, Lyons & Mediterranean Railway Company is, it is stated, seriously considering the electrical equipment of one or two of its lines. Although no estimates have as yet been asked for the necessary material, it is believed that the schemes will have some considerable magnitude. One of the first lines to be transformed electrically will be that from Cannes to Vintimille, on which the traffic is large during certain months of the year.

The development of the single-phase system is being watched with great interest here. There is a small shuttle line running on the Tramway Sud, as already detailed in this column, equipped with Latour motors of the repulsion series compensated type. Whenever a single-phase motor is evolved of fairly large output and suitable for meter gage tracks, it will find a ready application in several interurban railway systems at present in abeyance in France, and which would probably not stand the cost of a direct-current system.

In Vienna at the present moment, two rather important lines of the operating company are being transformed from direct current to single-phase, and it may be presumed that the activity shown in this direction will be accentuated in the near future..

On the State railways in Sweden it appears that it is absolutely decided to transform electrically as soon as possible. The government is being asked for a credit of four million crowns for the purchase of water-falls, of which no less than seventeen are located close to the railway system, and are capable of being turned into account. Of these, some ten are private property. Eight important falls are in the southern regions of Sweden and give an effective output of 40,000 hp, and the State believes it good policy to purchase these falls before they are exploited by private owners.

The party in France which favors the purchase of the French railways by the State is again showing some activity, but it cannot be said that any great headway is being made in this question, although it reappears for discussion periodically, and is as often turned down for further evidence. M. V.

PLANS FOR TOLEDO STATION

L. E. Beilstein, general manager of the Toledo Railways & Light Company, is having preliminary plans prepared for the proposed union passenger station for interurban roads entering the city. The company owns almost the entire square bounded by Beach, Huron, Superior and Jackson Streets, in the down-town section of the city. The union freight station is now located on this site. It is the plan to erect a building of several stories, where the roads could have their offices, and about 500 ft. long fronting on Beach Street and extending from Superior Street to Huron Street. A proposed feature is to have the passengers take the various cars by way of a basement, descending stairs from the waiting room with passages leading to any desired track. In this way there would be no crossing of tracks. The entire rear of the building would be devoted to tracks, and it would have a shed covering of glass and structural work. Last week Henry A. Everett, Barney Mahler, T. J. Ross and F. J. Stout, all prominently identified with the Everett-Moore interests, which controls the city company and two of the interurbans, met to consider the plans. The matter will now be presented to the various interurbans. The plan is to form a holding company to buy the property and erect the station; all the interurbans to be interested in the project.

ANOTHER IMPORTANT OHIO INTERURBAN

An important addition to Ohio interurbans was made last week by the opening of the 17-mile extension of the Toledo, Fostoria & Findlay Railway. The new division connects Fostoria and Pemberville, as shown in a map of the system published in the Street Railway Journal of Aug. 12, 1905, and its completion marks a record for quick construction. Grading was started on April 29, and although twenty-seven working days were lost on account of the wet season, the entire line was in operation on a regular passenger schedule in less than four months from the date of starting. The entire work was done by the company, in charge of F. W. Adams, the general manager of the company, who is being complimented upon his practical demonstration of how to build a railroad.

The Toledo, Fostoria & Findlay Company, always one of the best in the State, now takes on added importance because of its location as the connecting link between two great systems, the Lake Shore Electric and the Western Ohio. With the completion of the Western Ohio branch from Lima to Findlay, in about sixty days, the cross-State Cleveland-Cincinnati route will be a reality. While the route may appear to be rather indirect, it is not so in practice, as compared with steam routes between the same cities. This is owing to the fact that all the present steam routes have been made up by the joining of various small railroads, in a few cases favorably located. The interurban combination, as contemplated, foots a through mileage of 294 miles from Cleveland to Cincinnati. There are four steam lines between these cities whose mileage is a follows: Pennsylvania, 291; Big Four, 263; Erie, 372, and B. & O., 349. It can thus be seen that a through traffic arrangement between the roads forming the trans-Ohio route would start under more favorable circumstances than did some of the small steam roads, which have since been combined into famous railroad systems.

Taking for granted that the limited cars now operating from Dayton to Lima, via the Dayton & Troy, and Western Ohio will run into Findlay; and that the Toledo, Fostoria & Findlay cars will run the 5 miles from Pemberville to Woodville over the L. E. B. G. & N. to reach the Lake Shore Electric, only three changes of cars would be necessary in the 294 miles, without further traffic arrangements, which is certainly an unusual combination of traction lines.

A TERMINAL IN BALTIMORE FOR THE W., B. & A. RAILWAY

The Baltimore Terminal Company has been organized as a subsidiary company of the Washington, Baltimore & Annapolis Railway to construct a terminal in the city of Baltimore to accommodate the cars of the interurban company. An ordinance is already pending before the Council of Baltimore to permit the parent company to operate its interurban cars in the city, having Baltimore Street and Hopkins Place as the site of the terminal. This is in an advantageous location, within two blocks of the shopping district. George T. Bishop, president of the company, states that the subsidiary company will spend $5,000,000 in improvements at that point and proposes to start with the work at once. Touching upon the service that is to be given between Washington and Baltimore, Mr. Bishop states that it is the intention to have at least three, and possibly four, trains each way every hour. Cars will be equipped with four 125-hp motors, capable of 70 m.p.h. The track will be laid on private right of way except in the two cities, and the line will be double track.

ACCIDENT FAKIRS APPREHENDED IN CLEVELAND

Through efforts of Claim Agent Boone, of the Cleveland Electric Railway, aided by Cleveland detectives, a clever gang of accident fakirs which has operated succssfully in several cities has been apprehended and committeed to the Cleveland workhouse.

On Aug. 8, a man giving his name as John Edwards, residence, Buffalo, N. Y., boarded a car at the Public Square while it was in motion and apparently was thrown to the ground somewhat injured. He was taken to a hospital, and a day or so later a party giving his name as Edward Benson, a friend of the injured party, tried to secure a settlement of $200. The company's physicians were unable to find any injuries beyond a few bruises, but the patient complained of pains in his head and back and at times had convulsions. The point which was suspicious was the fact that one of the division superintendents happened to see the accident and reported that the man rolled off and held on to the step, permitting himself to be dragged. Putting them off a few days, Mr. Boone corresponded with officials of the International Traction Company, of Buffalo, giving description and address of the parties. A wired reply requested that the men be held, and the following day W. C. Smith, special agent of the Buffalo Company, with A. C. Reid, proprietor of the lodging house where the men boarded, came to Cleveland. They identified Benson, whom they knew under the name of H. C. Forbes, but were unable to identify Edwards, until Chief Doran, of the Cleveland detective force, stepped over and pulling off a false wig and mustache, showed a very different looking man, whom both the Buffalo men identified as F. Wilmot. Mr. Smith, of the Buffalo company, stated that the men had attempted to work a similar accident in Buffalo, on Aug. 5.

In an examination neither of the men would admit the truth of the charges, but they told conflicting stories. They were unable to show visible means of support, and their statements relative to business connections were found to be untrue; accordingly they were charged with suspicion, and in court last Monday they were fined $50, costs, and given 30 days. As they had no money it will take about a year to work out the sentences.

The reports from Buffalo indicated that there was another accomplice, and on Tuesday of last week the police apprehended a party giving his name as Jos. Burns, 189 Covert Street, Brooklyn, N. Y. He was induced to make a written confession. He stated that he met Wilmot and Forbes on May 5, at New York. They worked an accident on the Third Avenue line at Fourteenth Street, from which they were unable to obtain any money. On July 23, at Philadelphia, Forbes was "injured" at Market and Ninth Streets, as a result of which they secured $300. On Aug. 5, as previously stated, Wilmot fell from a car on Main Street and Atlantic Park, at Buffalo. They were unable to collect promptly and came to Cleveland, Aug. 8. He claimed that he had never worked any of the accidents, but operated simply as the disinterested spectator. Furthermore he said that, as a result of his refusal to have an "accident" in Cleveland, the other men abandoned him, and he was not associated with the Cleveland job. Burns is being held for trial.

Edwards, alias Wilmot, is about 5 ft. 8 ins., sallow complexion, black hair, dark brown eyes, slight droop to one eye lid, square shoulders, and weighs about 140 lbs. Benson, alias Forbes, is about 5 ft. 9 ins., closely cropped tow hair, wore brown curly wig, is slightly pock marked, blue eyes, wore glasses, weighs about 155 lbs. Burns is of boyish appearance, rather slight, blue eyes, brown hair, weight about 120 lbs. It is believed that Wilmot and Forbes have operated in other cities aside from those cases to which Burns admitted complicity.

PROPOSED MICHIGAN LINE TAKES OVER STEAM ROAD'S RIGHTS

By the closing of one of the most remarkable railroad deals in the history of the State of Michigan, the Kalamazoo, Lake Shore & Chicago Traction Company has come into possession of the Michigan Central Railroad track and right of way for a distance of 16 miles, between Kalamazoo and Mattawan, completing the right way for a line between Kalamazoo and South Haven. The section of track sold by the Michigan Central was not adapted to the giving of a perfect steam road service. It is winding and the grade is heavy. The work of laying a new line of track was begun two years ago, and is now completed. With the taking over of this track by the interurban company the prospects are bright for the opening of traffic between Kalamazoo and Lawton this fall, as the stringing of the trolley wires and the bonding of the track are comparatively simple jobs as compared with the building of a new line. The route of the interurban railway will be from South Haven through Bangor, Lake Cora, Paw Paw, Lawton, Mattawan and Oshetemo. The power house will be located at South Haven. The officers and stockholders of the company are. S. J. Dunkley, president; George E. Bardeen, vice-president; W. R. Beebe, treasurer; James Grand, general manager; Joseph E. Lockwood, consulting engineer; E. C. Dayton, C. W. Williams, George L. Craig, A. W. Norton, George T. Arnold, J. W. Thompson, Senator Julius C. Burrows.

INTERURBAN TRAFFIC MEN ORGANIZE

For the betterment of the service generally, and particularly to encourage interchange of traffic among the various interurban electric railways operating out of Toledo, the Toledo Interurban Traffic Association, composed of the general freight and traffic managers of the different roads, has been organized. A temporary organization, with C. T. Chapman, of the Toledo & Western, with headquarters at Sylvania, as chairman; Robert Dittenhaver, of the Toledo & Indiana, with headquarters at Delta, as treasurer, and J. S. Young, of the Maumee Valley & Toledo Railways & Light Company, as secretary, has been effected.

At a meeting of the association, held at the offices of the Maumee Valley Railways & Light Company in the Smith & Baker Building, Toledo, on the evening of Aug. 25, the temporary officers elected at Point Place on Aug. 17 were selected to fill these offices permanently, and the chairman appointed a committee to draw up the rules and by-laws, which are to be acted upon at the next meeting, Sept. 15. The association also decided to broaden out and take in the managers, heads of the operating departments and of the accounting departments and also any one who is connected with any of the various interurban lines entering Toledo who is not under a chief clerk. The hope of the organization of this association in Toledo is that similar bodies will be organized by representatives of companies in other cities. It is not the intention of the Toledo association to encroach upon the Ohio Interurban Railway Association, but simply to come together locally, so as to become better acquainted in social and business dealings.

THE FIRST SINGLE-PHASE ON THE COAST

A complete street car service is soon to be inaugurated in Napa, Cal., all cars starting from Lincoln Avenue, that city, and making connections at the depot in East Napa for Vallejo. Six round trips will be made daily between Napa and San Francisco, passengers taking boats at Vallejo to connect for San Francisco. In a few weeks work will be completed, extending up the valley to St. Helena and Calistoga. Trips will be made from St. Helena and Calistoga to San Francisco. This is the first single-phase electric railway on the Pacific Coast.

OHIO AND PENNSYLVANIA COMPANIES TO CONSOLIDATE

The Mahoning & Shenango Railway & Light Company, capitalized at $10,000,000, of which $4,000,000 is 5 per cent cumulative preferred and $6,000,000 common, has been formed under the laws of Pennsylvania to effect the consolidation of the Youngstown-Sharon Railway & Light Company and the Pennsylvania & Mahoning Valley Railway Company. Of the capital stock of the new company, $1,600,000 par value of the preferred stock and $2,400,000 par value of the common stock are set aside for the acquisition of the Youngstown-Sharon Railway & Light Company, and $2,400,000 par value preferred stock and $3,600,000 par value common stock are set aside for the acquisition of the Pennsylvania & Mahoning Valley Railway Company.

The new company will also authorize and provide for an issue of $10,000,000 of ten-year first consolidated refunding 5 per cent gold bonds, of which bonds to the par value of $3,000,000 are to be made available for extensions, betterments and improvements of the properties of the new company, and the acquisition of new properties. Two million eight hundred thousand dollars par value of the said bonds will be reserved by the trustee under the mortgage for the purpose of taking up and retiring a like amount of underlying bonds of the Youngstown-Sharon Railway & Light Company. One million three hundred and twenty-five thousand dollars of the bonds will be used in the acquisition of the Pennsylvania & Mahoning Valley Railway Company, and $2,875,000 will be reserved by the trustee under the mortgage for the purpose of taking up and retiring a like amount of underlying bonds of the Pennsylvania & Mahoning Valley Railway Company.

The proposed merger is based upon a valuation of 60 per cent for the Pennsylvania & Mahoning Valley Railway Company as against a valuation of 40 per cent for the properties of the Youngstown-Sharon Railway & Light Company.

Of the stock to be used in the acquisition of the Youngstown-Sharon Railway & Light Company 18,750 shares of common stock have been reserved for the purpose of taking up the stock of the Youngstown-Sharon Railway & Light Company; each share of stock of the Youngstown-Sharon Railway & Light Company being entitled to three-fourths of a share of the common stock of the new company.

The 16,000 shares of preferred stock, and the balance (5250 shares) of the common stock of the new company are to be used for the purpose of raising the amount of cash required for the payment of the floating debt of the Youngstown-Sharon Railway & Light Company; the reducing of its bonded indebtedness from $3,500,000 to $2,800,000, and the expenses of the managers, the whole sum necessary for said purposes being estimated at $1,000,000.

The said 16,000 shares of preferred stock and 5250 shares of common stock are offered to the stockholders of the Youngstown-Sharon Railway & Light Company in proportion to their respective holdings, each stockholder having the privilege to subscribe in cash to the amount of 40 per cent of the par value of his stock.

SINGLE-PHASE PROJECT FOR INDIANA

W. H. Schott, of Chicago, president of the Terre Haute & Indiana Southern Railway, says the construction of the company's proposed line will be begun in the near future, possibly this month. The line is to be 70 miles long, and will connect Terre Haute and Linton, with belt lines to the coal district. The road will be standard gage, and operate twelve cars. Of especial interest is the statement by Mr. Schott that the single-phase system will be used. The power station and the repair shops will be located at Shelbourne. The officers of the company are: W. H. Schott, president; Job Freeman, of Linton, Ind., vice-president; A. E. Hazlerigg, of Sullivan, Ind., secretary; James R. Riggs, of Sullivan, treasurer. Mr. Schott himself will act as chief engineer of the company.

PUBLIC SERVICE INTERESTS CONSOLIDATED IN NEVADA

The Nevada Power, Light & Water Company is the name of the new company, combining the lighting, railway and water interests in Reno, Nevada. The company has $1,000,000 capital stock and $750,000 bonds, $300,000 of which are reserved for the purpose of retiring a like amount of the Nevada Power, Light & Water Company 6 per cent bonds. The 6 per cent sinking fund bonds now offered are issued to acquire a controlling interest in the Washoe Power & Development Company and the Nevada Transit Company. There are no bonds against either of these two companies, and none can be issued in the future. The Washoe Company is acquired on a basis of $225,000, and the Nevada Company on a basis of $100,000. The proceeds of the bonds will be used entirely in payment of the stock of these two companies. An estimate of the value of the Reno Power, Light & Water Company properties before acquiring the two companies named was $806,424, against which $512,000 bonds are issued. This value does not include water rights and franchises. It is expected that the acquisition of the two companies named will increase the net earnings of the company at least $40,000 per annum, making total net earnings of about $135,000, against which the interest charge on the entire $750,000 bonds will be $45,000. The net earnings for the year ended March 31, 1905, were $156,597.

PERSONAL MENTION

MR. ALFRED SKITT, of the Interborough Rapid Transit Company, of New York, sailed from Europe for New York Thursday, Aug. 24. Mr. Skitt is understood to have gone to the Continent in the interest of August Belmont, for whom he is said to have been in conference with the Rothschilds.

MR. H. S. RYKERT, despatcher for the Aurora, Elgin & Chicago Railway Company, has been appointed superintendent of transportation of the Rockford & Interurban Railway Company, of Rockport, Ill. He was for several years connected with the operating department of the Brooklyn Rapid Transit Company.

MR. JOHN T. YOUNG has been appointed general manager of the Muskegon Traction & Lighting Company, of Muskegon, Mich., to succeed Mr. Samuel A. Freshney, who became, on Sept. 1, superintendent of public works of Grand Rapids. Mr. Young, who has had twelve years' experience as a mechanical and electrical engineer, comes to Muskegon from Akron, Ohio, where he was in charge of the mechanical and electrical department of the Cleveland Construction Company, his entire business career having been with that company.

MR. GEO. R. FOLDS, assistant to Vice-President and General Manager Calderwood, of the Brooklyn Rapid Transit Company, was tendered a banquet at the Clarendon Hotel, Brooklyn, on Tuesday evening, Aug. 29, by about thirty of his associates in the company, the occasion being his departure from Brooklyn for Chicago, where he is to act as general manager of the South Chicago City Railway Company and the Hammond, Whiting & East Chicago Electric Railway Company, which operate co-jointly in Illinois and Indiana. Mr. Calderwood, acting for the employees, presented Mr. Folds with a handsome silver loving cup.

MR. PETER M. KLING, recently superintendent of the John Stephenson Company, of Elizabeth, N. J., has been appointed manager of passenger car department of the Pressed Steel Car Company, with headquarters at McKees Rocks, Penn., appointment to take effect Sep. 1. The Pressed Steel Car Company, it will be remembered, recently announced its intention of building steel cars for regular passenger service on street and interurban railways. Mr. Kling is recognized as one of the most expert car builders in the country. Previous to his connection with the Stephenson Company, he for a long time was general manager of the St. Louis Car Company.

MR. J. C. COLLINS has been elected secretary and assistant treasurer of the Rochester Railway Company, of Rochester, N. Y., vice Mr. Geo. G. Morehouse, resigned. Previous to entering the street railway field Mr. Collins was in the employ of the accounting department of the Norfolk & Western Railroad. When E. W. Clark & Company, of Philadelphia, purchased the Chester Traction Company, Mr. Collins was appointed to the position of chief clerk and remained in that capacity until just previous to the time of the sale of the road by them. Mr. Collins next filled the position of assistant secretary of the Camden & Suburban Railway Company, with which he remained four years. Entering the employ of E. W. Clark & Company as one of their railway auditors, Mr. Collins remained with the firm until his appointment as chief clerk of the Rochester Railway Company on July 1, 1904. His election to the position of secretary and assistant treasurer of the Rochester Company was made to date from Aug. 10.

MR. F. H. LINCOLN has been appointed assistant general manager of the Philadelphia Rapid Transit Company. Mr. Lincoln prior to 1893 was engaged in practical electric railway work in the Middle West. In that year he went to Philadelphia, and was engaged in engineering work on the Philadelphia Passenger Railway system under Mr. J. R. Beetem. In 1895 he was made superintendent of lines and cables on the People's system, and when the Union Traction Company was organized he was appointed superintendent of lines and cables for the entire system, aggregating about 470 miles of track. He was continued in this position when the Philadelphia Rapid Transit Company took over the Union Traction property. He has retained this office ever since, and in 1903, in addition to his other duties, was made manager of Willow Grove Park. Mr. Lincoln's promotion to the office of assistant general manager comes as a well earned advancement and bears witness to energy and ability exhibited in the line of his previous duties.

MR. LEAVENWORTH WHEELER, who has been superintendent of the Worcester & Southbridge Street Railway since its opening, severed his connection with the company Aug. 20, and on the following day took up his new duties in Pittsfield as superintendent of another and larger division of the Consolidated Railway Company, viz., the Berkshire Street Railway. The appointment of Mr. Wheeler to the new position, with its added responsibilities, was in recognition of his able management of the Worcester & Southbridge property. Mr. Wheeler was very much surprised to find on entering his office at Pittsfield to take up his duties as superintendent, an elegant quartered oak Derby roll-top desk, which had been sent on from the factory at Boston as a gift from the employees of the Worcester & Southbridge and the Southbridge & Sturbridge Street Railways. Mr. J. B. Potter, of Webster, superintendent of the Worcester & Connecticut Eastern division of the Consolidated Railway Company, has been appointed superintendent of the Worcester & Southbridge and Worcester & Sturbridge Companies, and has entered upon his new duties.

COL. A. C. WOODWORTH, general manager of the Consolidated Car Fender Company, of New York, died suddenly at his home in Chicopee, Mass., at 10 p. m., Saturday, Aug. 26. Col. Woodworth, who had been ill for some time, had not been at the office of the company for more than a month before his demise. Although known to be suffering from a severe attack of two diseases that had become chronic with him, still fears were not entertained until Saturday morning, when complications in the shape of pneumonia set in. So rapid was the progress of the disease that by evening his vitality had become so exhausted that hope was finally abandoned. Col. Woodworth was born in Marysville, Ohio, June 5, 1841. One of his first business connections was with the Ames Manufacturing Company. Shortly after the organization of the Consolidated Car Fender Company, about 1895, Col. Woodworth accepted the position of manager of the company, and mainly to him is the success of the company due. Col. Woodworth's title was the result of his serving as colonel of staff of Gen. Butler, of Massachusetts. Col. Woodworth married into the Ames family, taking to wife Miss Sarah Ames, who, with a daughter, survives him. The funeral was held from the Woodworth home in Chicopee on Tuesday, and interment was in the cemetery at that place.

MR. H. F. J. PORTER has opened an office in the Metropolitan Building, 1 Madison Avenue, New York, as a consulting industrial engineer. He will give especial attention to installing modern methods of organization and management, and to the establishment of the welfare work which is now recognized as a most important portion of every large industrial plant. Mr. Porter has had a long experience in engineering and manufacturing, and is also known as an authority on social and economic subjects. He was one of the first advocates of hollow shafts for steam engines, and as western agent of the Bethlehem Steel Company in 1894-97, and later as assistant manager of the company, he took an active part in the manufacture and introduction of these shafts in railway power stations. In 1902 he resigned from this company to become connected with the Westinghouse interests, first as manager of the American branch of the publishing department, and later as second vice-president of the Nernst Lamp Company. In these capacities Mr. Porter has had an exceptional opportunity to study industrial methods and conditions. Many companies desire to improve their organization and the conditions of their employees, but do not understand how to effect a change from former methods, and it is this class of service which Mr. Porter proposes to render.

MR. W. B. ROCKWELL, general manager of the Syracuse, Lake Side & Baldwinsville Railway Company, is being mentioned favorably as a candidate for appointment as commissioner on the New York Board of Railroad Commissioners. It will be remembered that the New York Legislature at a recent session enlarged the commission to five members, and Governor Higgins will appoint the fifth commissioner early in the fall. Mr. Rockwell has received the support of the political and business interests in his locality, and his appointment to the place has been urged strongly upon the governor. Mr. Rockwell had his first experience in engineering work with the Delaware, Lackawanna & Western Railroad in 1874. In 1885 he was interested in the development of the Van Depoele system of electric traction at Scranton, Pa., and was one of the builders of the early street railway line laid down in that city, which is said to be the first practical electric railway in the Unitel States. He left Scranton in 1892 to build an electric road at Athens, Pa. In 1893 he went to Middletown, N. Y., and built the Middletown-Goshen Electric Railway, looking after all the details of securing the franchise, financing the enterprise and building the road. He operated this line for two years and then sold out to go to Staten Island, where he built the Staten Island Midland Electric Railway in 1895. In this connection Mr. Rockwell also planned and built Midland Beach on the southern shore of Staten Island, which is now one of the most popular beach resorts around New York. Some time after he was called to Syracuse to take charge as manager of the Syracuse, Lake Side & Baldwinsville Railway Company, which was then in financial straits. He has managed this property since with so much success that at receiver's sale, recently, the property brought more than the par value of the stock.

TABLE OF OPERATING STATISTICS

Notice.—These statistics will be carefully revised from month to month, upon information received from the companies direct, or from official sources. The table should be used in connection with our Financial Supplement "American Street Railway Investments," which contains the annual operating reports to the ends of the various financial years. Similar statistics in regard to roads not reporting are solicited by the editors. * Including taxes. † Deficit. ‡ Decrease due to strike.

Company	Period	Total Gross Earnings	Operating Expenses	Net Earnings	Deductions From Income	Net Income, Amount Available for Dividends
AKRON, O. Northern Ohio Tr. & Light Co	1 m., July '05	100,049	49,025	51,025	23,267	27,758
	1 " " '04	95,881	47,373	48,508	22,826	25,682
	7 " " '05	525,527	285,942	239,586	160,869	78,718
	7 " " '04	492,967	275,634	217,332	158,528	58,805
AURORA, ILL. Elgin, Aurora & Southern Tr. Co	1 m., June '05	40,333	21,873	18 460	9,226	9,234
	1 " " '04	39,944	22,037	17,907	9,451	8,456
	12" " '05	454,308	258,573	195,735	111 224	84,511
	12" " '04	456,100	274,797	181,303	110,676	70,627
BINGHAMTON, N. Y. Binghamton Ry. Co	1 m., July '05	31,612	13,602	18,009	------	------
	1 " " '04	29,120	12,495	16,625	------	------
	12" June '05	261,124	136,862	124,262	84,491	39,771
	12" " '04	241,789	130,887	110,902	77,872	33,030
BUFFALO, N. Y. International Tr. Co	1 m., July '05	469,121	206,132	262,990	139,632	123,358
	1 " " '04	405,589	187,529	218,059	140,270	77,789
	6 " June '05	2,037,786	1,147,311	890,475	818,071	72,404
	6 " " '04	1,900,212	1,263,485	636,728	772,711	†135,983
CHICAGO, ILL. Aurora, Elgin & Chicago Ry. Co	1 m., June '05	57,116	29,243	27,873	------	------
	1 " " '04	44,118	26,338	17,780	------	------
	4 " " '05	188,557	108,243	80,313	------	------
	4 " " '04	138,864	90,964	47,900	------	------
Chicago & Milwaukee Elec. R. R. Co	1 m., July '05	67,263	20,871	46,392	------	------
	1 " " '04	52,228	18,508	33,720	------	------
	7 " " '05	279,236	124,868	154,348	------	------
	7 " " '04	215,478	91,095	124,383	------	------
CINCINNATI, O. Cincinnati Northern Tr. Co	2 m., June '05	100,447	------	------	------	------
	2 " " '04	98,506	------	------	------	------
	2 " July '05	56,000	------	------	------	------
	2 " " '04	54,812	------	------	------	------
Cleveland & Southwestern Traction Co	1 m., July '05	54 823	28,304	26,519	------	------
	1 " " '04	50,542	26,663	23,879	------	------
	7 " " '05	292,198	177,196	115,002	------	------
	7 " " '04	255,295	171,139	84,156	------	------
DETROIT, MICH. Detroit United Ry	1 m., July '05	507,089	*285,682	221,407	89,891	131,516
	1 " " '04	456,269	*246,951	209,318	89,816	119,502
	7 " " '05	2,853,067	*1719706	1,133,361	643,815	489 546
	7 " " '04	2,541,589	*1592467	949,122	623,261	325,861
DULUTH, MINN. Duluth St. Ry. Co	1 m., July '05	64,461	30,037	34,424	17,361	17,063
	1 " " '04	60,777	26,642	34 135	16,544	17,591
	7 " " '05	369,203	197,502	171,701	117,940	53,761
	7 " " '04	353,523	195,595	157,928	115,422	42,505
FINDLAY, O. Toledo, Bowling Green & Southern Tr. Co	1 m., July '05	27,092	14,202	12,890	5,879	7,011
	1 " " '04	24,134	12,240	11,894	------	------
FT. WAYNE, IND. Ft. Wayne & Wabash Valley Tr. Co	1 m., June '05	85,500	53,242	32 258	------	------
	1 " " '04	77,117	52,461	24,656	------	------
	6 " " '05	426,159	267,504	158,655	------	------
	6 " " '04	370,977	251,315	119,662	------	------
FORT WORTH, TEX. Northern Texas Traction Co	1 m., July '05	59,874	33,574	26,300	11,488	14,812
	1 " " 04	52,281	27,551	24,730	10,209	14,521
	7 " " '05	362,455	203,289	159,166	76,834	82,332
	7 " " '04	311,217	175,525	135,691	70,757	64,935
HANCOCK, MICH. Houghton County St. Ry. Co	1 m., June '05	‡14,634	11,461	3,173	3,614	†441
	1 " " '04	16,937	10,242	6,694	3,381	3,313
	12" " '05	165,559	161,5[illegible]8	4,030	41,685	37,655
	12" " '04	189,037	131,348	57,689	37,310	20,379
HOUSTON, TEX. Houston Electric Co.	1 m., June '05	44,854	25,328	19,526	8,657	10,869
	1 " " '04	9,610	51,360	†41,750	7,968	†49,718
	11" " '05	411,227	259,672	151,555	93,272	58 283
	11" " '04	336,986	278,919	58,067	84,830	†26,763
MILWAUKEE, WIS. Milwaukee El. Ry. & Lt. Co	1 m., July '05	277,203	126,959	150,244	78,577	71,666
	1 " " '04	283,062	133,977	149,085	77,706	71,378
	7 " " '05	1,828,895	909,395	919,500	529,326	390,174
	7 " " '04	1,821,735	935,360	886,375	521,211	365,164
Milwaukee Lt., Ht. & Tr. Co	1 m., July '05	70,659	24,115	46,543	23,863	22,680
	1 " " '04	53,998	20,925	33,073	18,874	14,199
	7 " " '05	327,483	146,481	181,002	141,773	39,229
	7 " " '04	249,784	127,807	121,977	113,176	8,801
MINNEAPOLIS, MINN. Twin City R. T. Co	1 m., June '05	392,529	177,853	214,675	100,875	113,800
	1 " " '04	370,141	173,638	196,503	92,392	104,111
	6 " " '05	2,171,470	1,039,527	1,131,943	587,383	544,560
	6 " " '04	2,059,262	985,875	1,073,387	540,441	532,946
MONTREAL, QUE. Montreal St. Ry. Co	1 m., July '05	257,828	136,319	121,509	32,752	88,757
	1 " " '04	226,695	131,276	95,419	25,637	69,782
	10 " " '05	2,181,820	1,394,840	786,980	231,920	555,060
	10" " '04	1,988,612	1,281,213	707,400	201,008	506,392
OAKLAND, CAL. Oakland Traction Consolidated	1 m., July '05	119,817	59,774	60,042	32,929	27,113
	1 " " '04	104,276	55,869	48,407	26,525	21,882
	7 " " '05	804,160	418,691	385,469	221,985	163,484
	7 " " '04	707,705	367,455	340,250	185,918	154,332
San Francisco, Oakland & San Jose Ry	1 m., July '05	43,015	20,789	22,227	13,425	8,801
	1 " " '04	33,430	14,591	18,839	9,431	9,407
	7 " " '05	300,020	127,313	172,707	92,714	79,994
	7 " " '04	221,936	99,553	122,384	57,474	64,909
PEEKSKILL, N. Y. Peekskill Lighting & R.R. Co	1 m., June '05	12,904	*6,619	6,285	------	------
	1 " " '04	11,068	*6,030	5,038	------	------
	12" " '05	119,165	*68,568	50,598	------	------
	12" " '04	110,740	*66,311	44,429	------	------
PHILADELPHIA, PA. American Rys. Co	1 m., July '05	162,471	------	------	------	------
	1 " " '04	147,019	------	------	------	------
	12" June '05	1,471,991	------	------	------	------
	12" " '04	1 406,965	------	------	------	------
ROCHESTER, N. Y. Rochester Ry. Co	1 m., July '05	171,527	85,224	86,304	28,017	58,287
	1 " " '04	139,548	68,826	70,721	26,811	43,910
	7 " " '05	994,406	583,474	460,933	192,122	268,811
	7 " " '04	850,050	473,476	376,573	184,929	191,644
SAN FRANCISCO, CAL. United Railroads of San Francisco	1 m., June '05	555,513	------	------	------	------
	1 " " '04	518,996	------	------	------	------
	6 " " '05	3,386,495	------	------	------	------
	6 " " '04	3,206,932	------	------	------	------
SAVANNAH, GA. Savannah Electric Co.	1 m., June '05	53,177	29,939	23,239	10,554	12.684
	1 " " '04	49,511	26 471	23,040	10,407	12,634
	12" " '05	565,963	326,391	239,572	127,070	112,502
	12" " '04	534,014	305,083	228,931	123,949	104,982
SEATTLE, WASH. Seattle Electric Co	1 m., June '05	208,782	131,450	77,332	24,959	52,373
	1 " " '04	191,495	126,243	65,252	24,696	40,556
	12" " '05	2,395,327	1,638,055	757,272	301,680	455,592
	12" " '04	2,229,880	1,557,615	672,266	273,711	398,554
TERRE HAUTE, IND. Terre Haute Tr. & Lt. Co	1 m., June '05	55,543	38,636	16,907	10,613	6,294
	1 " " '04	47,654	30,748	16,907	9,579	7,328
	12" " '05	596,447	387,033	209,414	114,688	94,725
	12" " '04	526,293	352,540	173,753	105,357	68,397
TOLEDO, O. Toledo Rys. & Lt. Co.	1 m., July '05	171,994	*84,873	87,121	43,106	44,015
	1 " " '04	158,377	*77,820	80,557	41,186	39,371
	7 " " '05	1,067,788	*548,610	519,178	296,921	222,257
	7 " " '04	984,236	*534,784	449,452	291,535	157,917
YOUNGSTOWN, O. Youngstown-Sharon Ry. & Lt. Co	1 m., June '05	43,472	*23,884	19,588	------	------
	1 " " '04	37,342	*21,634	15,708	------	------
	6 " " '05	257,426	*143,060	114,366	------	------
	6 " " '04	224,267	*136,757	87,510	------	------

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Of this issue of the Street Railway Journal 8000 *copies are printed. Total circulation for* 1905 *to date,* 293,750 *copies, an average of* 8160 *copies per week.*

Taking Out Trucks

One evidence of the growing unpopularity of work conducted on motors and trucks in difficult positions under cars as against work in the open was indicated in the reply of J. L. Sullivan, of the United Railways of St. Louis, to a recent Question Box question on the comparative merits of pitwork and work in the open. Mr. Sullivan favors taking trucks out from under a car when work is to be done on them without regard to whether the motors are adapted to be handled over a pit or not. That is, he considers it so much of an advantage to have the truck out from under the car that it is worth while, simply on account of better light and accessibility, even if the motors are of a type to be handled from below and the work is done in the pit. The time required to get a truck out from under a car may be more than compensated for by the better work that can be done on it after it is out.

The Exhibits at the Coming Philadelphia Convention

All those who have inspected the South Pavilion of the Philadelphia Museum, where the exhibit will be held in connection with the coming convention, unite in the opinion that it could not be better for the purposes for which it will be used next September. Not only are the shipping facilities excellent, as the railroad cars can be run directly into the building, but the building was constructed especially for exhibition purposes, with a substantial floor, high windows admitting plenty of light and air, and ample space. Moreover, the exhibit hall is close to the meeting hall, in fact is on the floor directly below, and the entrance to the hall for meetings is through that which is to be devoted to exhibits. Rarely, if ever, has there been such a combination of conditions favorable to a good exhibit. It is satisfactory to learn through the Manufacturers' Association that the requests for space have been unusually large this year and that the success of this feature of the convention is assured. We understand that some space is still available, and that if any manufacturer is still considering whether to exhibit or not, it is advisable for him to make his application without delay.

The Cost and Value of Sprinkling

Some companies are obliged by ordinance to sprinkle their tracks, others sprinkle them by contract with the city, and still others sprinkle them entirely on account of the advantages gained by the company in so doing. The advantages, as far as comfort to passengers are concerned, are quite evident, especially on high speed suburban roads, but it is perhaps not often considered that there is a direct saving in operating expenses which may easily equal or exceed the cost of sprinkling and sweeping the tracks. Difference in weather conditions from day to day, leaving out of account snow storms, may easily make as much as 10 per cent difference in the amount of power required per car mile. This is largely due to the varying condition of the rail surface from day to day. A rail covered with dry dust and dirt offers considerable more resistance to traction and some more electrical resistance at the point of wheel contact with the rail than a clean or wet rail. If we assume that 300 cars per day are operated over a given mile of single track and the cost of power per car mile be 2.5 cents, a saving of 10 per cent of this, or .25 cent would amount to 75 cents per day per mile of track. In the course of a year, this would figure up many times more than the cost of cleaning and sprinkling, excluding, of course, the cleaning of snow which must be taken care of in any event. We have not at hand much data on the cost of this cleaning. H. B. Fleming, in a recent answer in our Question Box, gave the cost of cleaning on the Chicago City Railway's extensive system as $43.70 per mile of single track per season. It would certainly look as if sprinkling was a good investment on a road which has heavy traffic. Of course, as the number of cars passing over a given piece of track per

day diminishes, the gain by cleaning and sprinkling diminishes also and finally becomes a negative quantity.

The "Near Crossing" Ordinance in Milwaukee

A number of years ago at different times ordinances were passed in various cities of the United States requiring street railway companies to stop at the near crossing for passengers instead of stopping after they had crossed the street. Almost without exception these ordinances have been repealed after a more or less extensive trial. The New York city authorities were the latest to make the trial until recently, when the City Council of Milwaukee passed such an ordinance, making the near crossing the legal stopping place for passengers. After about two weeks' trial the new rule was abandoned. There are many things to be said both for and against the near crossing plan. Its advantages are most apparent at streets where other street railway lines are crossed. Under the usual far crossing rule, it is frequently necessary to stop at both the far and the near side of a street to take on passengers. Under the near crossing rule, it is only necessary to stop at the near side. In this way time is saved at transfer points. This seems to be the chief, decided advantage of the plan, as its other advantages are offset by certain disadvantages. For example, it is urged in favor of the near crossing rule that it makes the cars run at a slow speed when crossing a street and hence reduces the danger, but, on the other hand, it must be remembered that since cars do not stop at all streets for passengers, the new rule does not insure slow speed in crossing all streets and that a certain element of danger and uncertainty is introduced because of the fact that teamsters may take some chances on a car stopping at a street corner and be more reckless about crossing in front of cars than they would be if they knew that cars did not stop. What has killed the plan where it has been tried has been the unwillingness of passengers to board and leave the car at the rear end when the front end is at the crossing. This causes congestion at the front end at a point where the conductor cannot look after the passengers, and if the streets are in bad condition it is not pleasant for the passengers to get off at the rear end in the mud and snow.

Mile Posts on Interurban Roads

The use of mile posts has long been regarded with favor by steam railroads operating between large centers of population located several hours' run from each other, but as far as we are aware, the practice has as yet received little or no attention from electric interurban roads. On long steam lines the mile post is always a welcome sign of progress to observing travelers, but it serves in the day time a more important purpose on account of the assistance it gives to the locomotive engineer in making schedule time. Of course, a good engine driver soon learns the tracks upon his division as well as a man knows the inside of his home, and every object along the line for 200 miles or 300 miles becomes so familiar that at first sight there seems to be little real need of the mile post to emphasize the relation of each particular landscape to the schedule. On well-operated roads the abutting residents often set their watches by the regularity of some famous flier in passing certain points.

When a train is late, however, the mile post is often a real help to the engineer through the mental suggestion it silently conveys as the locomotive passes. It saves thought at a time when every faculty employed in running safely at high speed is obtained toward the point of nervous collapse, unconscious though the engineman may be of its momentary influence. Trainmen's time-tables generally indicate the hour and minute of passing stations, junction points, sidings, etc., but when a train is delayed, the question of recovering lost time is largely a matter of being able to traverse a certain mileage as quickly as possible, and there is little opportunity for time-table reading and calculations. Then, too, the mile post furnishes a most convenient reference point in case of accidents, inspections and construction work.

All these points apply to a certain extent to the higher class of interurban work, although the distances are almost always much shorter and the maximum speeds lower. Even though a mile post is rarely useful at night unless the full glare of an arc light falls upon it, the numbering sometimes placed upon poles is of still less value in the maintenance of schedules, important though the latter may be for other reasons. Certainly as interurban lines become linked together through agreements or consolidations, it may be in some cases desirable to install mile or half-mile posts referring to large terminal cities for the convenience of through passengers and trainmen. The refinements of electric railway service are constantly increasing, and matters which a few years ago were quite overlooked are now frequently considered standard practice by progressive managers.

Automatic Couplers

Inventors have not been nearly as active in the electric railway car coupler field as they were with steam railroad couplers. In the railway field they seem to have directed their energies more to fenders and sand boxes. This has been so much the case that a few years ago the announcement to the superintendent of a road that a fender or sand box inventor was waiting in the ante-room would be sufficient to cause such an official to leave precipitately by the back door. The need for automatic couplers not having been as great in the electric railway business as in the steam railroad business, there have been but few practical automatic couplers suggested, and still fewer put in operation. In fact, it may be truthfully said that the use of automatic devices of this kind on electric roads in the United States has been so far practically confined to one type of coupler. Recently, however, there seems to have been a wave of increased interest in automatic couplers for electric service, and other types have come forward. It is far from being as easy to produce a good coupler for electric roads as for steam roads. Steam railroad curvatures are such that whatever swiveling is necessary on curves can be accomplished between the jaws of the two couplers, so that each draw-bar can be rigid on its car. On electric roads, the short radius curves and the long overhang of cars which is frequently found, makes it absolutely necessary to have a draw-bar which swivels. Here is where the trouble begins. When two swivel draw-bars are coupled together loosely at the point of coupling, they behave very well on the pull, but on the push they will bend and buckle in proportion to the looseness of the coupling. The ideal coupling would be one absolutely rigid from the swivel of one draw-bar to the swivel of the other. As such absolute rigidity is impossible in an automatic coupler, all that inventors can do is to reduce the lost motion which permits side play to as small an amount as possible. An interesting fact brought out in the recent article by W. T. Van Dorn in these columns is that couplers on multiple-unit trains must be stronger than on trains pulled with a locomotive or motor car at the head of the train. This is due to the fact that frequently much of the strain on the draw-bars in a multiple-unit train is a pushing strain, which tends to push them out of line and bend them, the danger of bending depending on the amount of side play allowed at the point of coupling.

Municipal Amenities

The recent conclave of Mayors seems to have lacked the fervent harmony upon municipal ownership which perhaps was to have been looked for. There are certain features about municipal conduct of large enterprises which appeal strongly to the sentiments of the average machine-made Mayor, quite apart from any possible considerations of political economy. You are not safe in setting down as an ardent Socialist every politician who professes belief in the municipal operation of public utilities. The more places to be filled, the more loaves and fishes for distribution to the hungry multitude who vote and are yet unsatisfied because there are not offices enough to go around. Suggest putting municipal employees under civil service regulations and you can quickly separate the Socialist from the other fellow. Perhaps it would be more accurate to divide them into two classes, theoretical Socialists and practical Socialists. The former believe in the employment of city property for the common good, the latter practice its redistribution upon whatever scale opportunity permits. Now both of these classes were represented among the assembled Mayors, and their partisans fell out, as might have been anticipated. In fact, in the heat of discussion, one Mayor threw a bombshell into the camp by plainly intimating that the only man who could have carried out municipal ownership honestly was unfortunately dead. At which bland verity there was an uproar, as might have been expected.

And while the sound of the wailing has not yet died away, there comes a sad-eyed publicist from the Antipodes to tell the ghastly truth about the workings of applied Socialism in Australia. In that blest land, it seems, they hit upon the happy expedient of federation, in the hope of getting enough offices to go around, and by help of municipal and State enterprise on a large scale they have pretty nearly succeeded. Who would be an agricultural laborer under a grinding private employer who really wants to raise crops, when he can become third acting assistant shovel carrier to the gentleman who digs gravel on a government railway? And in the absence of labor, capital is reduced to twiddling its thumbs and vaguely wondering whether it would not do better to emigrate. By good fortune, too, they have coupled public enterprise in Australia with an iron-clad civil service, just to show us the virtues of the horn of the dilemma, which is here somewhat unpopular. The result seems to be most joyful for the public employee, who thereby has a permanent, instead of merely a temporary, license to take it easy. Just how politics is there affected by the permanence of the jobs does not appear, but we hope that ere long, for the benefit of Mayor Dunne and his followers, this all-important detail will be made clear. We have no doubt that American ingenuity will find a way for keeping the votes in line even under civil service. The Australians certainly have experimented in government to the edification of the world, and they have done some very excellent things in the way of the ballot and legalizing titles to real estate, but they seem to have met their Waterloo in exploiting public ownership.

Meanwhile time goes on apace, and we do not see the enthusiasm for municipal works bearing any fruit to speak of. Most of the cities which have gone in for municipal lighting plants have been accumulating experience rather than profits, and some of them have become pretty sick of the job. It is an easy one to talk about, but when it comes to taking over an existing plant which has capitalized its blunders for twenty years, and running it with political appointees on an eight-hour day, it is hard to make both ends meet. After all, there is a solid substratum of common sense in the American people that in the last resort protects them from the occasional assaults of rampant foolishness. The municipal ownership craze will before long go the way of the greenback craze and other economic delusions. Before municipal ownership can possibly succeed on any considerable scale, municipal graft must be abolished, and if ever it finally departs it will take with it the only substantial objections to private ownership. Private ownership has no terrors for the community that can maintain an incorruptible city government. It takes more than an honest Mayor to inaugurate honest municipal ownership—it takes a public opinion that is inflexibly against every form of graft. And when public opinion is thus reformed it will respect and co-operate with private initiative upon terms of mutual good will. Socialism and similar doctrines offer no remedy for existing evils, save as they quicken the conscience of the individual. Society has tried these and kindred plans for wholesale reformation for the last 2000 years, but it has not yet found any efficient substitute for personal righteousness, which fact we submit for the consideration of those who deal in economic nostrums.

Some Operating Details

The mechanical department of a road when properly conducted makes sure that everything pertaining to motors, trucks and electrical equipment is in good order before a car leaves the house. It has been our observation that the same attention to details is not usually given to those parts of a car which come more directly under the eye of the passenger. It should be the duty of certain men in each car house or of the conductor of each car of the smaller roads to see that everything pertaining to the comfort of the passenger is as it should be on a car. This refers particularly to the condition of windows on semi-convertible types of car. It is not uncommon to see semi-convertible cars run out of a car house on very hot days with part of the windows closed. Many semi-convertible cars have windows with top sashes which are intended to be raised or lowered in summer, but as a matter of fact these top sashes on some roads are rarely touched, consequently the full benefit of the semi-convertible feature is not secured. Of course, in stormy weather it should be seen to by the proper employees that the car leaves the house with its windows or curtains in a condition corresponding to the weather. A complaint not often heard at this time of the year, but coming more frequently in winter weather, is on the poor ventilation of cars. The fact that a car has ventilators is too often forgotten by men in the transportation department. No matter how well a car may be designed in this respect, the thought expended in design is wasted unless those who actually operate the cars make use of the ventilators provided. Another thing which is responsible for some of the complaints of poorly ventilated cars is the lack of ventilation while the cars are standing in the car house between midnight and morning. If a car is allowed to stand with doors closed in a car house where there is little ventilation of air, all the foul odors it has collected during the day remain and it does not take long for cushions and woodwork to get sufficiently permeated with these stale odors to make the car seem unventilated at all times. Good ventilation in the car house and the opening of all doors before a car is taken into a car house will do much to improve this condition. On many roads these details are well looked after at present.

THE BERLIN-ZOSSEN HIGH-SPEED TESTS OF 1901

Although the Berlin-Zossen high-speed tests of 1901, 1902 and 1903 have passed into history, and although there is little likelihood of railroading along the same lines being attempted at present in Germany or elsewhere, the results determined there will necessarily have an important influence on all high-speed electric railroading in the future. This is particularly true in regard to the information secured on train resistance at high speeds and on braking at high speeds. Upon these two points especially the reports of the Zossen tests give information which is not found elsewhere.

As is well known, the tests were conducted three successive years, viz., in 1901, 1902 and 1903, and the principal technical results secured during these series of tests are published in three volumes of pamphlets which were issued by the Studien Gesellschaft at the close of each series of tests. The records of the 1903 tests are the most interesting of all, as during that year the highest speeds were made. This is the only pamphlet which is available in an English translation. The 1901 and 1902 tests, however, give a great deal of valuable information on both train resistance and braking; and in view of the future importance of high-speed railroading, and as these results have not been published in an extended way, it has been thought of interest to present an abstract of them in this paper.

The tests in 1901 were largely preliminary to determining the capacities of the car and track to withstand the proposed high speeds of 200 km (or 125 miles) per hour. During this year speeds up to 90 m.p.h. were secured, but as the track proved insufficient to withstand even this speed, the tests were discontinued. In 1902 the trials were conducted principally to determine the train resistance at different speeds up to 75 m.p.h.

The 1901 report sketches briefly the alterations that were found necessary in the original roadbed of the military railroad, which was built for a maximum speed of only 80 km per hour, the principal changes being made in the replacing of some of the rails and ties and in the use of heavier ballast over the middle portion of the line. The shop tests of the electrical equipments of the cars are described, after which a list of the rules to be observed during the tests is given. The report then takes up the proposed plan of conducting the individual runs by presenting a definite programme of the manner in which the higher speeds are to be approached. A log of the different runs made is given in detail, special attention being called to the data collected dealing with the accelerating and braking periods, the condition of the track and weather, the air pressure used in the pipes and brake cylinders, the operation of the short-circuit and hand brakes, the temperatures of the resistances, the frequencies and potentials used, etc., after which the more important results obtained from the 1901 tests are given, of which the following extracts are of special interest.

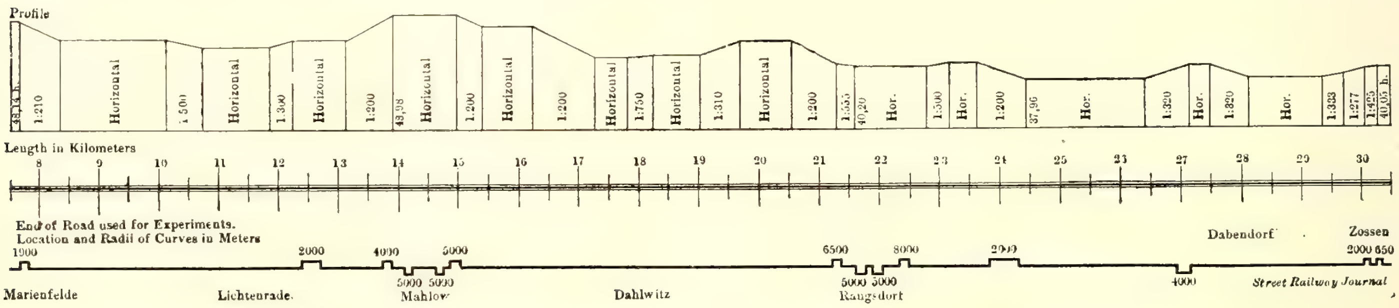
The article on braking is possibly the most valuable, as it suggests some of the difficulties encountered at speeds above those ordinarily used. Attention is called to the need of some automatic device for decreasing the brake pressure in proportion to the speed. Throughout all of the brake tests made upon this road, the lack of such a device was felt, and the curves of retardation obtained in the last year of these tests show plainly that at such high speeds the braking distance could have been materially decreased if such a device had been used. Another interesting point in this connection is the suggestion of using electrical means for braking at high speeds. No intimation is given as to how this would be best performed, but if some reliable method was devised whereby the excessive air pressures and tensions on the braking apparatus necessary at high speeds might be reduced, the safety of the service would be proportionally increased.

That some alteration in the present signal systems in use would have to be made in a service contemplating such high speeds is touched upon in the article on "Safety Devices," the suggestion given in this report being tried in the last year's tests with most satisfactory results.

Previous articles on these tests have appeared in the STREET RAILWAY JOURNAL for June 7, 1902, page 726; Aug. 2, 1902, page 142; May 20, 1905, page 915, and June 3, 1905, page 988. In a later issue some of the more important portions and diagrams of the 1902 report will be published.

REPORT ON ACCELERATION AND BRAKING

The time and distance required to attain a definite speed is limited both by the capacity of the motors on the car and the machines in the power house. The acceleration depends upon the ability of the source of energy and the motors at starting to withstand high and fluctuating loads.



PROFILE OF THE MARIENFELDE-ZOSSEN HIGH-SPEED EXPERIMENTAL LINE

To attain a speed of 100 km per hour on the Zossen test track, the distance varied from 2000 m to 3200 m, and the time from 138 to 220 seconds. These figures correspond to an average acceleration of .13 m to .20 m per second per second, although they might have been considerably increased, as the motors could have supplied 3000 hp for short periods, while for these accelerations only 700 hp to 1000 hp were required.

Accelerations of over .20 m per second per second were not attempted during the test runs on account of the generators in the power house not being able to withstand the great variations in power which would result from higher accelerations.

In the practical installation of high-speed service quick acceleration is important only when the distance to be traveled is short and the stations are close together. If the trains run long distances without stopping it makes little difference if the time taken in starting is increased one or two minutes. The advantage gained by using lighter loads on the machines in the central station and the motors on the car, and thereby making it possible to choose motors of smaller capacity, is greater than that to be gained by shortening the starting period.

More important than the question of starting is that of braking, as the safety of the service to a greater degree depends upon the latter.

Both cars used in the Zossen high-speed tests of 1901 were arranged to be stopped by the Westinghouse quick-acting air brake, the ordinary hand brake and by the use of short-circuit

current. Besides these devices, car A was supplied with an electric brake which was operated by exciting the alternating-current motors with a battery located in the car.

These various braking systems were arranged independently upon each truck. In this manner it was possible to operate the air and the electric brakes from either platform upon both trucks at the same time, while the hand brake located on each platform could be used to operate the braking system of only one truck. With a pressure of six atmospheres in the brake cylinders, two of which are arranged upon each truck, a pressure of approximately 6000 kg is exerted on each of the twenty-four brake-shoes arranged on either side of the wheels, the shoes being acted upon thereby by a total pressure of 144,000 kg, equal to 156 per cent of the weight of the car. The ratio between the pressure on the brake piston and that upon the three brake-shoes operated by this piston was approximately 1 to 6, thus a movement of 100 mm of the piston produced a brake-shoe movement of

$$\frac{100}{6} = 16.6 \text{ mm}.$$

By exerting a power of 40 kg on each wheel of the hand brake, a pressure of approximately 3640 kg was produced on each of the brake-shoes, which corresponds to a total pressure of 87,360 kg, equal to 95 per cent of the weight of the car. The ratio in this case is 1 to 1092.

In order to utilize the full value of the quick-acting air brake, a pressure regulator was placed before the train pipe, which allowed the air pressure in the brake cylinder to be properly regulated for different speeds through tightening or releasing a spring, and thus making it possible to obtain any desired brake pressure, within a definite limit, in the pipes during the operation of the brakes. For the tests, two of these pressure regulators were arranged on each platform and set for different pressures. By the use of a two-way cock either one or the other of the pressure regulators could be connected in the train pipe, and thus with the brakes, thereby allowing two different pressures to be used during the same brake test without it being necessary previously to adjust the tension on the springs.

Besides this, a pressure-reducing valve was connected with the brake cylinders on each truck, which performed the function of reducing the pressure in the brake cylinders as the speed decreased, and thereby prevented the skidding of the wheels due to the increased friction between the brake-shoes and wheels caused by the coefficient of friction increasing as the speed decreased.

During the progress of the test runs a great many brake tests were made with the air brakes, a summary of which is given in the accompanying table.

During these tests the principal points for accurate observation were the speed and the height of the air pressure in the pipes and brake cylinders. The time and the distance during which the brakes were in operation were also noted. The speed was determined by a recording distance key, besides which a Morse apparatus with two writing levers was arranged in car S, which made impressions every two seconds on a paper ribbon, and at the same time noted each revolution of the middle axle of one of the trucks.

The duration of the braking periods were determined very accurately by several observers using reliable stop-watches, and the braking distances were noted accurately within a few meters from the kilometer stones along the road. The recording distance key and the Morse apparatus served, at the same time, as an accurate check for the measured time and distance. The last-named apparatus also served as a suitable medium in determining accurately the braking curve and in fixing the speeds for each moment of the braking period.

The air pressure in the pipes was easily observed from the platforms, while the pressure in the brake cylinders was read from gages placed in the car.

The first brake tests showed less satisfactory results than had been expected, as the braking distances—even during emergency stops—were much greater than former experience

SUMMARY OF BRAKE TESTS, BERLIN-ZOSSEN, 1901

No. of Run.	Day.	Car.	Brakes Applied.	Speed km. per hour.	Braking Distance in Meters.	Braking Time in Seconds.	Air Pressure in Atmospheres. Pipes.	Air Pressure in Atmospheres. Cylinder.	Average Retardation met. p. s. p. s. $p=\frac{v^2}{2s}$	Retarding Force in Percentage of Car Wt. $\frac{100p}{g}$	Condition of Track.	Remarks.
1	Oct. 23	S.	Before Rangedorf, *	88	650	45	6.5	4.8	0.458	4.6	dry	†Brakes applied on only one truck.
2	Oct. 24	S.	Before Rangedorf, **	125	2,300†	147	6.5	4.8	0.262	2.7	dry.	Brake rods not properly adjusted. Stroke of the brake piston unnecessarily great. Triple valve standard construction of the Prussian Railways. A short ½-inch gas pipe was screwed in the exhaust of the pressure-reducing valve.
3	Oct. 24	S.	At 29.10 km. mark, **	95	750	758	6.9	4.8	0.465	4.7	dry.	
4	Oct. 24	S.	At 10.0 km. mark, *	113	1,250	69	5.5	4.8	0.38	3.9	dry.	
5	Oct. 24	S.	At 20.0 km. mark, **	123	1,300	70	6.0	4.8	0.45	4.5	dry.	
6	Oct. 26	S.	Before Marienfelde, *	128	1,770	92	braking during operation	4.4	0.36	3.6	dry.	
7	Nov. 1	S.	Before Rangedorf, **	143	1,700	80	6.0	5.0—4.8	0.46	4.65	dry.	
8	Nov. 2	S.	At 19.2 km. mark, **	138	1,600	78	8.0	5.3—4.8	0.46	4.65	damp.	Instead of the ½-inch gas pipe a choking disc with 3½mm hole was placed in the exhaust of the pressure reducing valve. Otherwise as above.
9	Nov. 2	S.	At 16.6 km. mark, *	142	1,560	75	8.0	5.5—4.8	0.50	5.1	damp.	
10	Nov. 4	S.	At 10.0 km. mark, *	141	1,400	65	8.0	5.5—4.8	0.55	5.55	damp.	Hole in the emergency valve piston increased from 3mm to 5mm. Valve otherwise as above.
11	Nov. 4	S.	At 16.45 km. mark, *	154	1,650	69	8.0	5.5—4.8	0.555	5.65	damp.	
12	Nov. 5	S.	At 16.3 km. mark, *	157	1,600	67	8.0	5.5—4.8	0.60	6.05	dry.	The ring was removed from the emergency-valve piston and the spring from the check valve. Otherwise as above.
13	Nov. 5	S.	At 16.6 km. mark, *	158	1,600	67	8.5	5.8—4.8	0.605	6.1	dry.	
14	Nov. 5	S.	At 10.0 km. mark, *	146	1,340	63	8.5	5.8—4.8	0.615	6.2	dry.	
15	Nov. 25	A.	Before Zossen, **	95	450	28	7.5	5.3—4.8	0.775	7.85	damp.	Triple valve the same as the earlier Prussian standard without spring in check valve with larger passage in slide valve. Choking disc with 1-6 mm hole. Otherwise as above.
16	Nov. 25	A.	At 9.0 km. mark, *	103	430	27	9.0	6.0—4 5	0.954	9.7	damp.	
17	Nov. 25	A.	At 9.0 km. mark, *	115	700	38	7.5	5.4—4.5	0.73	7 4	damp.	
18	Nov. 26	A.	At 12.7 km. mark, **	120	910	47	7.0	5.0—4.5	0.61	6 3	damp.	Choking disc with 2.5 mm hole Otherwise as before.
19	Nov. 26	A.	At 25.0 km. mark, **	120	850	45	8.5	6.5—4.5	0 658	6.7	damp.	
20	Nov. 26	S.	At 28.0 km. mark, **	106	500	32	7.5	5.4—4.5	0.92	9.4	damp.	Large new water-cooled brake shoes. Otherwise as above.
21	Nov. 26	S.	At 8.5 km. mark, *	120	800	39	8.2	6.0—4.5	0.74	7.6	damp.	
22	Nov. 28	A.	At 28. km. mark, **	127	800	45	8.5	6.0—4.5	0 78	7.9	dry.	
23	Nov. 28	A.	At 9.0 km. mark, *	85	320	27	5.5	4.5	0.87	8.85	dry.	
24	Nov. 29	A.	At 25.0 km. mark, **	120	750	40	8.5	6.0—4.5	0.74	7.6	dry.	Choking disc with 3 mm hole. Small brake shoes without water-cooling. Otherwise as above.
25	Nov. 29	A.	At 25.0 km. mark, **	120	720	39	6.0	4.5	0.77	7 9	dry.	
26	Nov. 29	A.	At 9.0 km. mark, *	122	800	40	5.5	4.5	0.72	7.3	dry.	
27	Nov. 30	A.	At 28.5 km. mark' **	118	550	36	8.5	6.0—4.5	0.98	10.0	wet.	
28	Nov. 30	A.	At 9.0 km. mark, *	115	620	34	8.5	6.0—4.5	0.825	8.4	wet.	
29	Nov. 30	S.	At 28.5 km. mark, **	125	850	46	8.5	6.0—4.5	0.71	7.2	wet.	2.5 mm choking disc, large brake shoes with water-cooling. Otherwise as above.
30	Nov. 30	S.	At 10.0 km. mark, *	110	550	32	7.6	5.4—4.5	0.85	8.65	wet.	

* Returning. ** Going.

with the air brake would indicate. The matter was taken up with the Westinghouse Air Brake Company, and through its representative, Mr. Führ, a number of alterations upon the braking apparatus was decided upon and carried out.

These alterations are noted briefly in the order in which they were made, under "Remarks" in the attached table. In

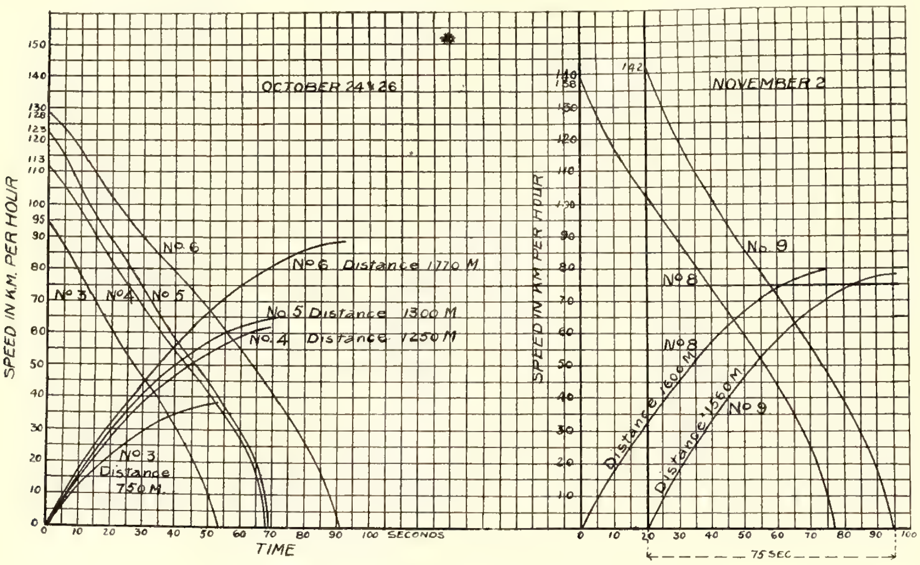


FIG. 1.—CURVES DERIVED FROM BRAKE TESTS

the first place the principal point was to carefully adjust the brake-rods so that all of the brake-shoes exerted equal pressure against the wheels; the piston stroke was also shortened. Various means were tried to obtain rapid increases of air pressures in the brake cylinders at the beginning of the braking periods. For this purpose the triple valve used for quick-acting brakes on trains, which was installed in the cars, was replaced by the ordinary triple valve of the earlier Prussian railways. Again, the pressure-reducing valve used did not meet the requirements, as it reduced the pressure in proportion to the time and not to the reduction of speed.

Through these alterations a decided shortening of the braking distance was obtained, which may be seen from the brake diagrams in Figs. 1 to 3, and they also showed the possibility of obtaining still better results through further modifications. Particularly, it was made evident that the initial air pressure must reach its highest value in the brake cylinder immediately upon applying the brakes.

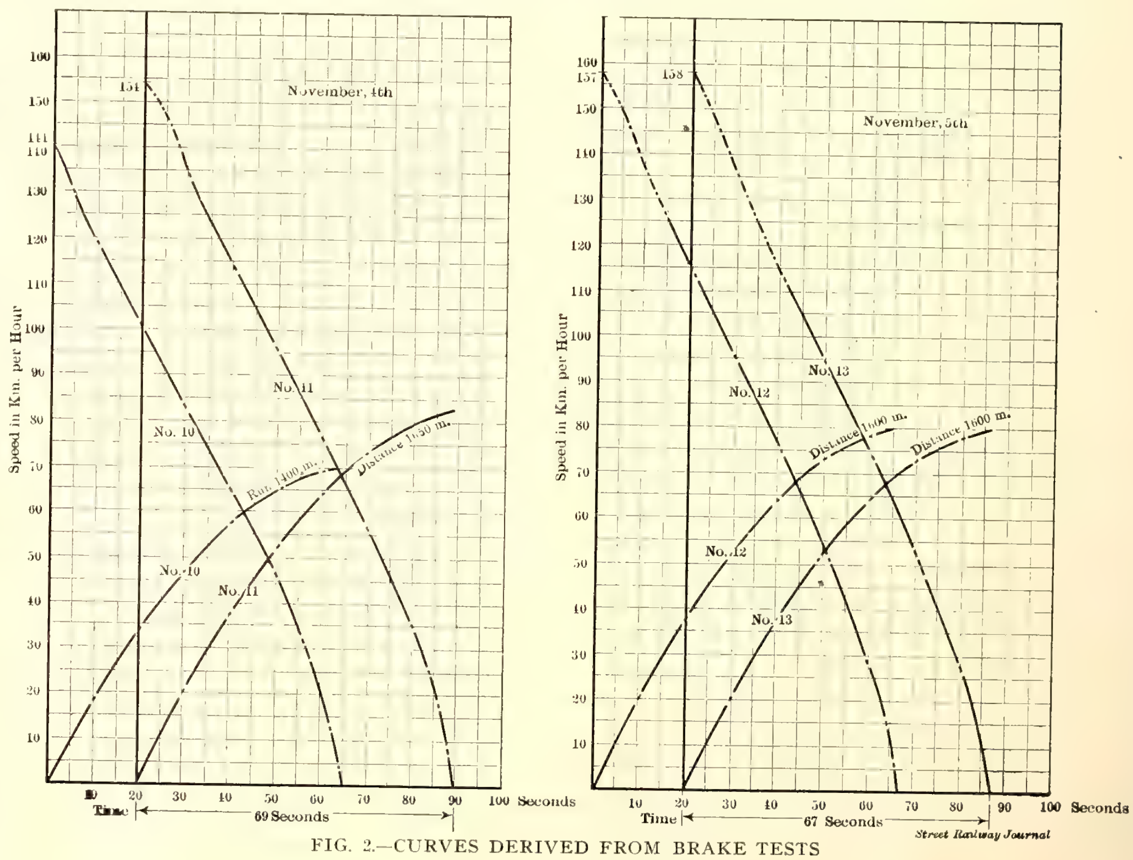


FIG. 2.—CURVES DERIVED FROM BRAKE TESTS

From the recorded diagrams in Fig. 5 is shown that with a pressure of 9, 8.5 and 8.4 atmospheres in the pipes the greatest pressure in the brake cylinders is only 7, 6.2 and 6.1 atmospheres. The triple valve should therefore be altered so that this great difference in pressure between the pipes and brake cylinders does not exist. Further, the pressure-reducing valve must be so arranged that the reduction of the air pressure in the brake cylinder during the braking period is made dependent upon the decreasing speed, so that the friction between the brake-shoes and the wheels remains as great as possible, but not so great that skidding of the wheels will result.

Since an automatic valve which fills these conditions is not to be obtained, the engineer's valve will be altered so that the motorman may return the brake pressure as desired during the braking period.

Finally, the tests also showed that the brake-shoes and the wheel rims became excessively hot through the continued application of the brakes. In the earlier runs the rims became blue, so great was the heating, and for test purposes car S was equipped with considerably larger shoes having pockets which were filled with water. The heating of both shoes and wheel rims was materially decreased by this arrangement, although they still became quite hot, and will become still hotter as the speed is further increased, so that there is danger that the tires will become loose upon the wheels. It will therefore be advisable to find a construction such that the braking power need not be applied entirely to the wheel tire, but partly to other brake discs attached to the axles or to the wheels.

The friction between the wheels and the brake-shoes depends upon the value of the coefficient of friction, which was confirmed by the elaborate tests of Galton and Westinghouse in the years 1878 and 1879, and by Wichert in the years 1887 and 1888. The value of the coefficients of friction for speeds up to 96 km per hour, as determined in these tests, is given in the curves of Fig. 5A.

It is interesting to calculate the corresponding braking coefficients from the curves which were obtained in the different brake tests.

Let the *

Coefficient of friction	f.
Total pressure on the brake-shoes	D.
Mass of the car $\left(\frac{Wt}{g}\right)$	M.
Rotating mass referred to wheel circumference	R.
Air and train resistance	W.
Up and down grade of road	± a.
Retardation	p.

* These dimensions are all metric.

Then

$$fD + W \pm gM.a = p\ (M + R)$$

We have, for instance, from test No. 30

$$a = 0$$

$$M = \text{approx.}\ \frac{93000}{10} = 9300$$

Also by calculation

$$R = 790$$

At a speed of 20 km per hour, the curve shows

$$p = 1.7$$

The total pressure on the brake-shoes, after making allowance for the reduction of air pressure in the brake cylinder and the resistance of the brake rods, may be taken at 100,000 kg. The final value of the resistance W for the speed in question, no matter how it is calculated, will be so small compared to the braking resistance that it will have little or no effect upon the value of f.

Using, for instance, the formula

$$W = \left(2.5 + \frac{v^2}{1300}\right)\frac{Mg}{1000}$$

we obtain for the above case

$$W = 260$$

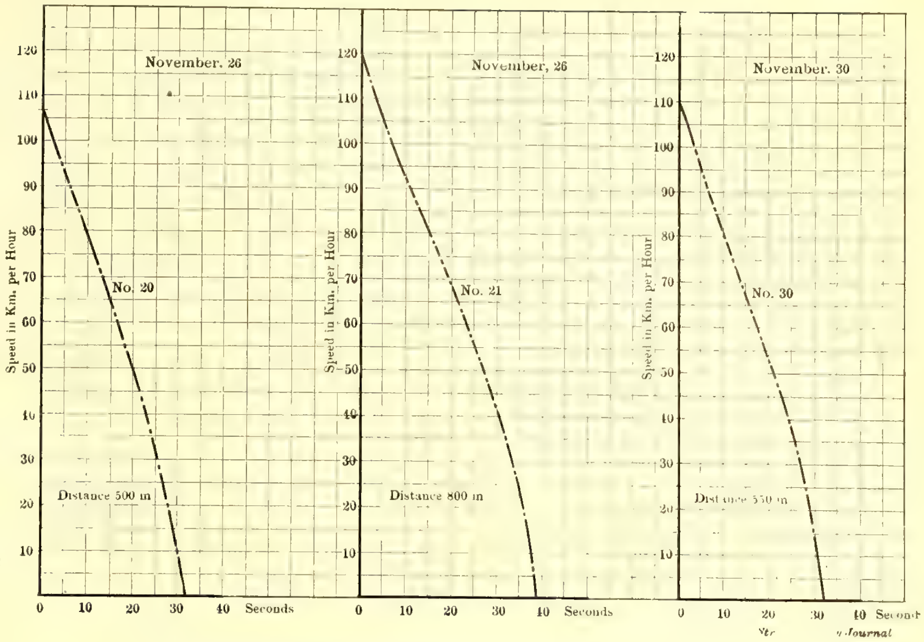


FIG. 3.—CURVES DERIVED FROM BRAKE TESTS, NOV. 26 AND 31, 1901

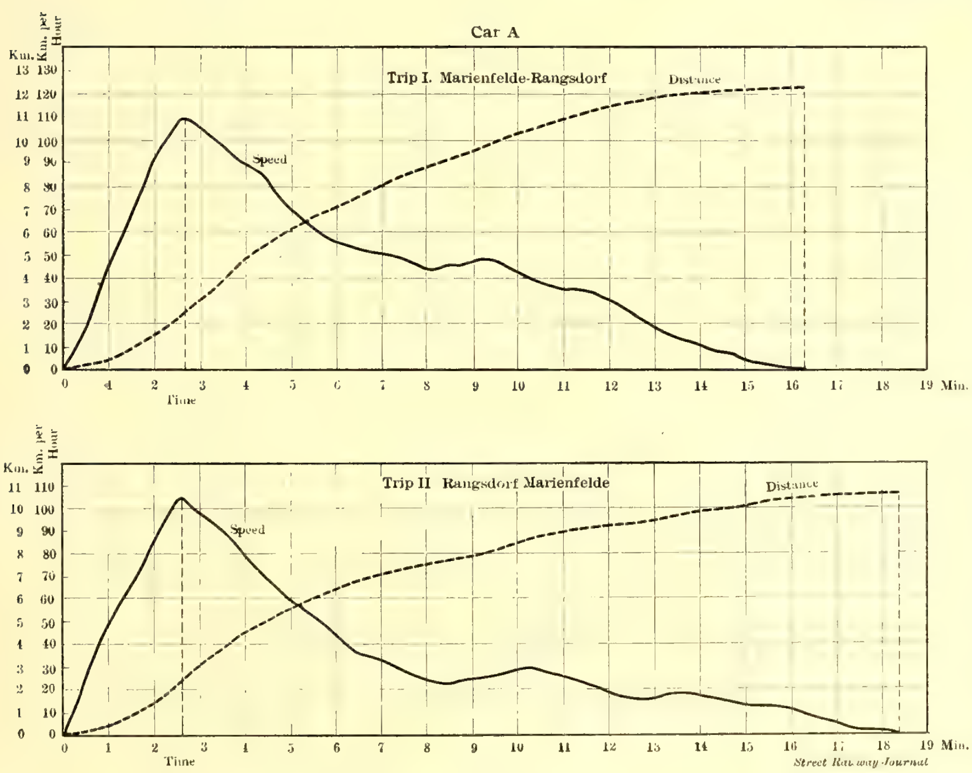


FIG. 4.—CURVES SHOWING COASTING TEST OF NOV. 28, 1901

By using these values in the original formula, we obtain

$$f = \frac{1.7\ (9300 + 790) - 260}{100{,}000}$$

$$= 1.7$$

At a speed of 60 km from the same test

$$p = 0.75$$

The pressure on the brake-shoes is approximately 110,000 kg.

From these values we obtain

$$f = 0.064$$

From test No. 29, at a speed of 100 km

$$p = 0.6$$

Assuming the pressure on the brake-shoes to be 120,000 kg, we obtain

$$f = 0.042$$

As shown by these results, the coefficients of friction—even at the greatest speeds—are less than those found by Westinghouse, which may be accounted for by the difficulty experienced in adjusting the brake rods, as the arrangement used did not insure all the brake-shoes being pressed equally against the wheels; also, because the friction is influenced by the material of the wheel tires and in that of the brake-shoes.

The selection of the Westinghouse quick-acting brake for the high-speed cars, due to its well-tested construction, was found to be correct for the present case; the particular brake arrangement used, however, is not satisfactory for single-operated cars. As suggested above, the condition met with here requires a braking system that operates quickly and insures an equal pressure upon all wheels which may be readily adjusted to suit the given speed. For this purpose a simple form of air brake in which the pressure can be easily regulated is sufficent. It would be still more desirable if, instead of the air brake, the momentum of the car could be utilized to stop it.

Tests were also made with the hand brakes, and were so conducted that at a given signal the shoes on both trucks were set at the same time. The results obtained showed that reliability could be placed upon this form of brake after taking into consideration the lower pressures between brake-shoes

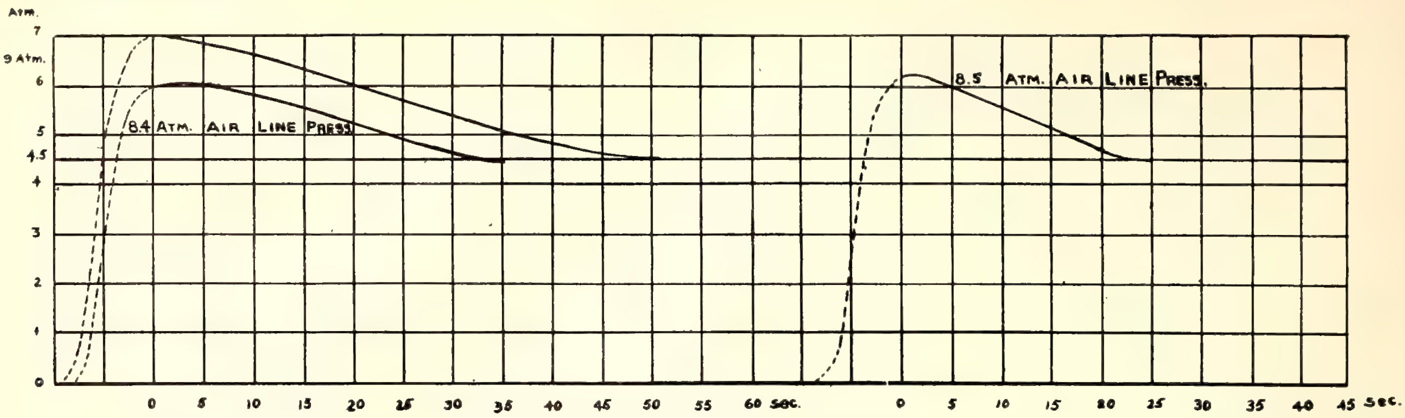


FIG. 5.—DECREASE OF PRESSURE IN AIR CYLINDER WITH 2½-MM AND WITH 3-MM CHOKING DISC IN THE EXHAUST PORT OF THE PRESSURE-REDUCING VALVE

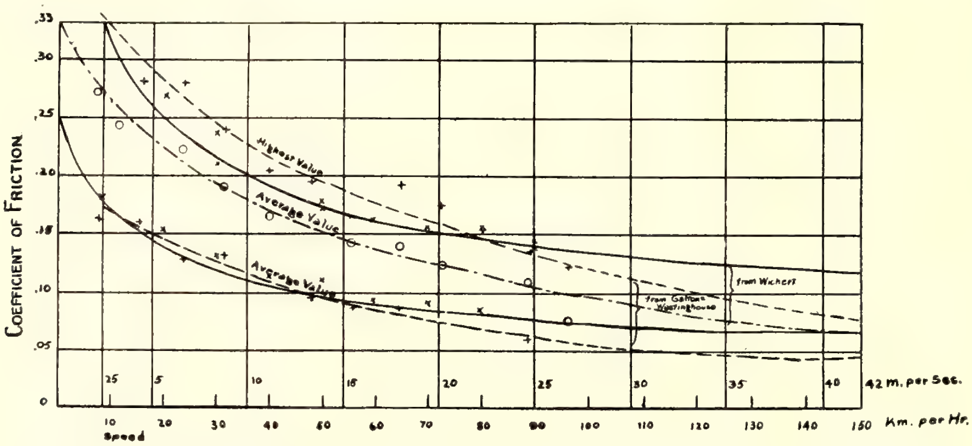


FIG. 5A.—VALUE OF THE COEFFICIENT OF FRICTION BETWEEN THE BRAKE-SHOES AND THE WHEELS, ACCORDING TO THE TESTS OF GALTON AND WESTINGHOUSE IN 1878 AND 1879, AND ALSO OF WICHERT IN 1887 AND 1888

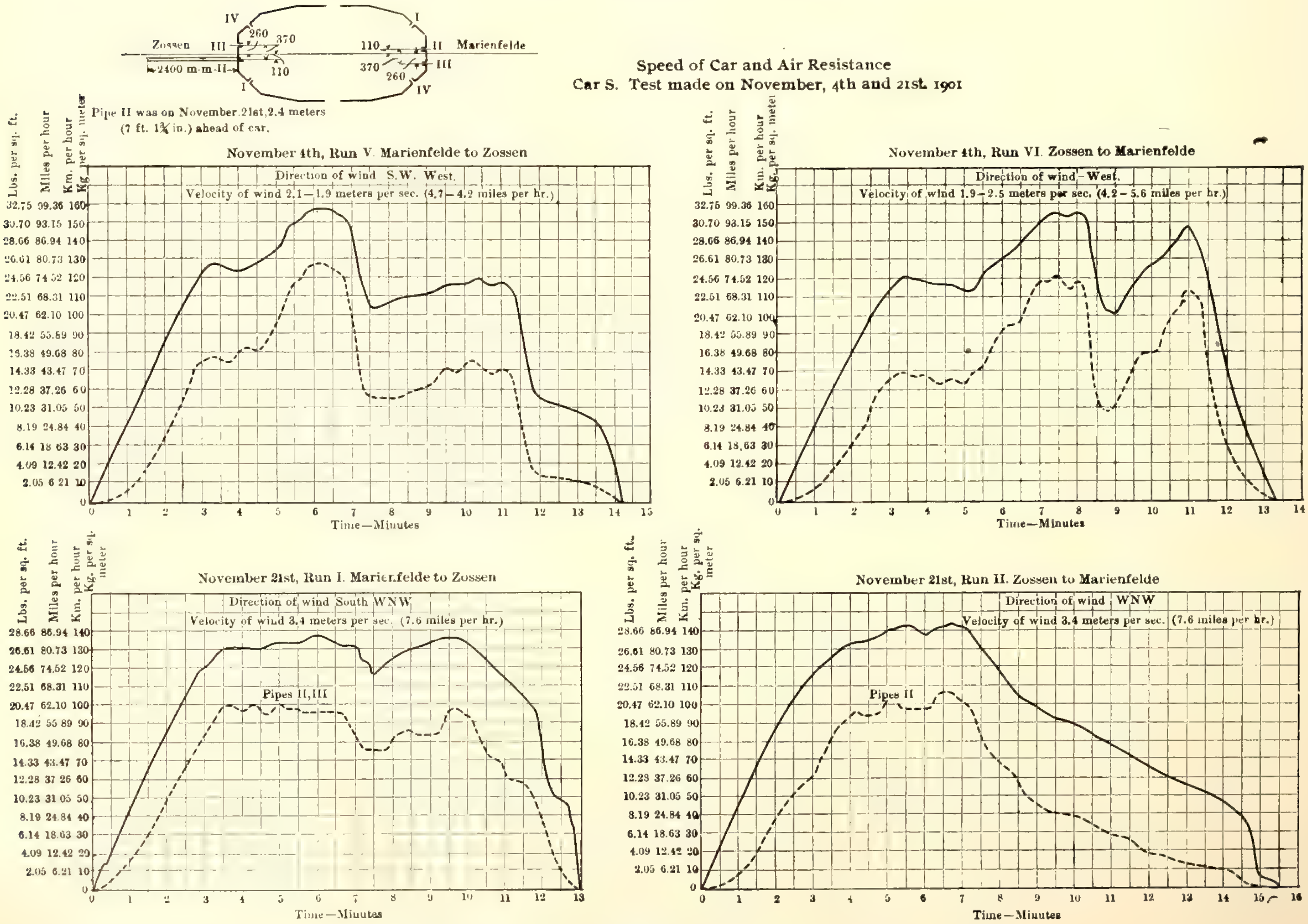


FIG. 6—SPEED AND AIR-PRESSURE TESTS OF NOV. 4 AND 21, 1901

and wheel rims. At an initial speed of 100 km per hour a braking distance of approximately 720 m in forty-two seconds was obtained, which corresponds to an average retardation of 0.66 m per second per second.

Many brake tests were attempted in car A with short-circuited current, but no decided results obtained. It is probable that much shorter braking distances could be obtained by using the short-circuit brake at the higher speeds. In general, braking by short-circuit current should only be attempted in case of emergency, as by the use of this method a great strain is thrown upon the motors, which might result in their injury. The braking system in car A, operated by exciting the motors with direct current, was not tested, as favorable results through the use of this scheme at high speeds have never been obtained.

A few words regarding the two coasting tests made on Nov. 28 with car A and shown in the curves of Fig. 4.

The speeds at the time of cutting off current were respectively 109 km and 106 km. The tests were made once in one direction and once in the opposite direction over practically the same part of the road. The distance the car ran without current in one case was 9600 m, and in the other, 8300 m, the corresponding times being 817 and 952 seconds. The curves and grades in either direction on the coasting stretch about equalized themselves. At the time of the tests the observations of the Potsdam Meteorological Observatory showed a wind direction of WNW and a speed of 11.4 m per second. The wind offered less resistance to the car when running in the direction Marienfelde-Zossen than in the opposite direction.

The differences in the coasting distances may be accounted for by the fact that the initial speeds were not the same. Taking the mean value from the recorded results of speed and time:

$$v = 107 \text{ km.}$$
$$t = 885 \text{ secs.}$$

Assuming that the speed decreases constantly, the retardation will also be constant and

$$p = \frac{v}{t} = 0.034 \text{ metres p. sec.}$$

The resistance of the car, which is assumed to be constant, will be

$$W = p\ (M + R) = 0.033 \times 9830$$
$$= 334 \text{ kg.}$$

From this the resistance per ton of train weight is

$$w = 3.7 \text{ kg.}$$

This average value for the resistance of the car looks small when compared with the average values obtained by the commonly used resistance formulæ.

From the formula already cited,

$$W = \left(2.5 + \frac{v^2}{1300}\right)\frac{Mg}{1000}$$

we obtain for a constantly decreasing speed starting at 100 km per hour an average value for the resistance per ton of train weight

$$w = 5.4 \text{ kg.}$$

In this formula the first term 2.5 depends only upon the sliding and rolling friction, and is applicable to an entire train as well as to the motor car in question. The difference in the final results therefore can only lie in the second term

$$\frac{v^2}{1300}$$

and the disagreement between the results of the test and those obtained by the formula is readily explained when we take into consideration the exceptionally great weight of the motor car, it playing no part in this term

$$\frac{v^2}{1300}$$

which relates chiefly to the air resistance.

In a train composed of many cars the formula gives more accurate results since the weight of the train as well as the air resistance increases with its length. Moreover, it is well known that this formula gives too high values for the higher speeds.

AIR RESISTANCE

To determine by test the relation between the speed and the pressure upon a rigid body, for the higher speeds, through opposite straight line movement, it was formerly necessary to use the ordinary measuring instruments, and it was consequently never practically possible to prove the accuracy of the results obtained in this manner.

The Zossen high-speed tests offered a favorable opportunity to correct this defect, as it was possible during the runs to make these measurements in a most accurate manner through the use of hydraulic pressure pipes. For this purpose holes were bored at different points through the front wall as well as in the rounded and beveled sides of the car, and short pipes were placed in them. Rubber tubes which connected with these pipes were led to water stand pipes arranged alongside of each other in the inside of the car. These latter consisted of simple communicating pipes of about 5 mm diameter, upon which a millimeter scale was attached. This scale could be adjusted vertically for a short distance so that its zero point could be set accurately at the level of the water in the pipes at the beginning of the observations.

Four such devices were arranged at each end of the car, two with openings in the front of the car and two on the rounded or beveled sides of the car ends. Several pipes were also arranged along the sides of the car, and at different periods during the observations were connected with the water pressure pipes. The placing of two openings at the front of the car was for the purpose of facilitating the use of different lengths of pipes, so that one opening always remained free and could be used for noting the pressure which was checked by the other.

The first thing of importance to determine was whether the length and the form of the mouth of the pipes at the front wall had any effect upon the pressure. To determine this a pipe with a funnel attached was placed in one of the openings at the front wall and a thin pipe without a funnel in the other. Further, the mouth of the funnel and then that of the pipe were reversed.

From these tests it was shown that the length and the form of the mouth of the pressure pipes placed at the front wall had no effect whatever upon the value of the air pressure. This method made it possible to reach all points at the front of the car with pressure pipes of different lengths and located in different positions, and accurately to determine the pressure at these points.

The determination of the manner and extent that the air pressure distributes itself upon the sides of the car was made independent from the influence of possible changes in speed by comparisons of the average openings, as well as the fixed openings, with the values obtained at the different points.

Further, a pressure pipe having different lengths was placed in the front wall opening and extended out in front of the car for lengths up to 3.4 m. Through this means it was shown that the pressure at the end of the pipe was about the same as that noted directly in front of the car and registered always the same as long as the opening of the pipe was kept toward the front. But as soon as the end of the pipe was bent toward the rear a decrease in pressure was at once noted, from which may be concluded that the compressed air cone driven before the car has its apex near this point.

Still other results were obtained by the measurement of the air pressure on the rounded and beveled sides of the front end of the car.

Upon these surfaces the air pressure is considerably less than on the straight surfaces at right angles to the direction

of motion, and a decided suction effect was sometimes noted at these places, depending greatly upon the direction of the wind. The pressure pipes along the sides of the car, whose mouths were placed even with the outside of the walls, indicated no decided variation due to the different speeds. Any difference of air pressure noted at these points was due more to the direction and the strength of the wind than from the speed. It was expected that a decided suction effect would be noted at the rear end of the car, but in reality only a slight effect was recorded, which did not increase very much as the speed increased.

On account of the time being limited for the tests, further observations were not possible along this line, as greater importance was attached to the determination of the air pressure at the front end of the car.

The results of these tests are given in the speed diagrams, a few of which are reproduced in Figs. 6-8. All of the pressure curves follow the general direction of the speed curves. Where this is not the case it can generally be accounted for by some local condition which caused the variation of the height of the water level at the moment the observation was being made. This could occur through a gust of wind of unequal pressure, also, as was often the case, the pressure would be suddenly altered when running by a building or similar object placed near the railroad.

The opening to which the pressure refers is noted upon each curve. In a few of the curves it may be seen what pressure was obtained at the end of the extended pipe. In Fig. 9 the observations for each day are plotted with air pressure as ordinates and speed as abscissæ. The different shaped points (that is, dots and crosses) refer to the different directions in running, and indicate that the pressure in the one direction has a different value than that in the opposite direction, although a general agreement between these values is clearly seen. The difference can only depend upon the strength and the direction of the wind which prevailed upon the particular day, the greater pressure applying to the direction of motion opposing that of the wind. The direction and speed of the wind is also noted as given by the Meteorological Observatory at Potsdam each day of the tests.

In Fig. 10 the final results of all of the tests are given, with the direction of motion separated. From this chart it is clearly noted that the air pressure increases in proportion to the speed through a curve somewhat similar to a parabola.

According to these measurements, up to a speed of 150 km per hour, the air pressure seems to follow closely the equation

$$p = 0.07v^2$$

in which v is the speed in meters per second and p is the pressure in kilogram on 1 sq. m of surface placed at right angles to the direction of motion.

Unfortunately, as above mentioned, it was not possible to conduct the measurements of the air pressure to such an extent that a final conclusion could be arrived at just what shape the car should have in order to lessen the air pressure as much as possible.

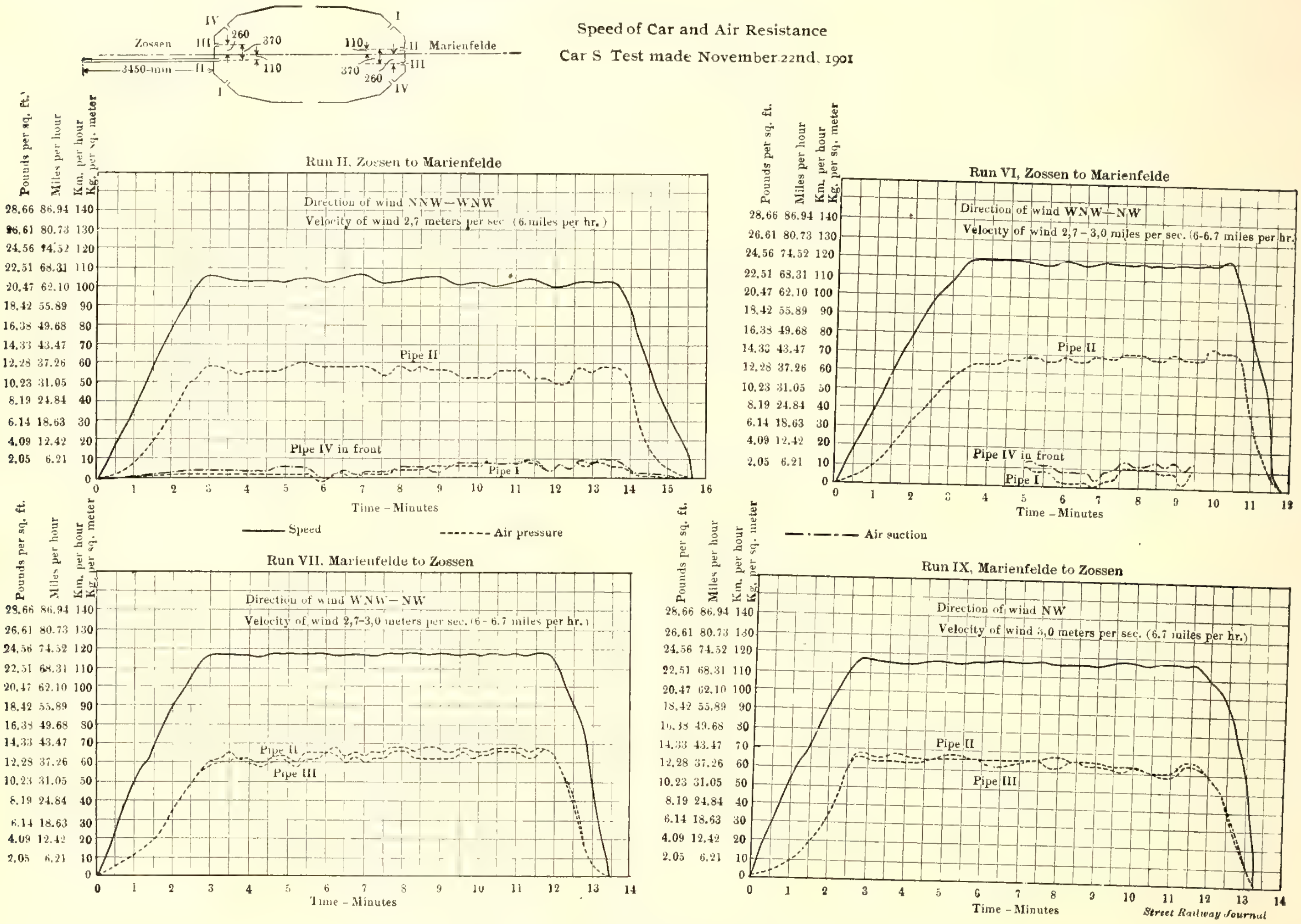


FIG. 7.—SPEED AND AIR-PRESSURE TESTS OF NOV. 22, 1901

ENERGY CONSUMPTION

For the determination of the energy consumption, observations were made in the car, as well as in the power station, and were taken during the latter series of the tests from the switchboard in the power station at intervals of ten seconds each. Records were made at the power station of the voltage, current strength and current consumption, and the frequency was determined through the number of revolutions of the generator. In the car the principal data taken were the voltage

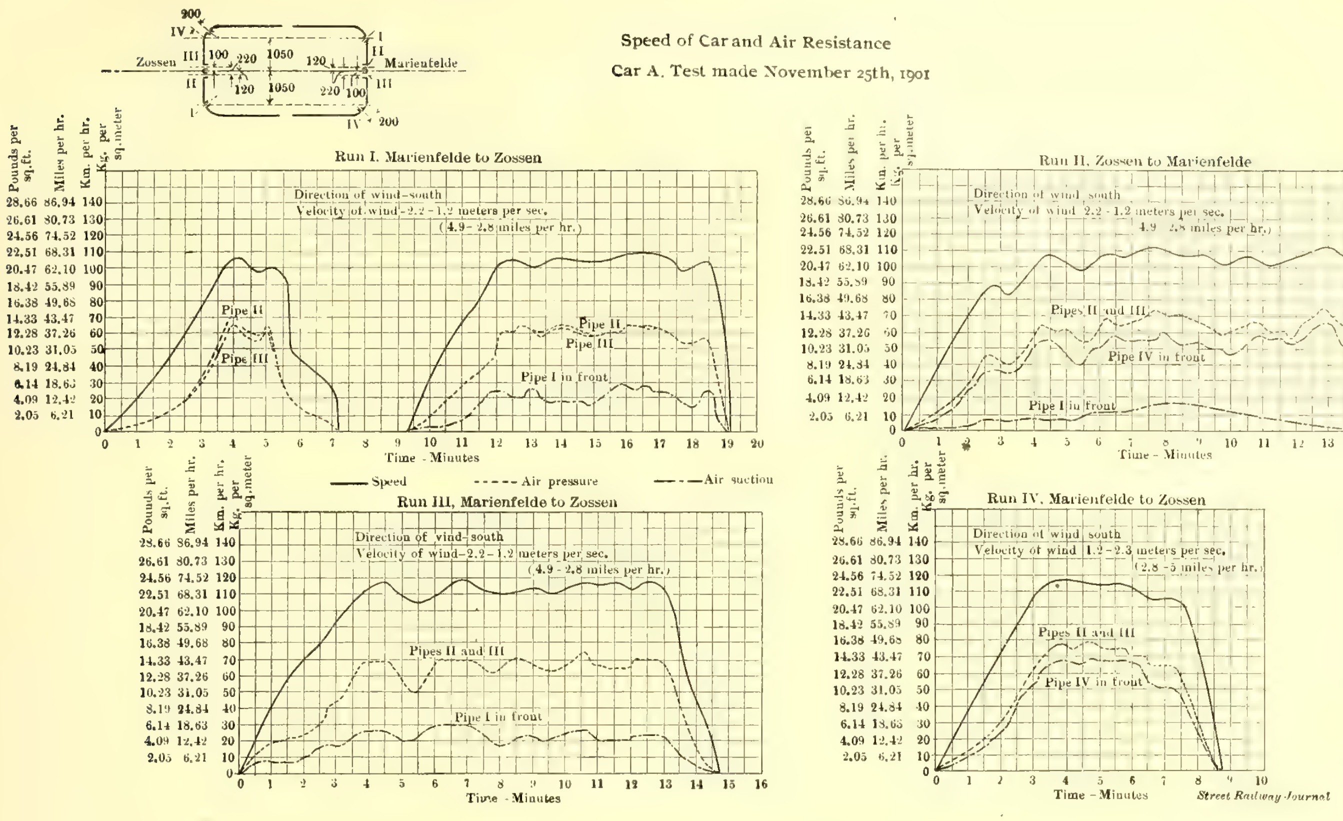


FIG. 8.—SPEED AND AIR-PRESSURE TESTS OF NOV. 25, 1901

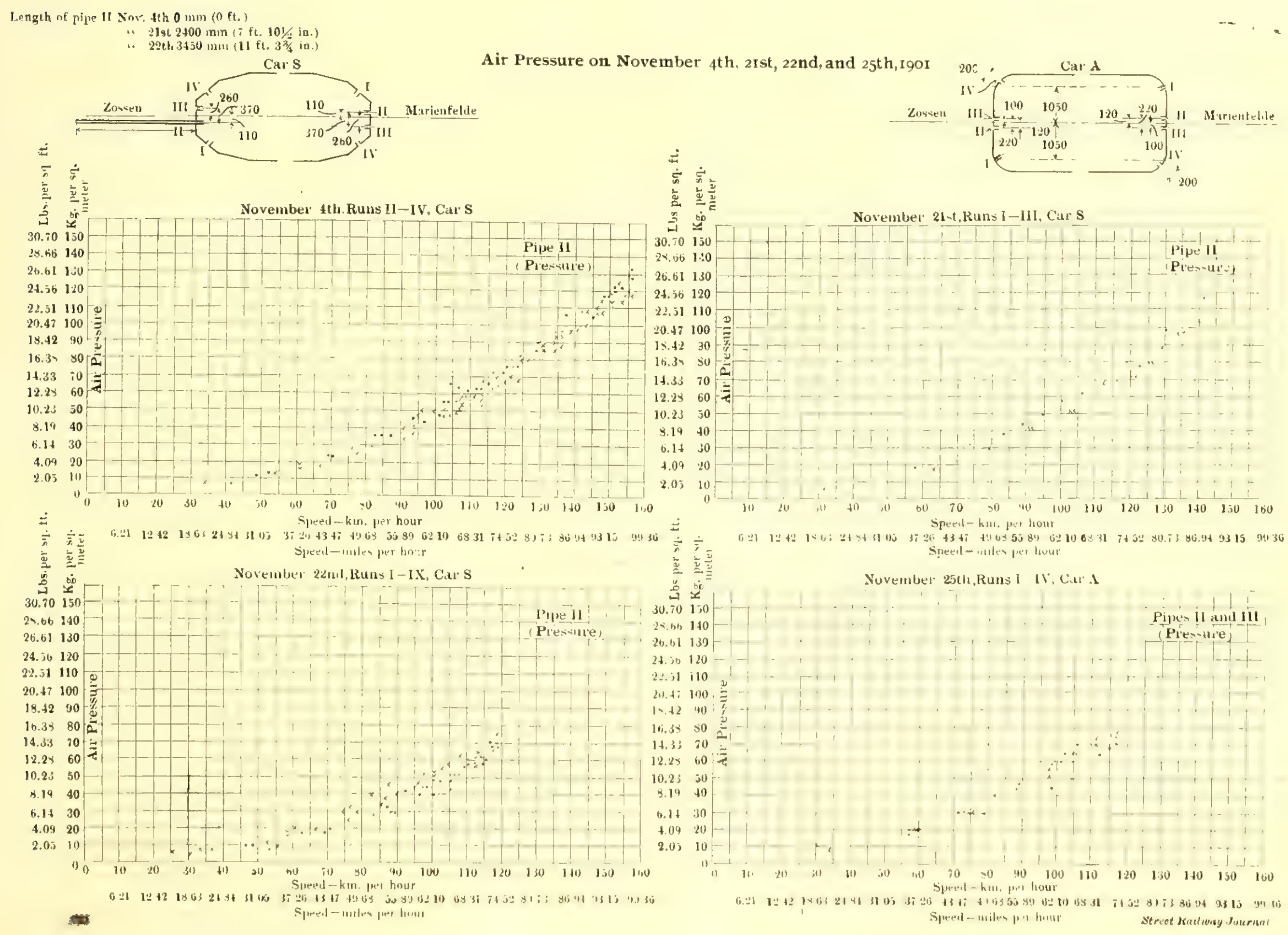


FIG. 9.—AIR-PRESSURE TESTS OF NOV. 4, 21, 22 AND 25, 1901

and current at intervals of 15 seconds or 30 seconds. Only during the latter runs could the current consumption in the car A be accurately observed, as previous to this no reliable instruments were available.

The frequency was determined quite accurately in car S by

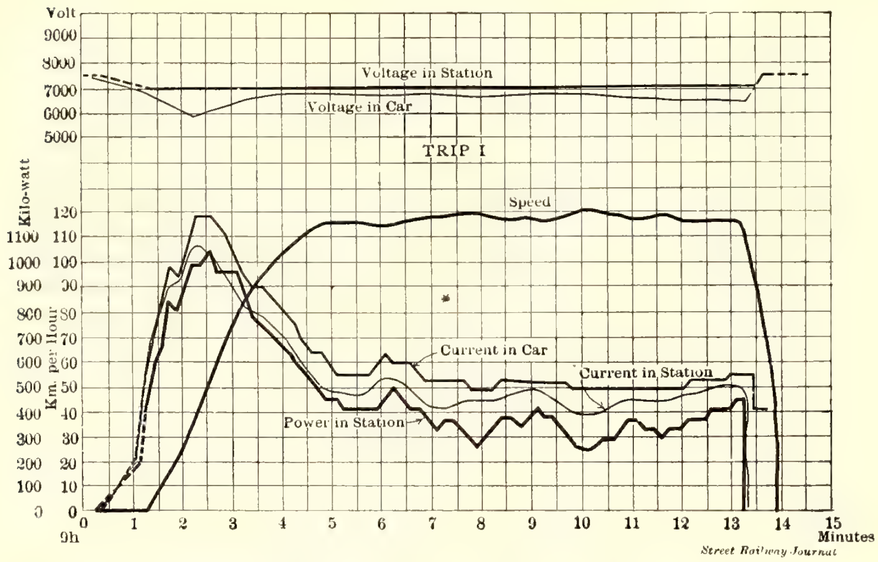


FIG. 11.—VOLTAGE, CURRENT, POWER AND SPEED CURVES FOR TRIP 1.

noting the revolutions of the motor for the air pump when running without load. The most reliable measurements were made at the power house, as it was possible to use very delicate instruments there, which could not be employed in the car

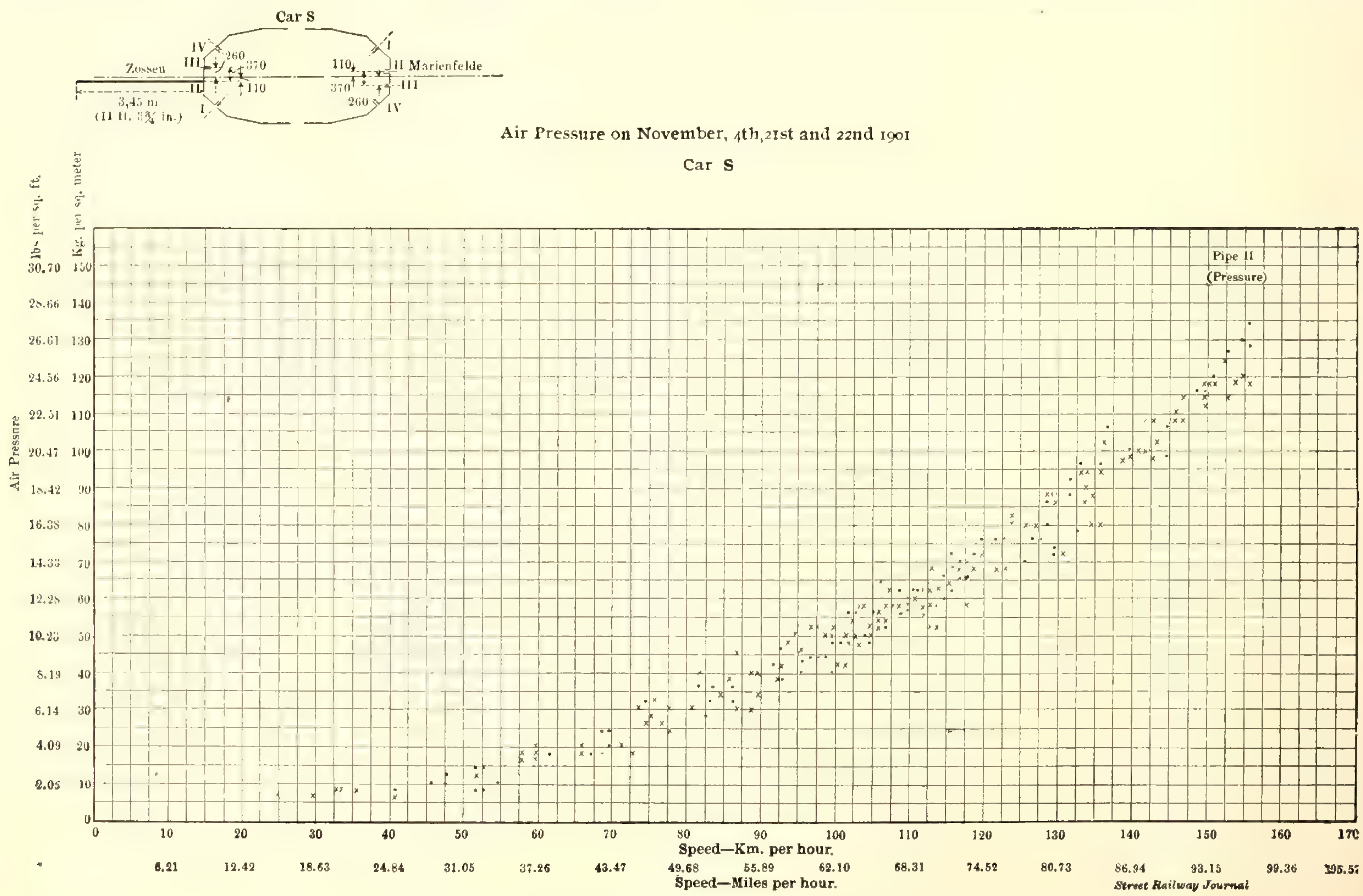


FIG. 10.—AIR-PRESSURE TESTS OF NOV. 4, 21 AND 22, 1901

during the trips, on account of the vibration. The results recorded by the instruments depend upon the frequency which was determined for each run by the speed desired, and was held constant in a very satisfactory manner by altering the weights attached to the governors on the steam engine. As the measuring instruments were calibrated for only one frequency, it was necessary at the end of the test to calibrate them again for the different frequency contemplated.

The current delivered from the primary machine had a potential of only 6000 volts, which was raised to 12,000 volts by transformers placed in the power house for this purpose.

In Figs. 11-14 the results noted at the power house and in the car are plotted in the form of curves, which include also the speed curves. The full lines show the consecutive results as actually recorded by the instruments, while the dotted lines (in Fig. 12) represent data not recorded for short periods. In these dotted lines, however, each separate point is accurately determined, and the remaining part of the line is drawn in accordance to the other measurements, so that great errors at these places are impossible.

The curves were originally plotted in two scales, and the average values given in the following table were determined from these charts through the use of a planimeter. The table on the opposite page gives the actual figures obtained.

The results are separated for starting and continuous running, and in each case the average values for the measurements of the energy consumption and the power factor are separately calculated. The losses in the transmission line and the transformers in the power house were determined through calculation, and the energy consumption at the trolleys in the car is given by the recorded results.

It is a well-known fact that the difficulties of making measurements of three-phase installations are many, and the necessary data are not easily obtainable with absolute accuracy;

CAR A

Date—Nov. 1901.	Run No.	Frequency.	Starting Place.	Accel. Time from Turning on Current, Seconds.	Maximum Speed Km. Per Hour.	Power House Reduced to Secondary of Transformer. Measured Mean Values. Amp.	Volt.	Kw.	Calculated. P. F.	Kw. Hr.	Car at Trolleys, Measured Mean Values. Amp.	Volt.	Kw.	Accel. Time from Starting of Car, Seconds	Mean Accel. Meters, p. s. p. s.	Accel. Distance, Meters.	Difference in Level Meters.	Losses in Line and Transformers. Trolley Line Kw.	Transmission Line, Kw.	Transformer, Copper, Kw.	Iron Kw.	Total Kw.	Energy Consumption at Trolleys on Cars. Kw.	H.P.
26	Ia	27½	Mf.	231	118	87	7,300	740	0.675	47.5	(80)	....	....	225	0.146	4,400	—4.00	(3.5)	(83)	9.0	12¾	106	634	860
26	Ib	27½	km 13.65	240	(125)	84	7,400	675	0.63	45.0	....	....	....	....	....	....	....	....	....	..	13¼	..	....	....
26	Ic	27½	km 25	198	(99)	84	7,400	710	0.66	39.0	....	....	....	....	....	....	....	....	....	..	13¼	..	....	....
26	II	27½	Zo.	240	85	69	7,400	520	0.59	34.6	(65)	....	....	225	0.105	2,630	—0.75	(47)	(55)	5.9	13¼	(120)	400	544
27	I	27½	Mf.	255	118	86	7,600	695	0.616	49.2	(80)	7,000	....	240	0.136	5,100	—3.16	(4)	(83)	8.9	13¼	(110)	585	795
28	III	30	Mf.	231	135	92	8,000	870	0.685	56.0	(82)	7,500	....	203	0.185	4,800	—2.45	(4.5)	(87)	9.7	14½	(116)	754	1,025
29	I	27½	Mf.	285	115	....	....	....	....	....	64.5	6,500	(645)	235	0.136	4,200	—4.36	2.2	54	5.8	(12)	74	.	(876)
29	II	27½	Zo.	270	115	....	....	....	....	....	85.5	5,600	(745)	230	0.139	4,250	—2.09	80.	94	10.0	(12)	196		(1,012)
29	III	27½	Mf.	210	119	....	....	....	....	....	77.	6,500	(740)	180	0.184	3,650	—3.65	3.	77	8.2	(12)	100	...	(1,008)
29	IV	27½	Zo.	255	115	....	....	....	....	....	83.5	5,800	(750)	225	0.142	4,380	—2.09	77.	90	9.5	(12)	188	...	(1,020)
30	I	27½	Mf.	270	113	74½	7,000	623	0.69	46.6	68.	6,600	....	210	0.150	3,770	—4.36	2.5	60	6.6	12	81	542	737
30	IIa	27½	Zo.	255	110	92	7,000	765	0.69	54.0	81.	5,600	....	225	0.136	4,030	—2.00	72.	85	9.6	12	179	586	796

CAR S

21	I	30	Mf.	216	130	102	8,700	900	0.587	54 2	99.	7,600	....	210	0.172	4,320	—4.30	5.	126	13.2	16.5	161	739	1,000
21	II	30	Zo.	255	133	95	8,500	895	0.64	63.3	91.	6,800	....	240	0.154	5,350	—2.09	90.0	107	11.25	15.9	224	671	912
21	III	30	Mf.	216	102	86	8,100	722	0.60	43.4	85.	7,100	....	210	0.135	3,625	—4.36	4.	93	9.55	14.7	121	601	817
21	IVa	30	Zo.	222	115	96	8,000	845	0.63	52.0	96.	6,400	....	210	0.152	4,000	—2.00	102.	119	12.07	14.5	248	597	811
21	IVb	30	Mf.	192	120	99	7,850	875	0.655	46.7	93.	6,950	....	180	0.186	3,300	—5.20	22.7	112	11.92	14.	161	714	970
22	Ia	25	Mf.	174	105	96½	6,900	760	0.66	36.7	91.	5,800	....	167	0.175	2,400	—3.15	2.2	107	11.4	12½	133	627	850
22	Ib	25	km 30	72	(35-40)	83	6,950	550	0.55	11.0	(80)	....	....	....	....	....	....	(72)	(83)	(8.6)	12¾	(176)	374	509
22	II	25	Zo.	192	104	102	6,950	750	0.61	40.0	97.	5,300	....	186	0.155	2,850	0.	104.	121	12.8	12¾	250	500	680
22	III	25	Mf.	180	110	107	6,950	734	0.57	36.7	93.½	6,000	....	....	....	....	....	4.6	113	12.8	12¾	143	591	803
22	IV	25	Zo.	246	113	100	7,000	757	0.625	51.6	84.	5,300	....	(220)	(0.140)	3,580	0.6	78.	91	10.7	13.	193	564	767
22	V	25	Mf.	189	118	103	6,950	730	0.59	38.4	95.½	6,000	....	185	0.177	3,500	—3.69	5.	118	12.7	12¼	148	582	792
22	VIa	25	Zo.	213	118	107	7,000	790	0.61	46.6	96.	5,000	....	208	0.158	3,820	—1.30	101.5	119	13.2	13	247	543	740
22	VIb	25	km 11.6	159	82	87	6,950	680	0.65	30.0	83.	5,900	....	145	0.158	1,940	+1.21	9.	89	9.4	12¾	120	560	762
22	VII	25	Mf.	186	118	106	6,900	750	0.595	38.6	94.	5,700	....	177	0.185	3,350	—3.69	4.5	114	12.8	12½	144	606	823
22	VIII	25	Zo.	228	118	105	6,900	790	0.63	50.0	98.	4,900	....	220	0.149	3,930	—1.70	106.	124	13.3	12½	256	534	725
22	IX	25	Mf.	174	118	109	6,850	772	0.60	37.4	95.	5,800	....	165	0.199	3,080	—3.69	4.5	116	13.3	12¼	146	626	850
22	Xa	25	Zo.	222	116	108	6,850	810	0.633	50.0	100.	5,000	....	214	0.151	3,700	—0.94	110.	129	14.	12½	265	545	740
22	Xb	25	km 22.5	78	(35)	88	6,900	615	0.585	13.3	(85)	....	....	....	....	...	....	(53)	(93)	(9.7)	12½	(168)	(447)	(608)
22	Xb	25	Rdf.	216	(118)	113	6,700	817	0.625	49.0	(105)	....	....	....	....	....	....	(72)	(142)	(15.3)	11¾	(241)	(576)	(783)
22	Xc	25	Licht.	159	(80)	113	6,800	830	0.625	36.7	(105)	....	....	....	....	....	....	(14)	(142)	(15.3)	12	183	(647)	(880)
26	III	27½	Mf.	213	109	90	7,350	705	0.62	41.7	(85)	....	....	213	0.142	3,360	—4.36	(38)	(93)	10.0	13	(120)	585	795
26	IV	27½	Zo.	249	117	88	7,400	730	0.65	50.5	(83)	....	....	243	0.134	4,560	—2.09	(76)	(89)	9.5	13¼	(188)	542	738
30	IIIa	27½	Mf.	210	123	102	7,000	815	0.66	47.5	(103)	6,600	...	200	0.171	3,730	—4.36	(5)	(130)	13.4	12	(160)	655	890
30	IIIb	27½	Dw.	156	124	104	7,000	865	0.69	37.5	(112)	6,200	...	156	0.166	3,420	—2.21	(55)	(130)	13.6	12	(210)	655	890
30	IV	27½	Zo.	246	121	100	7,000	805	0.666	55.0	98.	6,100	....	240	0.140	4,580	—2.09	106.	124	12.8	12	255	550	748

CAR A

Date—Nov. 1901.	Run No.	Frequency.	Run From Kw.	To Kw.	Average Speed Km. per Hour.	Power House Reduced to Secondary of Transformer. Measured Mean Values. Amp.	Volt.	Kw.	Calculated. P. F.	Kw. Hr.	Car at Trolleys, Measured near Values. Amp.	Volt.	Kw.	Time in Seconds.	Distance in Km.	Difference in Level Meters.	Losses in Line and Transformers. Trolley Line Kw.	Transmission Line, Kw.	Transformer, Copper, Kw.	Iron Kw.	Total Kw.	Energy Consumption at Trolleys on Cars. Kw.	H.P.
26	II	27½	27.82	11.22	88.	52	7,400	237	0.356	45.0	(47)	....	....	684	16,600	+4.48	12.	28½	3.2	13¼	57	180	245
27	I	27½	12.65	27.37	114.	57	7,600	332	0.444	43.0	(51)	7,000	....	465	14,720	—4.72	16.	33½	3.8	13¾	67	265	360
27	I	27½	20.15	27.37	124.	53	7,600	357	0.513	20.8	(48)	7,000	....	210	7,220	—4.23	18½	30	3.2	13¾	65	292	397
28	III	30	12.50	27.00	126.	58	8,000	405	0.504	46.7	(51)	7,500	....	414	14,500	—5.23	15½	33½	3.8	14½	67	338	460
29	I	27½	11.75	24.80	116.	....	....	....	....	....	46	6,700	(370)	405	13,050	—5.82	11.	27.3	3.2	(12)	53	...	(500)
29	II	27½	26.20	13.63	116.	...	..	..	....	....	54	6,600	(480)	390	12,570	+10.0	17.5	37.6	4.2	(12)	71	...	(650)
29	III	27½	11.40	24.40	120.	...	....	....	....	....	44	6,850	(370)	390	13,000	—5.8	9 6	25.0	2.6	(12)	49	....	(500)
29	IV	27½	26.07	13.30	118.	....	....	....	....	....	53	6,700	(515)	390	12,780	+8.35	16.6	36.3	4.0	(12)	69	...	(700)
30	I	27½	11.32	27.80	117.	51	7,000	353	0.57	50.0	46½	6,650	....	510	16,500	—4.48	12.5	28.0	3.0	12	55	298	405
30	IIa	27½	26.42	16.00	114.	78	7,000	580	0.615	53.4	62	6,450	....	330	10,450	19.0	25.7	49.6	6.2	12	93	487	662

CAR S

21	I	30	11.87	19.57	132.	86	8,950	630	0.472	36.7	76	8,000	...	210	7,700	+0.5	22.0	74.5	8.4	17.5	122	508	690
21	I	30	11.87	26.50	130.	79½	8,900	567	0.463	63.8	69	7,800	...	405	14,600	—5.60	26.8	61.5	7.1	17.3	113	454	618
21	II	30	25.10	18.10	140.	81	8,700	650	0.524	32.5	73	7,400	..	180	7,000	+4.3	36.7	69.	7.6	16.4	130	520	707
21	III	30	11.37	27.52	114	71	8,200	441	0.44	62.5	66½	7,500	....	510	16,150	—3 55	25.6	57.	6.1	14.6	103	338	460
21	IVa	30	26.45	17.53	119.	70½	8,200	490	0.49	36.7	64½	7,250	....	270	8,920	+3.9	29.6	53.7	5.9	14.6	104	386	525
22	Ia	25	9.95	27.71	100.	60	7,000	272	0.373	48.3	54½	6,200	....	639	17,760	—5.4	16.2	38.3	4.3	12.7	71	201	273
22	II	25	27.60	8.90	102.	65½	7,000	310	0.39	57.0	58	6,100	..	660	18,700	+5.0	17.2	43.5	4.9	12.7	78	232	315
22	III	25	10.90	28.50	111.	59	7,000	274	0.384	43.3	52	6,300	..	570	17,600	—5.45	16.0	35.	4.0	12 7	68	206	280
22	IV	25	26.87	10.07	111.	68	7,000	423	0.515	64.3	56	6,200	....	546	16,800	+5.5	16.5	40.5	4.9	12.7	75	348	473
22	V	25	11.25	28.35	118.	64⅓	7,030	381	0.487	55.3	58⅓	6,250	....	522	17,100	—5.45	20.2	44.	4.8	12.8	82	299	406
22	VIa	25	26.63	13.00	118.	65	7,100	394	0.493	45.6	59½	6,150	....	416	13,640	+6.25	21.0	45.7	5.0	13.	85	309	420
22	VII	25	11.10	28.60	118.	63⅓	7,100	378	0.485	56.0	56	6,300	....	534	17,500	—5.45	18.7	40.5	4 6	13.	77	301	410
22	VIII	25	26.52	9.80	118	69	7,100	424	0.50	60.0	61	6,300	....	510	16,720	+6.6	19.0	48.	5.5	13	85	339	461
22	IX	25	10.83	28.33	118.	63	7,000	382	0.50	56.7	56	6,200	....	534	17,500	—5.45	18.3	40.5	4.5	12.7	76	306	416
22	Xa	25	26.75	24.12	117.	70	7,000	445	0.525	10.0	59	6,300	...	81	2,630	±0.	31.2	45.	5.3	12.7	94	351	477
22	Xb	25	......	......	118.	74	7,000	452	0.505	20.4	....	....	....	162	(4,500)	....	....	...	2.8	12.7	....	....	....
26	III	27½	10.91	28.16	105.6	63⅓	7,400	337	0.415	55.0	(56)	....	....	588	17,250	—5.45	18.	40.5	4.6	13 3	76	261	355
26	IV	27½	25.89	8.99	114.	70½	7,400	420	0.465	62.0	(60)	....	....	534	16,900	+7.03	17.	46.5	5.5	13.3	82	338	460
30	IIIa	27½	11.28	16.53	123½	66	7,000	470	0.59	20.0	65	6,800	....	153	5,250	+1.45	12.0	54.5	6.6	12.	84	386	525
30	IIIb	27½	21.72	27.60	124.	64	7,000	456	0.59	21.7	60	6,600	....	171	5,880	—0.6	13.6	46.5	5.0	12.	94	362	492
30	IV	27½	25.87	11.21	123.	71	7,000	520	0.605	62.0	60	6,600	....	429	14,660	+5.82	19.0	46.5	5 5	12.	83	437	593

Note: Parentheses ( ) signify approximate values. HP. is metric HP.

however, the accompanying curves and tables usually show such close agreement in their corresponding values that the recorded results can be used as a reliable foundation for further discussion and calculations. A few results given in the table, which could not be positively checked throughout, are placed in brackets.

By observing the values given in the diagrams, we note the great fall in potential, which was due to the fact that the 13-km long-transmission line from the power house to the railway was composed of three single copper wires of only 50 sq. mm area each. It is also evident from the diagrams that the losses in the transmission line were greater than the loss in the trolley wires, even when the current was taken from the end of the trolley wires at Zossen.

Much better results would be obtained in a practical high-speed installation if the power house should be located at a more advantageous position.

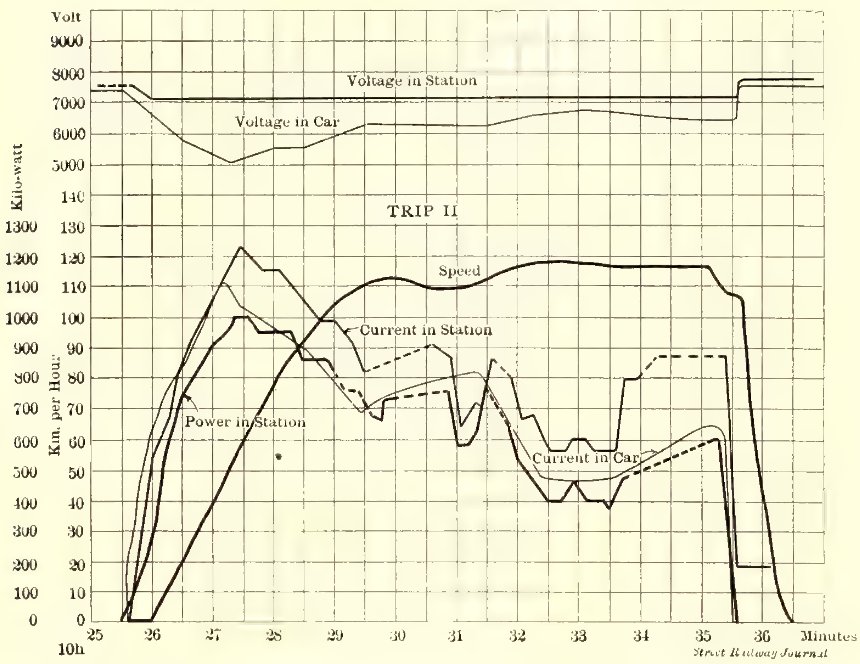


FIG. 12.—VOLTAGE, CURRENT, POWER AND SPEED CURVES FOR TRIP II.

The power factor at the power house appears unusually low, especially during continuous running, which on the whole was far under that for the accepted full load of the motors.

Generally, it must be remembered that in the design of this experimental installation, many unfavorable conditions had to be accepted which would not exist in the execution of a new installation. For such a case a suitable power house would be erected at the most advantageous location along the proposed line, and proper machines would be selected for the service conditions of the road, so that the supply of the necessary current could be accomplished without installing special transformers at the power house.

The recorded observations and measurements of the different tests for a constant speed gives the energy consumption at the trolley

for car A = 455 hp at 118 km per hour,
for car S = 405 hp at 115 km per hour;

the energy consumption at the sub-station

for car A = 478 hp at 118 km per hour,
for car S = 431 hp at 115 km per hour;

the energy consumption at the driving wheels

for car A = 397 hp at 118 km per hour,
for car S = 341 hp at 115 km per hour;

from which we obtain an efficiency

for the electrical equipment of car A = 87 per cent,
for the electrical equipment of car S = 79 per cent.

The average efficiency of the electrical equipment of the cars and trolley lines

for car A = 83 per cent,
for car S = 79 per cent.

The energy consumption at the engine shaft, under the supposition that the sub-station at the feeding point is included, but the transformers in the power house are not considered, and assuming an efficiency of the generators of 95 per cent for the given speeds, was

for car A = 504 hp,
for car S = 454 hp.

The efficiency of the electrical installation, including the generators, the trolley wires and the electrical car equipments, was

for car A = 79 per cent,
for car S = 75 per cent.

For the starting period, which is only a small part of the whole running time, we obtain an efficiency

for car A = 43 per cent,
for car S = 48 per cent.

According to the tests made by the Berlin Electric Works at the power house, the steam consumption of the steam engine was 4.6 kg per hp-hour, referred to the engine shaft.

Each developed horse-power on the driving wheels of the car at the above-named constant speeds of 118 km and 115 km per hour will require a steam consumption

for car A = 5.84 kg per hour,
for car S = 6.12 kg per hour.

The coal consumption by sevenfold evaporation for the above figures is, respectively, 0.835 kg and 0.875 per hp-hour.

These values would appear much better if the motors were heavier loaded, which will be the case at higher speeds; then the power factor, which in the above instances varies between 0.5 and 0.6, will be greater. This will cause the ohmic losses in the entire electric installation to be proportionately reduced. Also the higher potentials of 10,000-12,000 volts will help to increase the efficiency at the higher speeds by decreasing the losses. Higher voltages could not be used during the tests on account of the speed which required a low frequency, and also the disturbing influence upon the railway signal apparatus.

An accurate calculation of the total costs of the electrical service is not possible at this time, as the highest speed for which the electrical equipment of the power house and the motors in the car was designed could not be attained, and also the number of tests made was considered insufficient for such a determination.

For all future tests the measuring instruments employed should be of the best make and be calibrated beforehand for the different frequencies to be used. They should also be connected in circuit, and read at the same instant, whether in the power house or at the feeding station, as well as in each of the cars.

Previously, the measuring apparatus were connected in shunt circuits, but it would be better to connect them as far as possible directly in the high potential lines so as to insure as accurate results as possible from which reliable conclusions could be drawn.

SAFETY PRECAUTIONS AND DEVICES USED IN THE TESTS

Primarily, for the safety of the service of the railroad and the tests, it was considered absolutely necessary that the runs should take place by daylight and at a time when that portion of the road over which the tests were to be conducted was en-

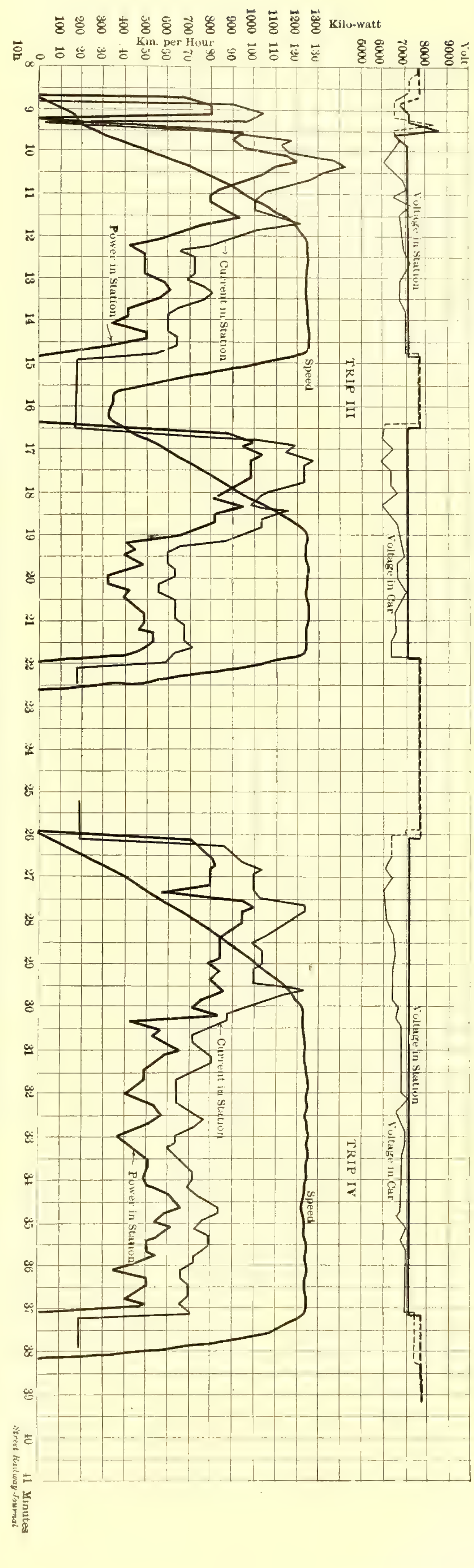


FIG. 13.—VOLTAGE, CURRENT, POWER AND SPEED CURVES FOR TRIPS III. AND IV.

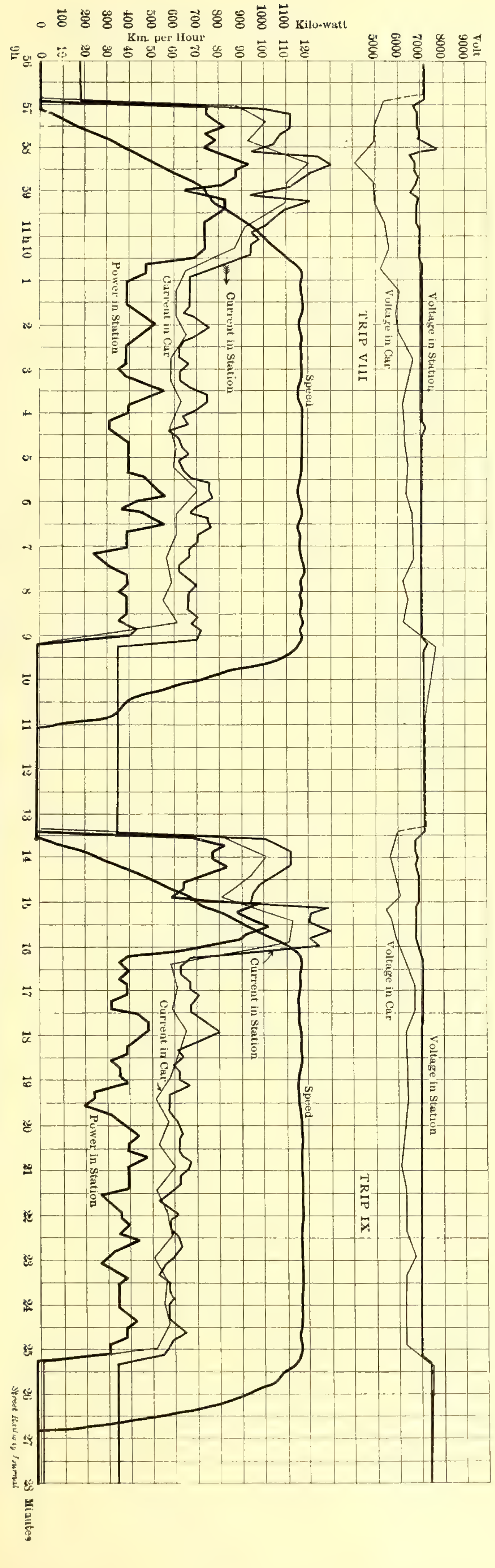


FIG. 14.—VOLTAGE, CURRENT, POWER AND SPEED CURVES FOR TRIPS VIII. AND IX.

tirely free. On account of these considerations, the time from 8 to 11:30 a. m., as proposed in the programme of the tests, was decided upon.

In order to make it impossible for any of the switches between Mahlow and Rangsdorf stations to be misplaced during this time, a special form of lock was used, which insured the proper placing of the switches. Besides this, an iron block with a movable wing-rail was fastened in each of these switches. To insure the allowance of sufficient time to stop the car at the end of the test stretch, four signal plates were used. These signal plates were furnished with white backgrounds and were fastened to pointed iron pipes, two being painted with the letter A (cut-out current) and two with the letter B (brake car). Two of these signals (one with A and the other with B) were erected alongside of the track near the end station, the distance from this station being so taken that the car could be easily stopped, even during the most unfavorable weather and when the motorman could only recognize the plate B by being close to it.

The regular guard of the road was increased so that when speeds of over 100 km per hour were made all roads crossing the test line were guarded by regular railroad employees, who were instructed to keep the gates at these crossings closed from the time the car left the starting station until it had passed. No further precautions for the safety of the service were attempted, and attention was turned to the working of the safety devices already installed as the higher speeds were approached.

The military road on which the tests were conducted is provided with the usual visual signals at the stations, and the less open parts of the road are furnished with signals which are operated from the stations through wire cables in conjunction with the main signals. Block signals are not employed on the road. For the ordinary service of the road, on which speeds of over 80 km per hour are not run, and on which trains are operated at comparatively great distances apart, the signal system installed is quite sufficient.

For the test runs, however, in which speeds of over 120 km per hour were made, it was found that these signals could not be recognized in time to stop the car before reaching them by using the braking apparatus at hand. This was the case even in clear weather, and on dark and foggy days the conditions were still worse, suggesting that it might be necessary in an organized high-speed service to slow up before reaching such signals, which would thereby lessen greatly the advantages gained through the use of the increased speed.

The worst conditions encountered proved to be during rainy weather, when the drops of rain adhering to the window panes of the motorman's cab obstructed the view. At such times it was possible to see only a portion of the track for a distance of 200 m to 300 m between or through the drops, and it was found necessary in these cases to reduce the speed in passing the stations.

On account of these considerations the signal system for a high-speed service must be so arranged that under all conditions the signals may be recognized absolutely and quickly.

If these objects are to be gained through signals arranged along the track, the first one must be placed at a distance from the station equal to the greatest braking distance required under the most unfavorable conditions. From the results of the brake tests already obtained, the first signal, for speeds up to 160 km, must be placed at least 1.5 km to 2 km before the station. Besides this, the form of the signal must be easily seen so that it may be unmistakably interpreted from the motorman's cab even at short distances, and during any prevailing fog, rain or snow. It would be better to employ a system in which a visual signal would automatically appear at a selected place in the cab itself and in plain view of the motorman, the system being connected with a separate acoustic signal (electric bell) which would sound whenever the visual signal stood at stop. The signal system in the car should be operated in conjunction with the one used along the track, and be so interconnected that if any defect in the latter should occur it would be automatically indicated by the former in the car.

During the tests that part of the road over which the runs were made was kept free from all other trains, so that special protection for guarding the necessary headway of the trains was not required. However, if the trains should be operated on short headway, special devices would have to be arranged for their protection, such as the automatic cutting out of the current on the different sections of the track.

THE MEGAPHONE AS AN AID TO RAPID TRANSIT IN BROOKLYN

In the vicinity of the Borough Hall, Brooklyn, the busiest point in the city, there is a perfect maze of street car lines. Just above the hall, at the junction of Adams and Fulton Streets, the Crosstown, Greenpoint, Bergen, Douglas, Fifth and Seventh Avenue lines all cross Fulton Street, nearly at right angles. Below the hall there pass the Fulton, Gates, Putnam, DeKalb and other lines destined to Fulton Ferry, New York and into Court Street. In addition to this, the Myrtle and Myrtle and Ralph Avenue lines turn into Washington Street from Myrtle Avenue at the junction of Fulton Street, Myrtle Avenue and Washington Street, destined to New York. Here transfers are issued in wholesale, which is not true of the other crossing, and confusion would be endless were it not for the scheme adopted by the Brooklyn Rapid Transit Company of stationing a man with a megaphone at this point, whose duty it is to announce cars and otherwise direct passengers. He announces the departure of the local cars in Brooklyn which encircle the City Hall, and directs passengers where to find seats. It is a plan worthy of emulation by companies in other cities that are hampered in moving cars by similar traffic conditions.

ELECTRIC RAILWAY PROGRESS IN WESTERN PENNSYLVANIA

The Titusville Electric Traction Company, of Titusville, Pa., is about ready to start an extension of its line from Trionville to Townsville, a distance of about 6 miles. It is planned to have the line ready for opening early in the spring of 1906. This extension is another link in the chain of electric roads which will ultimately connect the shores of Lake Erie with Pittsburg. Within another year this company will extend its line on the north from Townsville to Meadville, Pa. Surveys have been made to the south of this company's line, from Pleasantville to Oil City, and a road will ultimately be built to connect Titusville with Oil City. The Titusville road is one of the best paying properties in the western part of Pennsylvania. In the winter time its receipts are good and adequate to meet all its obligations. The summer traffic is enormous. As an example of what a small road can do with limited equipment and facilities, W. J. Smith, general manager, showed a representative of the Street Railway Journal the receipts for July 4, one of the best days during the summer. With eight cars more than 14,000 passengers were carried between 6 o'clock in the morning and midnight, the average being 72.48 passenger per car-mile. Considering these facts, together with the possibilities for the early realization of the extensions south to Oil City and north to Meadville, the company's future prospects are most promising.

The interchangeable mileage books in use on the electric railways of Ohio have been adopted by the Indiana Union Traction Company of Indiana. This is the first traction road in Indiana to adopt the mileage books.

CHANGING GAGE OF TRACKS IN EAST ST. LOUIS

BY W. A. BENNETT
Engineer Maintenance of Way, East St. Louis & Suburban Railway Company

In March, 1905, the management of the East St. Louis & Suburban Railway Company called for an estimate of cost of bringing to the standard 4-ft. 8½-in. gage all the tracks that were then 4-ft. 10-in. gage. The first impulse was to follow the example of the steam roads and make the change in one day. This would have not only suspended service for one day, and possibly longer, but would have necessitated the tearing up at one time every paved street in which tracks were laid, and the borrowing of all the men and tools that the neighboring steam and electric roads could furnish. It was therefore decided to do the work by divisions, keep up the service and tear up only a portion of the city at one time. The following estimate was made:

Changing 60 miles of T-rail track on ties, at $100	$6,000
Changing 17 miles of girder-rail track on ties, at $1,300	22,100
Changing 6 miles of girder-rail track in concrete, at $2,600	15,600
Changing 2 miles of miscellaneous track, at $1,300	2,600
Changing 65 railroad crossings, at $25	1,625
Changing special work	6,140
Changing equipment, 107 cars	3,000
	$57,065
New frogs, tie-rods, bolts, spikes, tie plugs, tools and incidentals	$11,413
	$68,478

This estimate was approved and work authorized March 31, 1905.

The work of organization and preparation was then begun. The plans for changing the complicated special work were made by the Pennsylvania Steel Company. An entire new plan of each job was prepared as for new work, but in addition the old location of the rails was shown. This formed a composite plant, giving the number of each piece, its length, etc. All the old parts that could be used were put back and new frogs put in where old ones would not line or gage. Where rails were too long or too short, the length of the cut or "dutchman" was given. As these plans were made and approved, the new frogs were started in the shops. The frogs from Steelton, Pa., arrived in our yard in July. While waiting for the frogs, all the small outlying lines (where no special work was required) and all the suburban lines were changed. These, for the most part, are double track, and were changed one track at a time. The cars were changed in the shops and taken out over the 4-ft. 10-in. tracks at night.

AN ESPECIALLY DIFFICULT SITUATION FOR A CHANGE IN GAGE

The work of preparing the suburban lines was given to the regular section foremen. Each foreman was given a plan of his section, showing which rail was to be moved. At switches the rails opposite the frog were moved; on long curves the inside rail was moved and the joints opened; on short guarded curves the outside rail was moved in and the surplus rail cut off.

The work of renewing ties was then rushed, and no new ties were spiked on the side to be changed, except where necessary

PLACING THE CHANGED GAGE CARS IN SERVICE

to hold the track safe. All inside spikes were then pulled, excepting at every third tie, after which the spike holes were plugged and ties adzed smooth. The spikes that had been pulled were reset 1½ ins. from the rail by spiking to an iron shim 1½ ins. x 4 ins. x ½ in. Bolt holes were drilled in switch rods on the side to be moved so that stands did not have to be disturbed. At road crossings the planks were taken up, spikes reset and inside planks put down 1½ ins. further from the rail. Guard rails were not disturbed until the day of change. A

ST. CLAIR AVENUE, LOOKING WEST

gang of saw and drill men was organized to do all cutting and drilling in special work and railroad crossings. This cutting was done mostly at night. A rail saw driven by motor was tried, but it was found that the work could be done more quickly and cheaper by hand. The power saw cut faster than the hack saw, but it took so much time to put it on and take it off and adjust the machine that there was no time gained in the end. A hack saw was put to work on each rail at the same time, and when one was done all were done. The cuts were made to the base of the rail and were finished the day the gage was changed. A pair of blank angle-bars was put on the cut rails and bored to fit the old holes. In the special work the plates were removed, cuts made to the base of the rail, plates

replaced, bolted with two bolts and paving replaced until the day of change.

The contract for taking up and replacing paving was let to a local firm of contractors. On double track the two inside rails were moved. The entire pavement between tracks was taken up, as was a strip 18 ins. wide along the opposite side of the rails.

An extra gang of seventy men was organized to change the concrete tracks. This gang was divided as follows:

	Men
First division—pick and shovel labor	35
Second division—wrench men	6
Third division—jack and bar men	8
Fourth division—wrench men	4
Fifth division—grout men and sweepers	6
Sixth division—concrete mixers	7
Sub-foremen	3
Blacksmith	1
	70

The first division dug out the concrete around the rail. The second ran back the inside tie-rod nuts. The third moved the rail with powerful jacks. The fourth brought the track to gage by means of the tie-rods 6 ft. apart. The fifth cleared and grouted. The sixth replaced the concrete. Sub-foremen were with divisions 1, 3 and 6. The blacksmith, with portable shop, repaired and sharpened tools. A pneumatic drill was tried for removing concrete, but it was found to be more expensive, slower and not so good as sharp picks. A high-grade, short, heavy steel pick tempered blue was used.

CHANGING THE GAGE AT MISSSOURI AND COLLINSVILLE AVENUES

By the time the new special work was ready, all the outlying lines in East St. Louis, and all the suburban lines, including all local lines in the city of Belleville, were changed. In Belleville, the cars were changed on the street while the work on the track was in progress. These lines being all single track, service was suspended for one day. After the suburban lines were thoroughly prepared they were changed one division at a time. The lines were divided into short sections and each gang given a certain amount to change. The gangs were organized as follows:

	Men
First division—three claw bars and one maul	4
Second division—three pinch bars and one maul	4
Third division—five mauls	5
Fourth division—one water carrier and push-car man	2
Total	15

Division 1 pulled remaining inside spikes and drove down broken spikes, took off guard rails at frogs and took up outside crossing planks. Division 2 moved the rail over to spikes previously driven and set an outside spike in every third tie. Division 3 drove the spikes and tested the gage. Each gang carried the following tools, viz.: One push car, nine mauls, four claw bars, three pinch bars, one adz, two wrenches, one monkey wrench, one gage, three chisels, one hack saw, one spike puller, one water keg, one water bucket, three extra maul handles, one pick, two shovels and 50 lbs. of ice.

The push cars were distributed by the work cars the day before changing. The men and tools were taken to their stations by the work cars early on the day of change. At quitting time the tools were collected and taken to the next day's work. The men were sent home in special cars. After the first suburban line was changed one work car was changed, and by using two cars of different gages, the men and tools could be taken to any point of the work.

At the signal to start changing, each gang tried to see which could be the first one ready for cars. Actual working time was kept for each gang on each day. At switches the bolts in the rods were removed and the switch point moved over 1½ ins. to holes previously drilled. The bolts were then replaced and stock rail moved up to point and spiked. At railroad crossings a piece of rail and rail-tongs were on hand to drive the crossings. The saw and drill gang was divided and stationed where cuts were to be finished and holes drilled. They finished cutting the crossings; the track men drove the frogs over, lined, gaged and spiked them, and the drill men replaced and bolted the angle bars. After the gage was changed and track safe for cars, each gang reported by telephone and then started back, pulling remaining outside spikes and spiking in full. A gasoline inspection car with wide wheels, capable of running on either 4-ft. 8½-in. or 4-ft. 10-in. track, was used for superintending the work. The best time was made by one gang on the Caseyville division, ½-mile section, in forty minutes. On the Belleville subdivision, 1-mile section, the best time on the westbound track in the morning was one hour and ten minutes; in the afternoon on eastbound track, one hour and fifteen minutes. On the Edwardsville division, from Collinsville to Edwardsville, 1-mile section, the best time was one hour and fifteen minutes, and on the same division, from Collinsville to East St. Louis, 1-mile section, one hour and five minutes.

THE LOUISVILLE & NASHVILLE AND BALTIMORE & OHIO CROSSINGS AT ST. CLAIR AVENUE

The changing of the main lines in East St. Louis was carried on by divisions, beginning at the outlying districts and working toward the center. This work was done in nearly the same way as on the suburban, except that each gang was given a shorter section and a large gang placed at each job of special

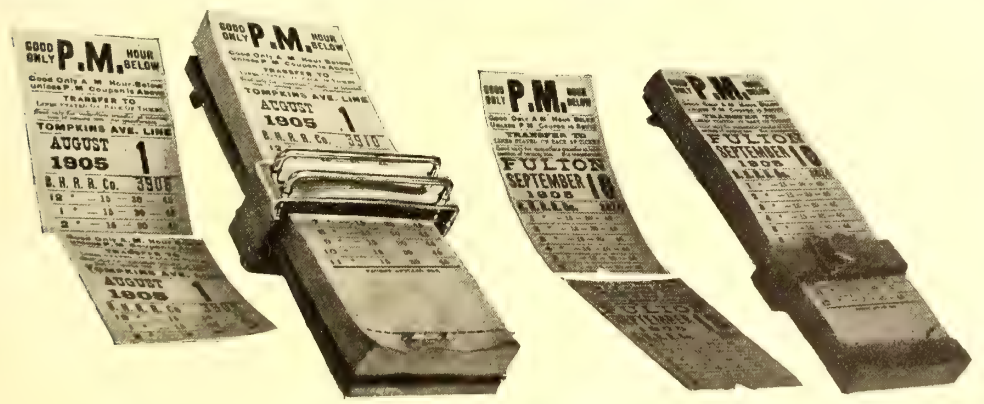
work. No work of changing was started until the line was thoroughly prepared. The girder rail tracks on ties had tie-rods every 10 ft., and only one tie was left spiked between tie-rods. All the inside tie-rod nuts were run back 1½ ins. and the inside spikes set 1½ ins. from rail, as in the suburban tracks. Temporary street crossings were made of planks after the spikes were pulled and all ties adzed smooth. Where brace tie-plates were used, the plates were moved with the rail, but claw tie-plates were not moved. In the special work all bolts were removed except two in each joint, and as many spikes pulled as safety would permit. Not so many claw bar men and spike pullers were needed in the city work as on the suburban, and these extra men worked on the tie-rods. In changing the special work, the plans were followed as closely as in putting in new work, and after the cuts were finished each piece was brought to its proper place, according to the plan. The frogs that were shown to be replaced were taken out and the new ones put in. The whole was lined and gaged before joints were tightened or spikes driven down. "Dutchmen" were then cut to fill openings, joints bored and bolted and all rails spiked down. The saw and drill gang did the cutting of "dutchmen," boring of holes and bolting in full. With few exceptions, the tracks and special work are in as good line and gage as before, and in some cases better. The paving contractors followed the track work as rapidly as possible, so that at no time was there a great amount of pavement taken up. The last change, and the only work that was done at night, was the Eads Bridge and the special work at the east approach. This was done on the night of Friday, July 28.

The entire work of changing the gage was done by our own men. No line was out of service more than a couple of hours except Belleville local lines. All of our reconstruction work was carried on at the same time, and at no time did we need more men than we had employed. Our total track force varied from 200 to 250 men.

The actual cost of the work has not yet been exactly determined, but will be within the original estimate.

A NEW DESIGN OF NON-PUNCH TRANSFER TICKET

A novel form of transfer ticket which is applicable to close restrictions as to time limits, and entirely without the use of a punch, has recently been perfected and is now in use by the Brooklyn Rapid Transit Company. The ticket and its holder were invented and placed into practical use by George R. Folds, who was formerly assistant to the general manager, and whose resignation to become general manager of the South Chicago City Railway Company was recently announced in these columns. In this new ticket the punch method of indicating time limits of the transfer is replaced by a novel method of tearing in the limit, the point at which the ticket is torn off the stub indicating the time at which transfer expires. The way in which this is accomplished is indicated in the illustration, in which bunches of transfers in the special spring holders are shown, together with sample transfer checks detached for different hours in both A. M. and P. M.



BOTH TYPES OF SPRING PAD HOLDERS AND SOME LOOSE TRANSFERS

The transfer ticket is ruled off with horizontal lines, one for each of the twelve hours of the half day. At the top is the hour of 12 for noon or midnight, and underneath are the later hours in order. In practical operation the spring holder is merely adjusted so that in detaching the check its straight edge will serve as the rule to cut the paper at the time limit desired; thus for 6 o'clock the check will merely be torn off beneath the figure 6, etc., the time limit thus always appearing at the bottom. The A. M. and P. M. designations are obtained by the coupon at the top of the check containing P. M. in heavy black letters. When this is torn off, the check is good only for A. M. use, as is clearly stated below the coupon, while if left on, it is only valid in the afternoon.

Two forms of spring pad holders are shown, one arranged for subdividing the hours and the other for tearing off the check plain without limiting the transfer for intervals less than one hour. It is probable that the Brooklyn Rapid Transit Company will eventually make use of the latter plan, as the experience there shows little advantage in the closer time limits. For this purpose a spring holder or clamp of a simple design in brass is used to grip the pad of transfer tickets, so that when properly set any number of transfers may be torn off across the straight edge without readjusting it. For adjusting the pad for later hours the clamp is merely released and the pad moved upward in the holder. The style of holder in which fifteen-minute intervals are recorded consists of a brass back with a spring slide covering the pad very similar to that already described, but carrying an adjustable thumb perforator. The slide is adjusted up and down the pad, as in the case of the other holder, but for subdivisions of hours the thumb perforator is moved crosswise to indent the lower edge of the check at the quarter-hour desired in tearing off. This quarter-hour designation results in a neat V-shaped indentation which is easily distinguished.

In the illustration the holders are shown with sample pads in place. The plain holder, carrying the Tompkins Avenue transfers, is shown put to a special duty of holding two pads, back to back, as upon this line two different classes of transfers are issued at different points. The holder works equally well on either side, so that, in effect, the conductor handles only one pad. At the sides of the holders are shown sample checks for P. M. and A. M., those for Tompkins Avenue torn off at even 2 o'clock limit, and those for Fulton Street at 6:15 a. m. and p. m. It will be noted that as the checks are torn off later in the day, their lengths become longer, so that expired time-limit transfers will be easily detected by the conductor. Furthermore, with this scheme the passenger cannot cut off the transfer to extend its time of expiration.

The most important advantage of the new form of transfer is, however, found to lie in the accounting department. In accordance with the policy in Brooklyn of collecting transfers from the conductors as quickly as possible, conductors are required to turn in their transfer receipts every half trip, so that the accounting department receives packages of transfers turned in at stated times. In checking these over it is found a most simple matter to examine time limits of all of them, even in very large quantities, as they must all necessarily be approximately of the same length. They are, in fact, sorted as to lengths before counting, and any checks received after the time limit had expired may readily be detected from their shorter length.

THE PLANS FOR REORGANIZATION OF THE AMERICAN STREET RAILWAY ASSOCIATION

President Ely, of the American Street Railway Association, has recently transmitted a circular letter to the members of the association, explanatory of the reorganization of the association and of the proposed constitution and by-laws, which were published in the last issue of this paper. This letter outlines the steps taken by the joint reorganization committee of the several associations, and describes some of the advantages which it is thought will result from the adoption of the new form of organization. As this letter is of interest to all engaged in the street railway industry, it is reproduced below:

THE AMERICAN STREET RAILWAY ASSOCIATION
OFFICE OF THE PRESIDENT

BUFFALO, N. Y., Aug. 28, 1905.

To the Members of the American Street Railway Association:

GENTLEMEN:—It will be remembered that the last annual convention at St. Louis devoted considerable time to the consideration of questions relating to a more complete and perfect organization of this association and the various associations affiliated with it in street and interurban railway work, and that all matters and things concerned in bringing about said objects were committed to your executive committee with power to act.

Pursuant to such action your executive committee entered upon the work so delegated to it, and, as you have been heretofore advised, held a meeting at the Holland House in New York City upon the third and fourth days of February, 1905. At such meeting there were present representatives of all affiliated organizations, and a committee to prepare a plan of reorganization was appointed, consisting of the undersigned, as chairman, and the following members: For the American Street Railway Association, E. C. Foster, New Orleans; Richard McCulloch, St. Louis; C. G. Goodrich, St. Paul; W. E. Harrington, Camden, N. J. For the Accountants' Association, W. G. Ross, Montreal, and Frank R. Henry, St. Louis, alternate. For the Mechanical Association, H. H. Adams, Baltimore, and E. W. Olds, Milwaukee, alternate. For the Claim Agents' Association, W. A. Dibbs, New York, and W. H. Renaud, New Orleans, alternate. For the Manufacturers' Association, W. H. Heulings, Jr., Philadelphia, and William Wharton, Jr., Philadelphia, alternate.

The committee determined to have a thorough examination and study made of the scope, plans and methods of work of the more prominent organizations of similar character throughout the country.

Professor Henry H. Norris, of the department of electrical engineering at Cornell University, was selected for that part of the work and he at once entered upon it. He made a most complete and thorough investigation and a comprehensive and admirable report. Professor Norris' report was based upon a careful study of practically all of the similar organizations in the United States and Canada, and embraced an extensive digest of the constitutions and methods of work of the following: (1) American Street Railway Association, (2) American Railway Mechanical and Electrical Association, (3) American Association of Street Railway Claim Agents, (4) Street Railway Accountants' Association of America, (5) New York State Street Railway Association, (6) American Railway Association, (7) American Railway Engineering and Maintenance of Way Association, (8) Master Car Builders' Association, (9) American Railway Master Mechanics' Association, (10) International Tramways and Light Railways Association, (11) American Association for the Advancement of Science, (12) National Electric Light Association, (13) American Bankers' Association, (14) New York State Bankers' Association.

In analyzing the methods of procedure of the various associations, their work was divided into the following sections: (*a*) Object, (*b*) means of attaining same, (*c*) members, (*d*) privileges of same, (*e*) officers, (*f*) meetings, (*g*) lines of work undertaken, (*h*) dues.

Professor Norris' report was voluminous, embracing nearly 150 printed and typewritten pages. A very complete digest of the same was made and printed. The report was considered at a joint meeting of representatives of the affiliated associations held at the Hotel Bellevue-Stratford, Philadelphia, Pa., on the 12th and 13th of June, 1905, at which meeting there were present the following members of the joint committee: For the American Street Railway Association: President Ely, John J. Stanley (in place of E. C. Foster), John I. Beggs (in place of Richard McCulloch), C. G. Goodrich, and W. E. Harrington. For the Accountants' Association: W. G. Ross. For the Mechanical Association: H. H. Adams. For the Claim Agents' Association: W. H. Renaud. For the Manufacturers' Association: Wm. Wharton, Jr. There were also present the following named gentlemen: John B. Parsons, John Grant, C. C. Pierce, James H. McGraw, E. H. Baker, D. M. Brady, H. W. Blake, Samuel Curwen, H. J. Kenfield, E. M. Williams, George Keegan, Newcomb Carlton, and Professor H. H. Norris, of Cornell University.

The report and the draft of form of proposed constitution and by-laws accompanying the same were carefully gone into and discussed at great length, and finally read section by section, and freely amended.

The constitution and by-laws were adopted as amended and recommitted to a sub-committee for revision, and have been by it carefully revised, submitted to counsel, and finally approved and printed, and are herewith submitted to each member of the association. They have been issued to the technical press to insure the widest publication to all interested in street and interurban railway work, and through the membership committee, of which H. H. Vreeland is chairman, a copy will be sent to every non-member company, together with a letter setting forth the increased advantages of membership which will be afforded by the reorganized association and its affiliated organizations.

They will be brought up for final action at the coming convention to be held at Philadelphia on the 27th and 28th of September, 1905.

They are now transmitted to all members by direction of the executive committee, with the earnest request that they be carefully examined by every member.

In presenting for your consideration the condensed result of the labors of many persons throughout a period of nearly two years, we have only to say that the work has been undertaken and proceeded with throughout as one of paramount importance to the street and interurban railway profession.

Many busy men of large affairs have contributed of their time and effort not a little.

Some of them consider the results attained as embodying the only method of saving the American Street Railway Association and its affiliated organizations from utter confusion and uselessness.

Concerning the writer's views it may not be inappropriate at the present time to quote from the president's annual address delivered at the last convention. He said in part: "A careful inspection of the proceedings of the conventions of the last few years reveals the fact that most of the time of each convention has been occupied with the reading and discussion of papers embracing subjects which, for the most part, relate to the small technicalities of the business, and nearly all of which might have been profitably committed to proper auxiliary and subsidiary organizations. Broad fields of co-operative effort in the most important lines of our work have remained almost untouched. It becomes immediately apparent upon investigation and discussion of the situation that we might profitably enter upon the discussion of the greater questions affecting our welfare. The confusion of laws throughout the country affecting our corporations is a matter to which we might well devote attention. There are also such great questions as taxation; municipal ownership of street railways; franchise rights and obligations; statutory laws affecting our class of companies; municipal laws and ordinances, and other questions of importance to which your minds will readily refer. The collection and preservation of data tending to throw light upon the problems of great importance that confront us is also a matter deserving of attention, and in this regard it would seem that through the medium of the secretary's office and of appropriate standing committees an invaluable collection of data could be made and permanently preserved in such form as to be conveniently accessible to any member of the association upon merely making request of the secretary. If the work of the secretary's office should be made continuous, there would thus grow up in time a vast repository of valuable statistical and historical information, readily available as a matter of right to every member. This branch of the work alone, if properly prosecuted, would render membership in this association so valuable that it is difficult to understand how any street railway corporation would feel justified in remaining outside of this association."

Some of the more important advantages to accrue from the proposed reorganizations, as stated by Professor Norris, are:

(1) *The Information Bureau.* The function of this bureau will be to supply such information as follows:

(*a*) Statistics regarding electric railway construction, maintenance, and operation.

(*b*) General information regarding various electric railway properties.

(*c*) Information regarding statutes affecting electric railway construction and operation in various localities.

(*d*) Advice as to the practicability of new appliances, looking toward the establishment of a testing bureau, if such be found desirable.

(*e*) Scientific information along lines allied to electric railway work.

(2) *The investigation of general problems* affecting the relations of electric railways and the public, *e. g.*, municipal ownership at home and abroad, franchises, taxes, etc.

(3) *The investigation of technical problems,* such as the utility of new fuels, new prime movers, new motors, new systems of transmissions, new signal systems, etc.

(4) *The distribution of important information* among the members by means of regular and special bulletins.

(5) *The arrangement, binding, and distributing* of the volumes of *proceedings* of the association, including the indexing and general supervision of printing, proof-reading, etc.

(6) *The arrangement of the details of conventions.* This will relieve the president and executive committee of much detail work, and will enable the association to do a large amount of investigation by means of special and standing committees.

With this brief explanation your committee submits herewith the draft of proposed constitution and by-laws, and the accompanying form of charter to be granted by the American Street and Interurban Railway Association to its affiliated associations, each of which will be left to draft its own constitution and by-laws, which will be subject to the approval of the parent organization.

We invite your careful attention and investigation, and urge upon every member the desirability of a full representation at the coming convention, where final action upon this important matter will be taken.

Respectfully submitted,
The Executive Committee of the
AMERICAN STREET RAILWAY ASSOCIATION,
W. CARYL ELY, President.

CORRESPONDENCE

STARTING OF TURBINES

GENERAL ELECTRIC COMPANY
Schenectady, N. Y., Aug. 31, 1905.

EDITORS STREET RAILWAY JOURNAL:

I have read the editorial on the "Practical Operation of Steam Turbines" in your issue of Aug. 26, which expresses doubt concerning the practicability of starting large steam turbines suddenly without a previous warming process. While many turbines now in operation require such treatment, it is not required in turbines recently produced by the General Electric Company if they are properly set up and adjusted.

With these turbines, the matter of clearance between revolving and stationary parts, within such limits as are ever desirable, does not affect the steam economy to an appreciable extent. Clearances from 1/8 in. to 3-16 in. are used on large turbines, and if, under any extraordinary conditions, these should prove insufficient, a considerable increase can easily be provided without appreciable effect upon the steam economy. It is also possible to increase the clearances of existing machines where trouble is experienced, and in a few cases such changes have been made.

The following paragraph from a paper by A. S. Mann, published in your issue of June 10, shows the conditions under which 1500-kw turbines are started in the General Electric Company's power plant:

> We have taken the time in a number of instances when all the auxiliaries have been in motion and it only remained to start the turbine and phase it in on the line; the only valves to open in such cases are the throttle and one small oil valve. The quickest two starts have been made in 45 seconds and 70 seconds, respectively, including phasing-in. Others range between 1 minute 10 seconds and 1½ minutes. These quickest two starts were made on a turbine which had stood for 24 hours with the throttle valve shut tight, though there was a slight leakage past the seat. After the throttle valve is off its seat, it is not more than 30 seconds before the turbine is up to speed. A cross-compound reciprocating engine of the four-valve type, 2250-hp capacity, can be brought up to speed from a standstill in 5 minutes if it is hot all over. This 5 minutes is to be compared with the 70 seconds required for the similar turbine operation.

These machines were among the first Curtis turbines produced, and similar conditions are obtainable in any other machines of this type, and should be characteristic of all future production, except in cases of inaccurate machining or improper adjustment.

W. L. R. EMMETT,
Engineer, Lighting Department.

INQUIRY REGARDING TESTS ON AXLES

Edgewater, N. J., Aug. 30, 1905.

EDITORS STREET RAILWAY JOURNAL:

We are looking into the matter of adopting a regular system of drop test for all car axles, and in that way we propose to check weak axles due to flaws or crystallization. The writer would like information, first, as to the methods in force on other roads for inspecting axles, and, second, as to the maximum and average life of car axles on interurban lines.

In regard to the first question, what is the method pursued by interurban, or even city, companies in inspecting their car axles under daily operating cars, and how often is this inspection made? Is it covered in the regular daily car inspection, or are special axle inspections made at stated intervals? Further, when the wheels upon a pair of axles are being changed, are these axles put through any form of tests, or are they given just the regular external inspection? If they are regularly tested, what method of testing is pursued on 4-in., 4½-in. and 5-in. axles?

In regard to the second question as to the maximum life of axles, do the companies make it a practice of discarding all axles after a certain life or mileage, and if so, what is this life? Or at the end of a certain life, is it the practice to put the axles through a test for tensile strength and take this as a governing factor as to whether the axles shall be discarded or continued in service?

F. W. BACON, General Manager,
New Jersey & Hudson River Railway & Ferry Company.

THE FILIPINO AND THE ELECTRIC RAILWAY

A copy of the "Manila Sun" to hand contains a series of electric railway notes from which the following are extracted:

A cochero got out of his carretela and held his horse's head the other day when he saw a trolley car in the distance. The car passed, the horse never moved—but the cochero climbed a telephone post.

A motorman lost control of the brake the first day of the opening of the car lines and dashed madly down the Escolta end of the Bridge of Spain. The watching crowd surged wildly backward, ladies screamed, and Marker of the Klosko Habanero clutched his cash register. As the car took the curve the motorman reversed his current, and the car swung protestingly around, grunted a couple of times and stopped. Everybody breathed again, and Marker began to figure on how much he could have sued the company for if the car had left the track and dashed into his place of business.

An old mujer stopped the car the other day and tried to climb in. She had a pig, a bundle of zacate and some three pecks of vegetables with her, and wanted to take the whole lot aboard; but the car sailed merrily away and left her angrily expostulating.

When an American sees one of the street cars for the first time he grins a bit and then looks around to see if any one is watching him. A Filipino stares at it as though he believes the devil was somewhere inside. A Chinaman doesn't look at the car at all—he stares at the wire above and wonders what makes the car go.

A trolley car isn't so very different from an automobile. I saw one standing in the middle of the Escolta the other day, while three men lay on their backs under it and softly swore as they tried to see why it wouldn't run.

NEW COUPLERS ON THE NORTHWESTERN ELEVATED, CHICAGO

All the cars of the Northwestern Elevated Railroad Company in Chicago are now being equipped with a new type of vertical plane automatic coupler which is the invention of R. B. Stearns, superintendent of the road, and F. D. Ward,

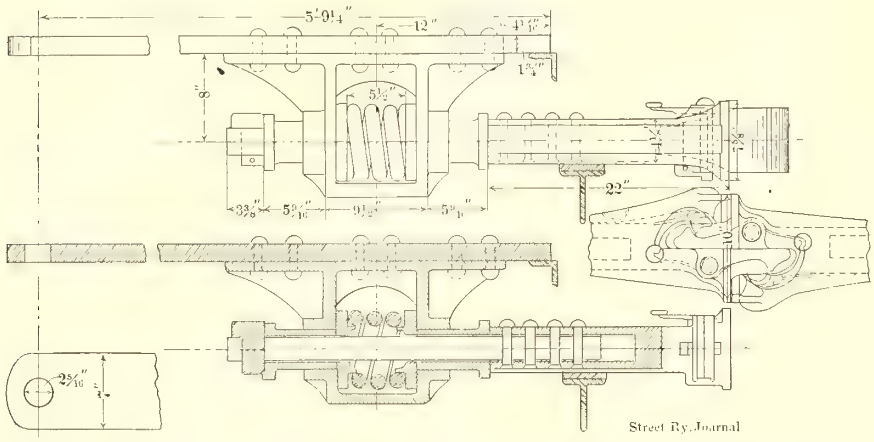


FIG. 1.—DETAILS OF VERTICAL-PLANE TYPE COUPLING FOR MOTOR CARS AND TRAILERS

formerly master mechanic of that road, but now with the Underground Electric Railways Company, of London, England. The company has equipped its 254 cars with this type of coupler, and all cars of the Underground Electric Railways

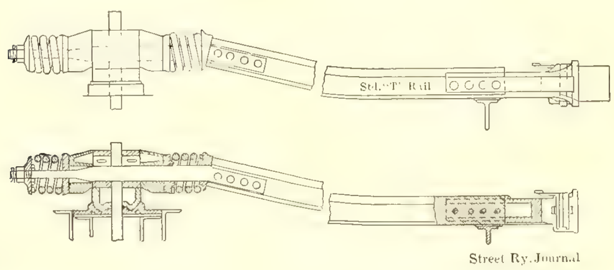


FIG. 2.—SIDE VIEW AND SECTION

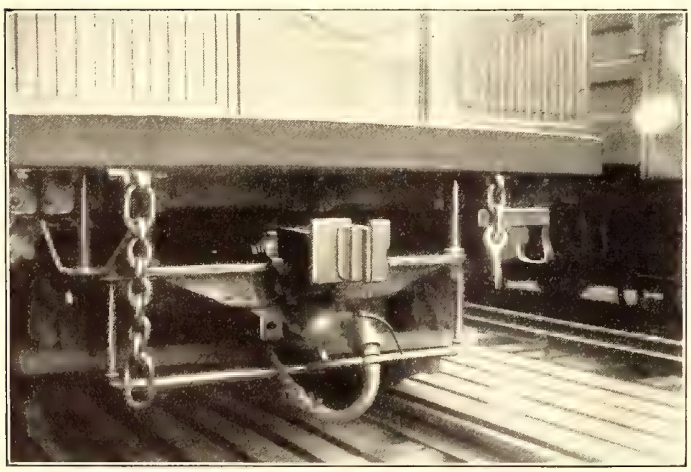


FIG. 3.—VIEW OF COUPLER IN POSITION

Company, of London, England, are being furnished with it. A number of these couplers were put on the Northwestern Elevated during the winter of 1902-3 and have run until the present summer.

In addition to adopting this new automatic coupler, the company has arranged all its cars so that the air-brake hose and train cables for heat and light and multiple-unit control are attached to the draw-bars and swivel with them. The S. & W. automatic coupler is shown in the accompanying drawings, Figs. 1 and 2, and illustrations, Figs. 3, 4 and 5. It is a vertical plane coupler which requires no separate link, although the projecting parts, shown in the illustrations, are fastened in by pins and can be removed just as a link can should they wear out or break. It will be seen from the drawing that each coupler has a projecting part, which slides into a recess in the opposite coupler and is engaged by a notched pin, one segment of which has been removed. As the projecting part strikes this pin in entering, it revolves the pin a fraction of a revolution so that it can pass and catch. The pin revolves back to its original position by virtue of the pressure of leaf springs, which bear against a cam on the pin, and which tend to hold it in a position to lock the coupler. As there is a lock of this kind on each coupler, there is a double lock every time a coupling is made, although the coupler will hold if only one side locks. To uncouple, the pin or lock is revolved a fraction of a revolution by means of the handle on top of the coupler. The lock on each coupler must be unfastened in this way and then the couplers can be pulled apart. In the act of uncoupling, the locks are automatically thrown back into a coupling position so that no further attention to them is required. The cam on the lock against which the spring presses is of such a shape that, when the locks are pulled clear around to uncoupling position, they will remain there until the locks are partially revolved in

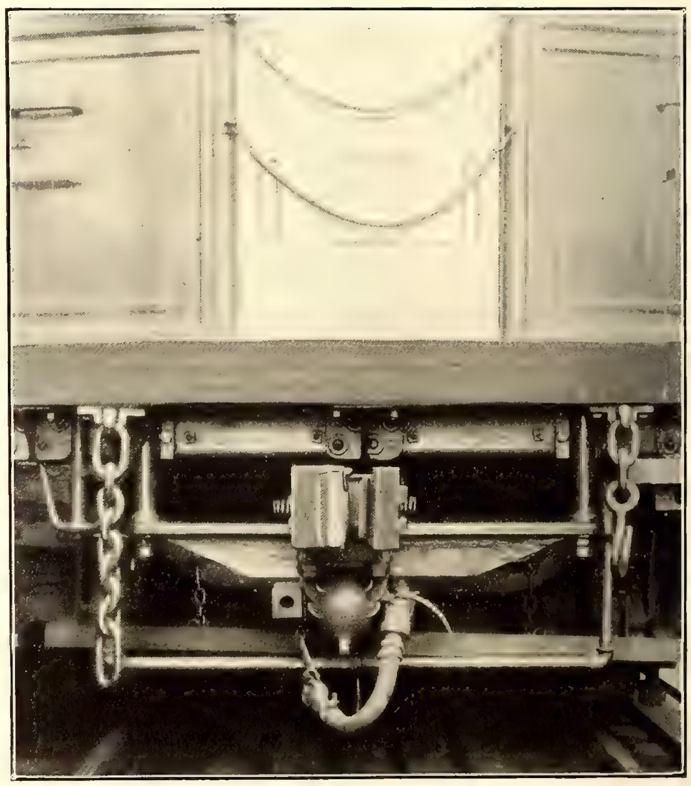


FIG. 4.—FRONT VIEW OF COUPLER AND TRAIN LINE CONNECTIONS

the act of uncoupling. When this occurs they strike back to a coupling position.

Two types of draft rigging are shown. One of these is for use where there is plenty of room for the swiveling of the draw-bar without interference with platform timbers or apparatus, such as motors, etc. On this, standard T-rails are employed, running back to the king pin of the truck. On the other, a long, flat steel plate under the car body has the buffer attached to it. The latter type employs a sin-

gle buffing spring, which serves both for compression and draft. The couplers are made of cast steel, and are only machine-fitted in part, as they do not depend on the tightness of the lock to prevent them from buckling or bending out of line when pushing. They are kept in alignment by the

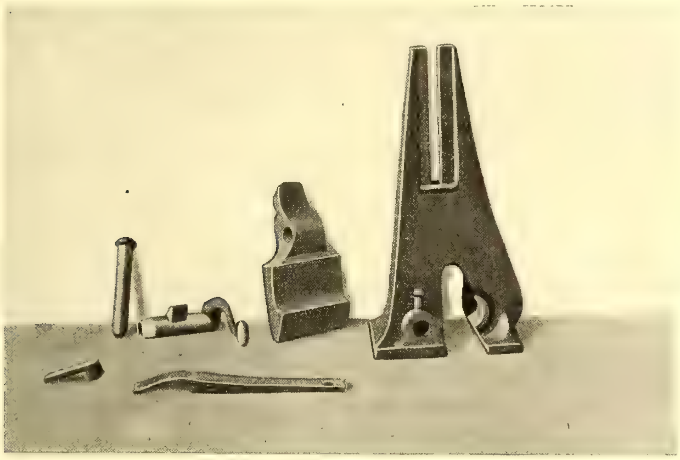


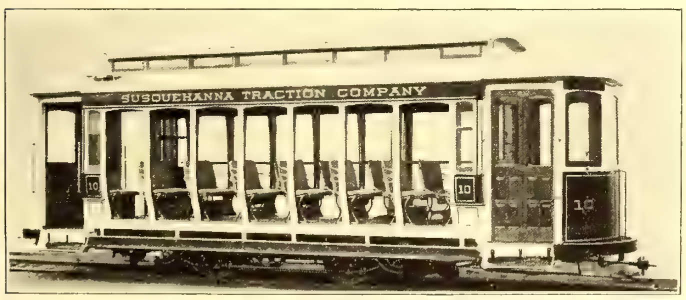
FIG. 5.—DETAILS OF COUPLER

long, flat backs of the links or projecting parts, which are back to back when the coupling is made. As there are no sudden changes of grade on the elevated road and the overhang is not large, couplers are made so that they may move up and down freely, just as do M. C. B. couplers on steam railroads.

The air-brake piping, the train cable for the multiple-unit system, and the light and heat-circuit cable are attached to the draw-bar and swivel with it. The connection with the air-brake hose swivels on a metallic joint in the piping located some distance back under the car body. The electric cables are protected by a spiral wire guard to prevent mechanical wear on the insulation.

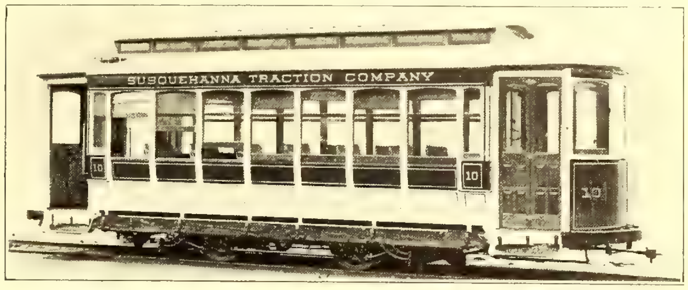
CONVERTIBLE TYPE CAR FOR CENTRAL PENNSYLVANIA

The Susquehanna Traction Company, Lock Haven, Pa., recently received from the J. G. Brill Company the convertible type of car shown. The railway company operates a line in the central part of Pennsylvania, connecting Lock Haven, Flemington and Mill Hall. As will be seen from the illustrations, the type, when opened or closed, has the appearance of the standard types. By simply pushing the sashes and panels into pockets in the side roofs, conversion may be effected quickly and easily, the car always being prepared for any change of



SUSQUEHANNA TRACTION COMPANY'S CAR, OPEN

weather. The builder's "grooveless post" arrangement is included, which, besides making it unnecessary to cut into the posts, reduces friction, increases strength and enables the panel to be readily removed for inspection and repairs. With the "grooveless post" system each pair of sashes is joined together with brass tongue-and-groove sliding connections and conducted into a pocket in the side roof by means of small metal roller brackets moving on bow-shaped steel guides which extend from top plate to lower ventilator rail and are within the pocket. The panels slide into the pockets by means of metal guides on the posts, which are straddled by the projecting edges of the two sheets of thin steel which compose the panels. These metal sheets are held $\frac{5}{8}$ in. apart by horizontal wooden slats, and have spaces between which successfully air-jacket the car against cold. The car illustrated is mounted on the No. 21-E single truck, which carries the car body 2 ins. lower than any other single truck. Brackets connect the back of the seats with the posts, thus forming convenient handles, which encourage passengers to face in the right direction when leav-



SUSQUEHANNA TRACTION COMPANY'S CAR, CLOSED

ing the car. Twenty-eight passengers may be comfortably seated, the seats being of spring cane. Ash in natural color and decorated birch ceilings constitute the interior finish. The vestibule sashes are composed of single lights and are arranged to drop into pockets.

The general dimensions are as follows: Length over the end panels. 20 ft. 7 ins., and over the crown pieces and vestibules, 30 ft.; panel over the crown piece and the vestibule, 4 ft. $8\frac{1}{2}$ ins.; width over the sills and the panels, 7 ft. $2\frac{1}{4}$ ins.; width over the posts at the belt, 8 ft.; sweep of the posts, 5 ins. The side sills are $5\frac{1}{4}$ ins. x 7 ins., reinforced with $3\frac{1}{4}$-in. x 5-in. x $\frac{3}{8}$-in. Z-bars, and the end sills are $4\frac{1}{4}$ ins. x 6 ins. The thickness of the corner posts is $3\frac{5}{8}$ ins., and of the side posts, $3\frac{3}{8}$ ins. The No. 21-E trucks have a wheel base of 7 ft. and 33-in. wheels.

DURKIN CONTROLLER HANDLE

In the description of this device which was published in the issue of this paper for August 25 an engraving appeared in the article showing various unassembled parts which did not belong to the Durkin controller handle. This engraving has given rise to some misconception, so that the explanation should be made that the engraving did not relate to the handle, and was published through an error of the printer.

SPECIAL TRAIN FROM CHICAGO FOR THE CONVENTION

The Pennsylvania short lines have arranged to run a special train from Chicaga to Philadelphia on account of the convention of the American Street Railway Association and its affiliated associations. The train will leave Chicago on Monday, Sept. 25, at 7:30 p. m., and will arrive at Pittsburg the next morning, where cars from the following points were attached to the train; from Cleveland, carrying the Northern Ohio and Michigan delegations; from St. Louis, carrying the delegates from the Southwest, and from Cincinnati, carrying the Southern delegates. The run from Pittsburg will be by daylight, and the train will reach Philadelphia in time for dinner. This will afford a delightful ride over the Alleghenies.

For rates, sleeping car space, and further particulars, address G. C. Beltzhoover, district passenger agent, or C. L. Kimball, assistant general passenger agent, 2 Sherman Street, Chicago.

FINANCIAL INTELLIGENCE

WALL STREET, Sept. 6, 1905.

The Money Market

The money market this week reflected to a greater extent the heavy losses in cash sustained by the local banks as a result of the outflow of money to the West and South for crop-moving purposes. The tone of the market was firm, and rates for all classes of accommodations were about ¼ per cent higher than those prevailing at the close of last week. The advance in rates, however, failed to stimulate any decided increase in the demand for funds, but at the same time there was no disposition on the part of lenders to press their funds except at the full asking rates. Call money, which a week ago ruled at about 2 per cent, averaged about 2½ per cent this week. In the time loan department sixty day money loaned at 3½ per cent, as against 3¼ per cent recently quoted. Ninety day money, which carries the borrowing up to the middle of December, was offered at 3¾ per cent by some of the large trust companies, while four months' funds were obtainable at 4 per cent. Six months and longer maturities were quoted at 4¼ per cent, but the demand at that figure was extremely light. Commercial paper was decidedly more active, dealers reporting a better assortment of names, and a good absorption both by local trust companies and by out-of-town institutions. Rates moved up in sympathy with the advance in time loan quotations, prime endorsements being quoted at 4¼ per cent, choice single names at 4¼ to 4½ per cent and other good names at 5 to 5½ per cent. Foreign exchange ruled weak at about 4.8590, due to liberal offerings of cotton and finance bills. The European markets were practically unchanged, except at London, where discounts displayed a hardening tendency, owing to the withdrawal of gold by the continent. The bank statement, published a week ago, showed a further loss in cash of $7,103,500, and a further reduction in the surplus reserve of $3,479,300 to $5,498,875, which, with the exception of 1902, is the lowest point for this period since 1893. The regular monthly statement of the Treasury Department of the amount of money in circulation in the United States (exclusive of Treasury holdings) on September 1, showed a total of $2,621,659,054, as against $2,604,902,301 on August 1, 1905, and $2,558,279,984 on September 1, 1904. The estimated population of the United States on September 1, 1905, was $83,493,000. The circulation per capita on that date was $31.40, the highest per capita circulation ever reached in the United States, and compared with $31.29 on August 1, $31.16 on September 1, 1904, and $29.60 on September 1, 1903. At the close there was nothing in the situation to cause any concern regarding the money market in the immediate future. The belief prevails in banking circles that owing to the enormous crops which now seem assured, the local institutions will be called upon to furnish more money for their movement than in former years, but there is no doubt that the banks will be able to furnish all necessary funds without causing a stringency in money.

The Stock Market

The stock market has been lower and at times under considerable selling pressure from the bear party, and speculative opinion has been influenced to some extent by the frequent sensational utterance of the leader of the Boston bear pool. Consideration of the possibilities of the money market for the next sixty days has, however, been the dominant influence, and is responsible for the more pessimistic feeling which prevails. Money is moving to the interior in large volume, and this movement will continue for some weeks, and it is doubtful if any return movement will set in before November. Money rates have ruled somewhat firmer, and if there should be any active demand for funds for speculative purposes, it will probably result in the establishment of higher rates for both call and time money. The peace agreement was signed on Tuesday, and there has been much discussion of a forthcoming Russian loan, the amount of which is uncertain, although it is intimated that it will be larger than many expect. The large foreign banks had made preparation for such a loan before the termination of the war on the belief that Japan would compel the payment of an indemnity by Russia, and there should therefore be no difficulty in financing the proposed new loan on the other side. The demand, however, will tie up a large amount of foreign capital which might otherwise be available for this market. General conditions continue highly satisfactory, and the activity in all lines of trade, coincident with large crops, has created a legitimate demand for money somewhat in excess of early expectation, but according to the best banking authority there is no reason to anticipate any stringency, and consequently no bear campaign in the stock market based upon dear money. The point of speculative attack has been the metal stocks, and this has been influenced by the weaker tone of the copper metal market and anticipated decrease in the foreign demand for the metal. The selling extended to the other active stocks, with considerable pressure on the higher priced issues, although at the end of the week there was a rather sensational advance in Canadian Pacific, Reading and American Smelting. This was followed by a renewal of the selling movement, and prices ran off to the lowest point reached in several months. The banking interests have not rendered any pronounced support, and their attitude appears to be to discourage any active bull speculation in stocks until the money market is in better shape and the supply of funds is larger. The cotton market has been adversely influenced by the bearish government report, showing a higher average condition than expected, and indicating a yield considerably in excess of 10,000,000 bales, which, with the amount carried over from the last crop, will be ample to meet all requirements. There has been nothing of especial importance in the grain markets, which are inclined to sag under the weight of the indicated yields of wheat and corn.

The local traction stocks held fairly well until toward the end of the week, when they weakened in sympathy with the general market. Some selling of Brooklyn Rapid Transit was undoubtedly influenced by the delay in the publication of the annual report.

Philadelphia

Little interest was manifect in the market for traction stocks this week. Dealings were upon a much smaller scale, and although prices displayed irregularity, the net changes were insignificant. A noteworthy feature of the trading was the continued firmness in Philadelphia Traction, over 500 shares of which changed hands at 101. Philadelphia Rapid Transit was extremely quiet, about 1000 shares being dealt in at prices ranging from 28¼ to 28¾. Philadelphia Company common after selling at 46½ at the opening ran off a point and closed at 45⅜. About 1200 shares were dealt in. Consolidated Traction of New Jersey sold at 83½ to 83¾ for 282 shares. Union Traction changed hands at 62 to 61½, to the extent of about 500 shares. United Traction of Pittsburg preferred sold at 50, and an odd lot of United Railway Investment preferred brought 88⅞. American Railways opened at 54¼, and later sold at 53½ ex the dividend. Railways General sold at 4 for 100 shares. The directors of the Railways Company General have called a special meeting of the stockholders to be held on September 18, to consider a proposition to reduce the capital stock from $1,200,000 to $900,000, by retiring the stock owned by the company.

Baltimore

The feature of the Baltimore market was the strength displayed by the United Railway issues, all of which scored decided gains. The buying was especially heavy in the stock and in the income bonds and was accompanied by reports of a deal whereby the property will eventually pass to the control of the interest that now dominate the local gas industry. The free stock sold to the extent of more than 1000 shares at prices ranging from 15¼ to 16, while upwards of 3000 shares of the deposited stock changed hands at from 15¼ to 16½. The income bonds opened at 66 and declined to 64⅛, but later recovered to the opening figure. The certificates for income bonds deposited rose from 63⅛ to 65 and closed within a small fraction of the highest. About $79,000 of the free bonds, and upwards of $20,000 of the certificates were dealt in. The 4 per cent bonds were quiet but strong, about $18,000 changing hands at around 95. Other transactions included Macon Railway & Light 5s at 99½ to 99⅝, Norfolk Railway & Light 5s at 111, City & Suburban 5s at 114 and Washington City & Suburban 5s at 105.

Other Traction Securities

There was a decided improvement in the Chicago market. More issues were dealt in than for many weeks past and prices generally showed improvement. Chicago City Railway sold at 190 for 100 shares, and a like amount of West Chicago brought 45. South Side Elevated continued the upward movement, upwards of 600

shares changing hands at from 97 to 99. Kanass City Railway & Light common was active, about 1000 shares selling at from 56¾ to 54½, with a subsequent rally to 55¾. The preferred stock sold at 88½. Metropolitan Elevated common sold at 26 and 25¾, while the preferred was dealt in to the extent of 700 shares at from 69¼ to 68. It is said that the company's earnings are large, and that a resumption of dividends on the preferred stock is almost certain this year or early in 1906. An odd lot of Chicago & Oak Park preferred sold at 18. The Boston market was dull and irregular. Massachusetts Electric preferred broke from 62 to 60, but later recovered to 61. Boston Elevated sold at from 155 to 154. Other sales included 168 West End common at from 99¾ to 99, 9 preferred at 113, $2,000 4 per cent bonds of 1915 at 102½, 50 Boston & Worcester common at 25, 50 Boston & Suburban at 21, and 5 shares of the preferred at 68. In the New York curb market Interborough Rapid Transit displayed decided strength, upwards of 24,000 shares selling at prices ranging from 215 to 220, the final transactions taking place at 219. Washington Railway common sold at from 42⅞ to 44, but later eased off a fraction. The preferred brought 92½ for 300 shares, and $30,000 of the 4 per cent bonds brought 91. American Light & Traction preferred sold at 105 for 5 shares.

It is interesting to note that in spite of the existence of the fever in New Orleans the prices recorded in some securities at the New Orleans Stock Exchange on August 30 exceeded the high water mark, New Orleans Railway & Light common closing at 36½, which was within two points of the highest price ever recorded for the stock. On that date the sales amounted to 2120 shares, and the market closed firm at 36⅛. The preferred stock opened and closed at 78¾, which is within 4⅛ points of high water mark. The present condition of the Stock Exchange reflects public sentiment in New Orleans, and a renewal of confidence is plainly evident.

There are indications that the United Gas Improvement Company (Widener-Elkins syndicate) is again seeking to lease the Cincinnati, Newport & Covington Company, to operate it in connection with its Cincinnati traction and lighting interests. This doubtless accounts for the activity in the securities of this company during the past few weeks. About 1600 shares of the common changed hands last week, advancing to 38⅛; a few weeks back it sold at 33, the preferred sold at 95½ to 56¼. Cincinnati Street Railway sold at 146¾, Detroit United at 94⅜, and Toledo Railway & Light at 34⅝.

Aurora, Elgin & Chicago continues the active feature in Cleveland. About a thousand shares of the common sold with a range of 24⅜ to 24⅞. Cleveland Electric was active, and advanced to 80¼. Cleveland & Southwestern Traction strengthened slightly to 10 for the common, while the preferred showed a slight decline to 49⅜. Elgin, Aurora & Southern sold at 37, a slight advance. Lake Shore electric common advanced to 13⅛, and the preferred to 56. Northern Ohio Traction was weaker at 22⅞, while Northern Texas advanced to 70. Western Ohio sold at 15. The 5 per cent bonds of this company have been particularly active, $57,000 worth advancing the price from 83 to 84½. Aurora, Elgin & Chicago 5s sold at 95⅜. All of the Cleveland tractions are showing fine increases in earnings the past two months.

Security Quotations

The following table shows the present bid quotations for the leading traction stocks, and the active bonds, as compared with last week:

	Aug. 30	Sept. 6
American Railways	53	53½
Boston Elevated	154	154
Brooklyn Rapid Transit	71⅜	69¼
Chicago City	190	190
Chicago Union Traction (common)	8	8⅜
Chicago Union Traction (preferred)	—	—
Cleveland Electric	—	80
Consolidated Traction of New Jersey	—	—
Consolidated Traction of New Jersey 5s	—	109½
Detroit United	94⅜	93⅜
Interborough Rapid Transit	215¾	219
International Traction (common)	—	34
International Traction (preferred) 4s	—	73½
Manhattan Railway	166	164
Massachusetts Electric Cos. (common)	17½	17
Massachusetts Electric Cos. (preferred)	60½	60
Metropolitan Elevated, Chicago (common)	25	24½
Metropolitan Elevated, Chicago (preferred)	68½	67
Metropolitan Street	131⅜	129⅛
Metropolitan Securities	83½	82¾
New Orleans Railways (common), W. I	36	36½
New Orleans Railways (preferred), W. I	78	78⅝
New Orleans Railways, 4½s	90½	90½
North American	99	98¾
North Jersey Street Railway	—	—
Philadelphia Company (common)	46¼	45¾
Philadelphia Rapid Transit	28⅜	28¼
Philadelphia Traction	101	101
Public Service Corporation 5 per cent notes	96¾	96¾
Public Service Corporation certificates	69¼	69¼
South Side Elevated (Chicago)	96	a98
Third Avenue	128½	127
Twin City, Minneapolis (common)	116¾	115½
Union Traction (Philadelphia)	61⅝	61¼
West End (common)	99	99
West End (preferred)	113	113

a Asked. W. I., when issued.

Iron and Steel

The "Iron Age" says the feature of the market during the last week has been the heavy buying of steel rails for 1906, notably on the part of the Western lines. It is estimated that the total sales foot up to fully 250,000 tons. Further heavy equipment orders have been placed, the Pennsylvania leading with over 16,000 steel cars. The activity in nearly all lines of finished material is evidenced by the fact that the orders booked by the United States Steel Corporation for August make that a record month. The pressure which caused the advance in structural material from 1.60 to 1.70 cents base Pittsburg is expected to lead to a like advance in the price of plates at an early date. In the pipe trade the principal item has been the placing of an order for 60 miles of 18-in. pipe by the Ohio Fuel Supply Company. A smaller order placed is for 15 miles of 10-in. pipe. In the pig iron trade a feature has been some contracting for foreign iron.

MANILA SYSTEM NOT FOR SALE

Reports circulated early in the week to the effect that negotiations are pending for the sale of the street railway lines and lighting system in Manila prove to be erroneous. J. G. White & Company, of New York and London, who, in association with other important interests financed the work, built the system and control and operate it, state emphatically that the shareholders are satisfied with results and that the stock is not for sale.

A CHICAGO ROAD CHANGES HANDS

W. S. Reed, First National Bank Building, Chicago, formerly of the firm of Townsend, Reed & Company, has secured control of the Chicago Electric Traction Company and will use it to secure an entrance to Chicago for the Chicago & Southern Traction Company, which he is promoting between Chicago and Kankakee. The Chicago Electric Traction Company has a line running from Sixty-Fourth Street and South Park Avenue, Chicago, to Blue Island and Harvey. It connects with the South Side Elevated Railroad at Sixty-Fourth Street. It has been in the hands of a receiver for several years, and has a number of times been considered in connection with interurban railway enterprises projected into Chicago from the south.

WESTCHESTER COMPANY GETS MT. VERNON FRANCHISE

The aldermen of the city of Mt. Vernon have voted unanimously in favor of granting the application of the New York, Westchester & Boston Railroad for a perpetual franchise to cross over or under the streets of the city, and the franchise has been signed by the mayor. This action was taken at a public meeting and followed a favorable report of the railway committee of the Board of Aldermen, which has been considering the company's application for several weeks. The Westchester Company has given a bond to begin work in the city within sixty days. The company's plan is to build a four-track, third-rail railway from New York to Port Chester, N. Y., a distance of 27 miles. Construction work of that part of the line in Bronx Borough, New York, is rapidly approaching Mt. Vernon.

REPORT OF THE ALLIS-CHALMERS COMPANY

The fiscal year of the Allis-Chalmers Company has been changed to end on June 30, instead of April 30. The net profits of the company for the fiscal period ended June 30, 1905, after deducting all expense of manufacturing and selling, and after making provision for the depreciation of business and machinery, and for possible bad debts, amounted to $58,982. For the fiscal year ended April 30, 1904, the net profits were $952,624, out of which dividends of $853,125 were paid on the preferred stock, leaving a surplus for the year of $99,499. President Warren in his annual report says, "The contraction in general business referred to in the last annual report, as then justifying the postponement of dividends, continued during the first half of the last fiscal period, with particular manifestation in the steam engine department of this company. This was due largely to the introduction of steam turbines, especially those of large capacity, for which certain manufacturers had been preparing for several years. Our engineers have been engaged during the last year in improving our established standard lines of apparatus and machinery, and in reducing its cost. Particular attention and effort have been devoted to developing and perfecting a line of steam turbines, gas engines, centrifugal pumps, hylraulic turbines, steam turbo-generators, hydraulic turbo-generators, induction motors, street railway motors and controlling devices therefor, transformers, steam and hydraulic dredges and steam shovels. Soon after the beginning of this calendar year an improvement was manifested in the general business of the company, the orders increasing in April to the normal volume, and since then exceeding in extent the previous record of the organization; but the results of these orders will be realized only upon their execution and the delivery of the work. This increase pertained more particularly to the older branches of the business of the company."

PLANS FOR SAN FRANCISCO'S MUNICIPAL LINE

Plans and specifications are now being prepared for the conversion of the present Geary Street Cable Railroad, in San Francisco, into an underground conduit road, from Market Street, along Geary Street, to Point Lobos Avenue, and along Point Lobos Avenue to Fifth Avenue, a distance of 3.33 miles; also for the construction of a new electric underground conduit road from Fifth Avenue along Point Lobos Avenue to Tenth Avenue, and along Tenth Avenue to Fulton Street at Golden Gate Park, an additional distance of .81 mile. The cost has been estimated at $304,705, which has been appropriated and is now available. An appropriation will be made next year for the necessary cars, tool and appliances. Bids will be received for the present work in about three months. The stockholders of the cable railroad, whose franchise has expired, have given notice that they claim the rails and roadbed, and will probably contest the city's taking possession of them for its municipal road. Thomas P. Woodward, city engineer of San Francisco, is in charge of construction details.

ACCIDENT FAKIR RUN DOWN IN PHILADELPHIA

In a signed confession obtained Saturday, Sept. 2, by the Philadelphia Rapid Transit Company, Edward L. Pape, of New York, aged 24, tells how he mulcted companies in New York, Chicago, Cleveland and Buffalo. He had turned State's evidence on the men who were connected with him. Two of these, John Burns and John Wilmott, were arrested, while the police are after a New York lawyer, who, Pape says, did the gang's legal business. Pape was held under $2,000 bail for court, while his two confederates, who are confined in a workhouse in Cleveland, will be taken to New York where they will face a number of serious charges.

Pape, who was the leader of the gang, has a peculiar physical asset that was most valuable to him in these schemes. Time after time, after he had apparently been hurled from a moving street car, he has been taken to hospitals of various cities in an unconscious condition. Doctors at these institutions, after making an X-ray examination, would declare that he had either a fracture of the skull or an injury to the vertebra. With his confederates for witnesses to the accident and the endorsement of the physicians, Pape would have a case for damages that could not be attacked. He did have an injury to the fifth vertebra, but this was received as a result of diving from a height of 40 ft. into a vat containing 6 ft. of water. A miscalculation caused Pape to strike his head against the side of the vat. When he recovered from the effects of this accident, which broke a vertebra, there was a lump on the back of his neck, and the muscles of the front of the neck had taken a peculiar formation. By simulating the actions of a man who had his spine injured, he could, by the aid of these physical evidences, fool the doctors.

CHICAGO RAILWAY INTERESTS IN LARGE AMUSEMENT ENTERPRISE

Plans are about completed for the organization of a company to construct and operate an immense amusement park at Ravena, Ill., a suburb of Chicago. The principal owner will be the Chicago & Milwaukee Electric Railroad, which has at present a track operating through Ravena to Chicago, and which has been placed in operation through Zion City. A. L. Drum, general manager of the company, visited Coney Island, New York, last week, and as a result the announcement is made that Frank C. Bostock, who now runs a Hippodrome at Blackpool, England, the Paris Hippodrome and another in Cleveland, and has large interests at Coney Island, will be manager of the company.

A large tract of land will be devoted to the new amusement park. In the center will be an immense artificial lake, fed by a lagoon from Lake Michigan. At one end of the lake the summit of a mountain will project, and resting on the top of it will be as exact a reproduction of Noah's Ark as human ingenuity can make it. A long runway will lead to the ark from the shore, and on this runway Bostock's animals will pass to and fro in representation of the old Biblical legend, "The animals passed in two by two." The main deck of the ark will be an immense arena in which Bostock will put on the best features of his many animal acts.

At the other end of the lake and on solid foundation, will be an immense spherical shaped structure, to be known as "The Moon." In it will be the most up-to-date theater that has yet been planned, and designs for which are now in the hands of McElatrick & Sons, of New York. The immense globe will represent the planet after which it is named. Mr. Arthur will be the manager of this theater, and will conduct high-class summer shows in it. The first production he will make will be "Moonshine," the comedy with music by Royal-Hobart-Klein, in which Miss Marie Cahill will star this season.

"A Trip to the Moon" in miniature will be afforded patrons of the park, it is hoped, by having airships, modelled on the types that have already made successful flight and supported on glide line, flying about this imitation moon. The surface of the sphere will be modelled to represent the outer crust of the moon, along the lines of recent astronomical researches.

AN IMPORTANT PENNSYLVANIA PROJECT TAKING SHAPE

Frank G. Patterson, president of the Southern Traction Company, says that within a month the contract will be awarded for the construction of an electric railway touching Altoona, Hollidaysburg, Roaring Springs and Bedford on the south, and Johnstown, Ebbensburg, Gallitzin and intervening points on the north and west. It is stated that a complete right of way for the line has been obtained. The preliminary and final surveys were made by Fitzgerald & Hamilton, of Pittsburg. Complete estimates for the building of the road, cost of cars and machinery and buildings have been prepared by the firm. It will cost, according to the final estimate of the engineers, not less than $450,000 to put the road in operation. The line will pass through a community containing a population of over 135,000. No opposition to the construction of this line is to be offered by the Pennsylvania Railroad interests, it is now stated. Through an arrangement just perfected with the Real Estate Title & Trust Company, of Altoona, that company will act as trustee for the mortgage that will be given by the Southern Traction Company. The announcement is made that the new company will operate its line entirely independent of any other interests in this section of the State, and that through traffic arrangements will be made with all lines now in operation and those in prospect.

Power houses, general offices, car houses and car shops will be built, it is stated, at Duncanville. It is proposed to have much of the grading and track laying completed before the ground freezes too hard, and by May 30 next, it is to be arranged to operate the first cars. The company contemplates operating a park in the mountain country next year. At Gallitzin the company will have a connection with the Wilmore & Gallitzin line proposed by other Pittsburg interests. This line will be about 15 miles long, and with the Southern lines a total of 33 miles of electric railway will be started this fall.

LONG ISLAND EXTENDS ELECTRIC SERVICE

The institution of the third-rail system upon Atlantic Avenue, Brooklyn, and the partial abolishing of steam as motive power during the last week, was another step in the extension of the electric service of the Long Island Railroad. Aug. 29 the company ran the first train through the completed improvement, using all of

the subways and viaducts for the first time, and bringing the train to a standstill at the subway station in the Flatbush Avenue depot. Everything about the improvement is now completed, with the exception of the subway station at Flatbush Avenue, and the work on that portion is being rushed. Two subway platforms are in the station, and the steps leading to the street are completed. The company is now running about thirty trains a day over the improvement. These trains are what are known as the rapid-transit service to Jamaica. The through trains are run by steam. The railroad is now making up the fall schedule of trains, which will go into effect on Sept. 20 or thereabouts. Every train on the avenue will then be run by electricity. Passengers going further east than Jamaica from Brooklyn will be forced to change cars at Jamaica for the eastern points. It is intended by the company to run trains through to Manhattan as soon as the river tubes and the Fulton Street (Brooklyn) subway are completed. The next line which will be run by electricity is the North Shore division running from Long Island City to Bayside, L. I., and Port Washington, L. I. Work has already commenced on the line, and surveyors are busy mapping. Part of the electricity which is to be generated in the two big power houses will also be used on the Bay Ridge line and the Manhattan Beach line. The line is to be four-tracked from Bay Ridge to Long Island City and to Manhattan Beach from Long Island City. Cut-ins and cross-overs are to be maintained at all intersecting lines.

STREET RAILWAY PATENTS

[This department is conducted by Rosenbaum & Stockbridge, patent attorneys, 140 Nassau Street, New York.]

UNITED STATES PATENTS ISSUED AUG. 22, 1905

797,582. Switch Operating Device; Cyrus C. Johnson, Mount Vernon, Ill. App. filed Oct. 18, 1904. The car has a pair of depending hooks which engage one or another end of a centrally pivoted lever arranged to throw the switchpoint in either direction.

797,591. Electrical Railway Signaling System; Leonidas N. Lyon, Jr., Flatonia, Tex. App. filed Nov. 29, 1904. The patentee provides a pair of conductors adjacent to the usual track rails which constitute "a main circuit." When it is desired to telegraph from one train to another, the main circuit is shunted through the trains by electro-magnetic devices so as to form an auxiliary telephone or telegraph circuit.

797,647. Composite Brake Shoe; Daniel O. Ward, Oak Park Ill. App. filed Feb. 26, 1904. The brake shoe is made in the form of a skeleton frame or box having ribs with a plurality of hard cast-iron plates inset therein.

797,678. Electric Railway Signal; Jake Friedlander, Fargo, N. D. App. filed Dec. 27, 1904. Contacts are provided beneath the usual track rails, which are completed by the depression of the rail under the weight of a train. By stopping the train over one of these contact points, a telephone circuit is completed by which communication is had with the train despatcher.

797,772. Switch; Charles M. Hibbets, Washburn, Tex. App. filed Feb. 21, 1905. In order to prevent spreading of the rails at a switch, known as "splitting a switch," the patentee provides a form of guard rail which will automatically throw the train back on the main line, even though the rails at the switch point are spread.

797,783. Railway Signal; Vibe K. Spicer, Kenilworth, Ill. App. filed Sept. 12, 1902. The semaphore arm is mechanically raised by projection on an endless belt, which is driven by an electric motor. When the arm is raised the circuit is automatically broken and a brake applied.

797,839. Switching Device; Carl J. Carlson, Spokane, Wash. App. filed Dec. 9, 1904. A diamond-shaped block is pivoted in a slot in the path of the car in such a way as to be shifted to its alternate position when engaged by a depressible roller on the car. The block is connected to the switchpoint.

797,861. Car Platform; Augustine Melgarejo, Harrison, N. Y. App. filed May 16, 1905. A pivoted shelf or step is hung adjacent to the car door, and may be depressed by a lever so as to constitute a bridge to a stationary platform.

797,863. Syntonic Signaling System; Maurice Milch, Schenectady, N. Y. App. filed March 30, 1904. A signal circuit arranged in resonance with the alternating high frequency power circuit when only a single car is on a block. If two cars enter the same block, the resonance is destroyed and warning signal given.

797,870. Switch or Point for Railways, Tramways, and the Like; Albert J. Smith, Cardiff, England. App. filed Jan. 9, 1905. A spring-pressed switchpoint is normally held against movement by a detent which is depressed by a roller on the car manipulated by the motorman. A cam in the track is afterward depressed by the car wheel so as to restore the switchpoint to normal position.

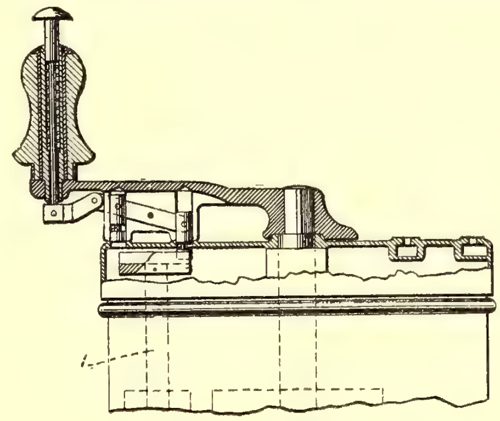
797,896. Street Car Brake; Mathias Klein, Pittsburg, Pa. App. filed April 29, 1905. Comprises a serrated shoe which is pivotally mounted beneath the bed of a car, and which can be manipulated by the motorman to engage the roadbed over which the car is traveling.

797,905. Cable Grip; Horatio S. Moore, Monongahela, Pa. App. filed Jan. 5, 1905. One of the cable-gripping shoes has a wedge surface on the back thereof, against which a co-operating wedge is applied by a toggle-joint.

798,050. Sanding Device; Charles Thompson, Philadelphia, Pa. App. filed Jan. 21, 1905. A sand box for street cars in which the mouth of the hopper is closed by a plunger having wings or blades thereon, which are reciprocated by an air cylinder so as positively to feed out the sand. The wings have a slight revoluble movement.

UNITED STATES PATENTS ISSUED AUG. 29, 1905

798,069. Car Fender; William W. McClung, Butlet, Pa. App. filed April 29, 1905. A U-shaped bar having sides of unequal length, and means for connecting the longer of said sides to the lower member of the truck-frame of a car with the looped end depending nearly to the rails and in advance of the flanged wheels and the spaced sides disposed at opposite sides of the wheel.

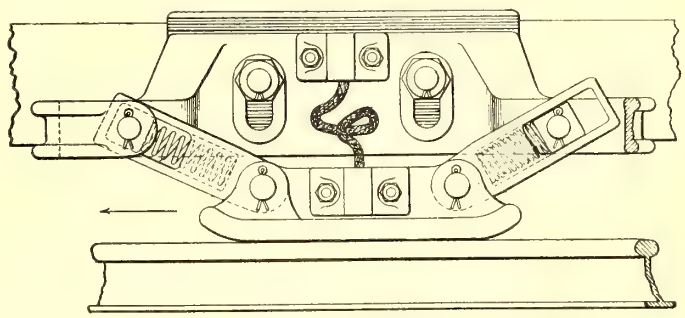


PATENT NO. 798,190

798,097. Trolley Stand; Boniface A. Grasberger, Richmond, Va. App. filed Dec. 12, 1904. Pneumatic means for controlling the trolley pole.

798,099. Point and Crossing for Railways; Robert A. Hadfield, Sheffield, England. App. filed Jan. 27, 1903. Details of a removable wear plate.

798,173. Gear Casing for Electric Railway Motors; Henry R. Edgecomb, Edgewood Park, Pa. App, filed Aug. 17, 1904. An electric motor having a field-magnet frame comprising two parts, ringed together for independent movement, and a gear-case formed in two parts, which may be removed independently of each other.



PATENT NO. 798,368

798,190. Controller for Electric Motors; George Laird and John P. Todd, Manchester, England. App. filed July 22, 1904. Comprises in combination a main drum and a reversing switch-drum, a single operating lever having means for so adjusting its connection with the reversing switch-drum that a one-way movement of the lever may effect rotation of said drum in either direction.

798,227. Electric Railway Motor; Norman W. Storer, Pittsburg, Pa. App. filed Aug. 6, 1904. An electric motor comprising a field-magnet frame having upper and lower halves, which are hinged together at one side, and axle-caps secured to both halves at the opposite side.

798,263. Brake Shoe; Cyrus L. Bundy, Dover, N. J. App. filed April 3, 1905. A brake shoe comprising a bearing member and a backing of sheet steel, or similar material anchored thereto along

the back thereof, and having an eye member with its side walls integral and continuous with and drawn in from the edges of the main portion.

798,283. Track Sanding Device; John E. Holcomb, Winsted, Conn. App. filed Dec. 22, 1904. Adjacent to the valve at the end of the sand pipe is an air cylinder and piston. When air pressure is admitted to the cylinder the piston is forced downward, carrying with it the valve stem of the sand pipe, with which it is suitably connected, and also operating a device for cleaning the end of the sand tube.

798,368. Third-Rail Contact Shoe; Samuel B. Steward, Jr., Schenectady, N. Y. App. filed May 5, 1904. The shoe is spring-pressed against the conductor.

798,394. Trolley; Frederic C. Cottrell, Taunton, Mass. App. filed April 26, 1905. A pair of vertical rollers mounted in the trolley harp and spring-pressed toward each other, and adapted to be separated when a hanger is encountered.

798,410. Controller; George H. Hill, Schenectady, N. Y. App. filed May 2, 1904. In order to provide a cheaper construction of controller for small motors, the blow-out magnet is carried directly by the controller arm.

798,427. Controller Attachment for Supplementary Circuits; William Lintern, Westpark, Ohio. App. filed Nov. 7, 1904. A supplemental switch upon the controller arm makes a contact for ringing a gong or other purpose at the axis of the arm in whatever position such arm occupies.

798,439. Trolley Wire Finder; Peter McDonald, Harrison, N. J. App. filed Oct. 8, 1903. A pair of spirally grooved rollers mounted one on each side of the trolley wheel, which guide the wire onto the wheel.

798,556. Railway Switch; Victor Angerer, Ridley Park, Pa. App. filed June 8, 1905. Sufficient resistance is placed upon the switchtongue to prevent accidental throwing of the switch, while it can be readily moved in the ordinary manner by a bar.

798,557. Railway Switch; Victor Angerer, Ridley Park, Pa. App. filed June 8, 1905. See above patent.

798,574. Pedestal for Car Seats; Robert Dunning, Winton Place, Ohio. App. filed Oct. 17, 1904. The pedestal is hollow and adapted to contain an electric heater.

PERSONAL MENTION

MR. GEORGE WESTINGHOUSE returned Sept. 5 on the "Kaiser Wilhelm II.," after an extended trip abroad.

MR. F. P. FOSGATE, train despatcher at Concord, N. H., for the Boston & Maine Railroad, has been appointed assistant superintendent of the Portsmouth Electric Railroad.

MR. B. H. WARREN, who retired from the presidency of the Allis-Chalmer Company on Sept. 1, will, it is said, become the head of the new engineering and contracting company, which is to be established in New York, and which will have several powerful interests associated with it.

MR. G. M. BASFORD, formerly editor of the "American Engineer and Railroad Journal," has been appointed to the position of manager of the bureau of publicity of the American Locomotive Company, a department of the company just established. Mr. Basford will assume his new duties Oct. 1.

MR. JOHN T. MANSON, president of the Yale National Bank of New Haven, Conn., has just been elected president of the Recording Fare Register Company of that city. Mr. Manson has for several years been identified with the operation of street railways, being president of the Milford & Uxbridge Street Railway, of Milford, Mass.

MR. FRANK J. DUFFY, who some time ago had under consideration the question of resigning as secretary and treasurer of the Beaumont Traction Company, of Beaumont, Tex., to become general manager of the Vicksburg Railway & Light Company, of Vicksburg, Miss., is now acting as secretary, treasurer and manager of the Beaumont Traction Company, some changes having been made in the personnel of that company. The Vicksburg and Beaumont properties are controlled by the same management.

CAPT. HENRY GROVER, retiring superintendent of the Chelsea division of the Boston & Northern Street Railway, was last week given a purse of gold and his wife a purse of silver by the employees of the division. The presentation was made by Mr. John J. Sullivan, foreman of the Broadway barns of the division. Capt. Grover resigned after working for the company and its constituents nearly twenty-five years. He entered the service as a driver. A year later he was made stable foreman, in 1892 purchasing agent for the road, and seven years ago superintendent of the Chelsea division. One of Capt. Grover's early associates in the company was Mr. E. C. Foster, now president and general manager of the New Orleans Company. Capt. Grover's successor is Mr. George H. Gray, who was superintendent of the Woburn division of the company and formerly was foreman of the Broadway car house of the company.

MR. P. J. MITTEN, who has been superintendent of overhead lines for the Milwaukee Electric Railway & Light Company for the past nine and one-half years, became superintendent of motive power of the Indiana Union Traction Company, with offices at Anderson, Ind., on Sept. 1. Previous to his experience at Milwaukee, Mr. Mitten was with the Denver Tramway Company for four years. Just before leaving Milwaukee he completed a line car with independent gasoline motor, which had a number of novel features. The evening of Aug. 29 he was presented with a fine gold watch by the employees of his department.

MR. GUTHRIE GRAY, of the National Battery Company, of Buffalo, died at Muskoka Lake, on Aug. 26, at the age of thirty-one years. Mr. Gray was graduated from the Lawrence Scientific School of Harvard University in the class of 1896. After his graduation, he was for a number of years employed in the engineering department of the Buffalo General Electric Company, whose employ he left to accept a position under Mr. Henry Rustin, the superintending engineer in charge of the extensive lighting systems of the Pan American and the St. Louis expositions. For the past two years Mr. Gray has been employed in the engineering department of the National Battery Company, of Buffalo, N. Y.

MR. WILLIAM RANDOLPH STRICKLAND has resigned from the New York Central Railroad and is now associated with J. G. White & Company, of New York, as assistant to the secretary. Mr. Strickland is a graduate of the Massachusetts Institute of Technology, and during the Spanish War served at the Mare Island Navy Yard as assistant engineer. After the war Mr. Strickland was employed by the Blake Pump Company and Buckeye Engine Company as draftsman, and also in designing special electric cranes and controllers for the Case Manufacturing Company in the capacity of assistant and also as chief engineer. Mr. Strickland made the hydraulic calculations for the North Fork power house scheme at Denver, Col., in 1900. After he had completed this work he joined the staff of the Colorado Fuel & Iron Company as engineer of location on a standard gage line over M'Clure Pass. He also located several electric and narrow gage steam lines in Colorado. In 1902 Mr. Strickland was appointed designing engineer for the Lannius Machine Company, and in that capacity laid out its combined amalgamator, concentrator and arrestor. In 1903 he was appointed location engineer on the New York Central Railroad and supervised the extension from Cherry Tree to Possum Glory, as well as several of the double tracking and grade revision schemes. For the past year Mr. Strickland has been assistant engineer in the maintenance of way department, handling correspondence from all divisions in regard to the repair and construction of bridges and buildings.

MR. ARTHUR N. DUTTON has been promoted from assistant superintendent of elevated lines of the Brooklyn Rapid Transit Company to the position of assistant to the general manager, succeeding Mr. Geo. R. Folds, who recently went to the South Chicago City Railway as general manager. Mr. Dutton's duties in the new capacity will not for the present, however, embrace the wide scope of those of Mr. Folds, but will be confined more to that of personal representative of General Manager Calderwood. Mr. Dutton is 32 years of age, a native of Milwaukee, Wis., and has had an extensive railroad experience, a liking for which he inherited from his father, Mr. C. F. Dutton, a man well and favorably known in steam railroad circles, principally as general manager of the Milwaukee & Northern Railroad. Mr. Dutton's first business experience was obtained in the First National Bank of Milwaukee, following which, in 1896, he began active railroad work by entering the office of Mr. A. G. Wells, general superintendent of the A., T. & S. F. at Albuquerque, N. M. A year later he was placed in charge of the timber-treating plant of the company at Flag Staff, subsequent to which he was promoted to the position of chief clerk to the superintendent of the Arizona division, at Winslow. Later, in the desire for a more practical experience, he gave up the more remunerative position to become yardmaster at Seligman, following which he was promoted to assistant train despatcher at The Needles. He was in the employ of the Santa Fe during the reconstruction period of the old Atlantic & Pacific Railroad, westward from Albuquerque, during which time he gained valuable experience. In March, 1903, Mr. Dutton was secured by the Brooklyn Rapid Transit Company as general inspector of elevated lines, but three months later was appointed assistant superintendent, for which position he was eminently well fitted, and in which he has been highly commended by his superiors for his efficiency. Mr. Dutton is succeeded as assistant superintendent of elevated lines by Mr. L. V. Smith, who has formerly been general inspector for the company.

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office by 10 a. m. Monday preceding the date of publication, except the first issue of the month, for which changes of copy should be received two weeks prior to publication date. New advertisements for any issue will be accepted up to noon of Tuesday for the paper dated the following Saturday.

Of this issue of the Street Railway Journal 8000 *copies are printed. Total circulation for* 1905 *to date,* 301,750 *copies, an average of* 8158 *copies per week.*

The Accident Fakir

We have been pleased recently to notice a wholesome tendency to prosecute accident fakirs when detected, not for any manner of fraud, but for plain perjury. No one outside of the street railway business fully realizes the number of completely fraudulent claims that are yearly presented, and the falsity of the testimony used to bolster them up. Every little while a new gang is unearthed, after a long series of swindles, and now and then a ringleader gets put behind bars for obtaining money under false pretenses, conspiracy, or other suitable cause. But until lately it has been rather rare for the fakir to be prosecuted for perjury, without which he has no hope of success. A series of convictions for this offense would go further toward reducing the number of fraudulent suits than any other force which could be brought into play. There are, of course, two classes of suits by which claimants endeavor to extort money from street railway companies. One consists of cases in which a genuine injury is so magnified as to secure damages all out of proportion to the most liberal construction of recompense for injuries done; the other, of cases in which there is deliberate malingering after feigned or trivial injury, backed up by perjured evidence as to the facts. The really dangerous gangs depend, of course, upon the latter procedure, which involves no real personal risk. The perjury can then be adjusted to the scope of the damages claimed.

The former class of damage suits are annoying and costly enough, but most of them can be, and usually are, forestalled by tactful and liberal treatment on the part of the claims department. The latter, however, involve dealing with criminals, and it becomes almost a public duty not to compromise, but to fight them. A shrewd claim agent can very often discriminate between the two types, but now and then even the most astute will be temporarily deceived. Our readers will remember many instances of fraud, some of them of a most sensational character. A very serious feature of the situation is that, while many cases of slight and afterwards exaggerated hurts fall into the hands of the ambulance-chasing lawyer, whose motives are so notorious as to injure his chances of success, the really worst cases of fraud are likely to get into the hands of an able lawyer, who is selected for his unscrupulous methods, or of counsel both capable and reputable, before whom the fakirs rehearse glibly their tale. There are few lawyers of reputation who have not at one time or another been completely taken in by mendacious clients, and personal injury cases furnish numerous instances of this. Likewise, while the ambulance-chasing doctor is disgracefully in evidence in some minor cases, the most distinguished practitioner may be called quite innocently into utterly fraudulent suits, having to depend, as he sometimes must, on the previous history of the case for his judgment, and being furnished with entirely erroneous premises.

The only way to put a stop to this sort of fraud is to follow up remorselessly every instance of perjury. No such case can be won by the claimant without pretty promiscuous lying upon the witness stand; and whenever there is good reason to suspect it, it ought to be pursued rigorously. It is not enough to defeat the attempt at fraud; that may be the simplest thing to do, but it is not justice to the public nor to the courts. Perjury has gone unpunished so long and so often that it has become an

open scandal in our legal procedure. It would be going too far to say that the average witness has little regard for the sanctity of an oath, but it is rare to hear a case through without the conviction that one witness at least has, while upon the stand, consciously perverted the truth. In personal injury cases, perjury may not be entirely on the side of the plaintiff, for now and then an employee may swear falsely to free himself from personal blame. But if our courts are to stand for even-handed justice, as they should, perjury must be punished; and it is for the ultimate interest of everybody that it should be. To let a fraudulent case go by after merely a defeat is not enough; in fact it is giving aid to crime. If all parties would unite in bringing perjury to prompt punishment, the tone of the courts would be greatly raised. Aside from the matter of public duty, a criminal convicted of perjury is pretty much out of the running, so far as further fraud upon railway companies is concerned, and this gain of itself is worth the effort. Put up every instance of perjury before the Grand Jury and let the law take its course. You can count on the active co-operation of the judiciary before whose very eyes the scandal of false testimony yearly grows, and you can count on the sympathy of every decent citizen who believes in the proper administration of justice and the punishment of crime.

The Chicago City Railway Car

It is seldom that as much careful attention is given to all the details of the construction of a car, as far as these details affect operation and public comfort, as was devoted to the design of the new standard car of the Chicago City Railway Company, regarding which an extended article will be found elsewhere in these columns. The new car is not an attempt to introduce any radical features of car construction, but to perfect the semi-convertible type. Although there is nothing radical or experimental in the design of the car, there are a number of new features which, taken altogether, make the car very much worth considering. While it is of the semi-convertible type which carries its windows with it at all times, the design is such as to make it very open in the summer and easy to heat in winter. For example, the ends are capable of being thrown open by virtue of certain improvements in design. On the other hand, for winter use, storm sash are to be used, which indicate that the management of the company is fully aware of the great difficulties of heating cars in a city like Chicago, where both front and rear doors are open at almost every stop. It is also gratifying to note that the company has not, as is too frequently the case, attempted to save money on electric heater equipment by purchasing a few heaters with comparatively small radiating surface, and expecting them to heat a car under the most trying conditions that exist anywhere in the United States. As our readers are aware, we have repeatedly urged the provision of plenty of radiating surface when electric heaters are used, for the reason that it is almost impossible to get the results desired with a few heaters run at high temperature.

One novel feature of the car, which solves several problems at the same time, is the ingenious sliding step. The motorman can, by a single turn of the handle, withdraw a step from one side of the platform and lock one in position on the other side. The operation can be quickly performed in changing ends at the end of a route, and does away with many complications with doors and gates for covering the space usually left between the door and the step. This space has always been troublesome, because if vestibule doors are made even with the outer step, a trap door over the step must be provided, and even then there is a chance for boys and irresponsible persons to attempt to ride by getting a foothold on this step. If the vestibule doors are made to close even with the edge of the platform it is practically certain that some one will attempt to steal a ride on the step outside the door. The sliding step solves this whole problem at once without introducing apparatus which takes too much time to operate at a crowded stub terminal, out of which cars must be operated every 10 to 20 seconds.

As a city car, the inside dimensions are notable as providing unusual width of aisle and much more knee room between seats than is common on city cars. In deciding on the width of car, the management evidently considered that it was better to make one bite of the cherry than to make two bites and make a mess of it. Since the distance between the tracks in Chicago is such that, with the present cross-seat cars now in use there, persons cannot stand on the devil strip between cars without being crushed and rolled to death, it was wisely considered that the cars might as well be made wide enough to take full advantage of the distance between track centers, thus giving a car with wide aisles. There is less likelihood that persons will attempt to stand between cars with very small clearance between them than between cars with 10 ins. or 12 ins. clearance. This is a point that it is well to remember whenever increase in the width of cars in use on a road is being considered. Either the space between cars should be kept so that persons can safely stand between them or the other extreme should be adopted.

The electric lighting of these cars is to be commended from an illuminating engineering standpoint. The use of frosted bulb lamps throughout avoids the blinding glare of bare lamp filaments, which is painful in a long car plentifully supplied with lamps. Although the frosted bulbs absorb in the neighborhood of 12 per cent of the light, the car is for all practical purposes better illuminated with them than if the bulbs were of clear glass. The object of illumination is to enable us to "see things," and this is always best accomplished when a blinding glare, which causes the eye automatically to shut out part of the light, is eliminated.

The car wiring is in iron pipe conduit, and in view of the fact that this is probably the forerunner of much work of this kind on surface cars the next few years, the plans by which this work was carried out are of much practical interest just now. The introduction of kick coils in the auxiliary circuits for lighting, heating and compressor motor, as well as in the main motor circuits, is an innovation, the results of which will be watched with interest. There is apparently no good reason why the apparatus on these auxiliary circuits should be sacrificed to lightning unless it is on the principle that if the lightning is going to puncture somewhere it had better take the least expensive and important apparatus. It appears only logical, however, to offer the lightning every inducement possible to take the lightning arrester rather than any of the apparatus on on the car, even if this apparatus is of minor importance.

Another feature of the car wiring of much interest is the use of a new type of connection box for connecting the motor leads to the controller cables. Connection boxes are not by any means a new feature, as those who have been in the electric railway business long enough can well remember the connection boxes used with some of the earliest equipments. The use of connection boxes was abandoned in the early days, because the possibilities of poor contact and poor insulation in

a connection box were thought to be greater than the evils of joints made with connectors and covered with tape or hose. After disappearing for a number of years, the connection box has now come back to us in a new and much improved form, in response to a decided demand on the part of master mechanics for some arrangement which will make it possible easily and quickly to disconnect motor leads from the controller wiring without going through the process of removing the insulation from and disconnecting joints of any kind. It is to be hoped that the present connection box is as far ahead of the old-fashioned ones as the present motor equipments are ahead of the motors that were used in the days of the old connection boxes. There is good reason to suppose that they are, and we hope that they have solved a troublesome problem.

In connection with the type of motor selected, the point of most interest is that the motor is one which opens from below. Much has been said against pit work the past few years, and while it is undoubtedly desirable to do away with it as far as possible, the Chicago City Railway management evidently does not consider it possible to do away with it entirely. The ease with which armatures and fields can be replaced in any car house where there are pits, without taking the car several miles to the general repair shop, decided the question in favor of motors opening from below. At the same time, when cars are brought into the general repair shop for overhauling, the crane facilities there make it possible to lift the motors out of the truck quickly and easily and turn them over for opening up when general overhauling is in progress.

Enlarging the Membership of the A. S. R. A.

At its annual convention in Philadelphia we believe that it would be advisable for the members of the American Street Railway Association to consider the plan of enlarging the qualifications for active members in the association so as to include others than operating street railway companies, which at present are alone eligible for membership. Such a restriction was perfectly proper at the period at which the association was established. At that time the financial interests in the street railway industry, as well as practically all the knowledge and experience extant in street railroading, were confined to the operating officials, who usually included the largest stockholders in their respective companies. This condition is gradually changing and is certain to undergo a still greater evolution. The operating officials are no longer the only ones vitally interested in the street railways of the country, nor are they working alone toward their improvement or development. At least three great classes of outside interests participate with the operating companies in knowledge of the art, contributions toward its advancement and influence in practically all that affects its future welfare. Their inclusion into the membership would not only strengthen the association but in other ways would be decidedly beneficial.

The first of these factors to which we refer is the financial interests, which are represented by the bankers. We feel confident that if a great many of these banking firms were eligible for active membership, they would take advantage of the opportunity. They would not only derive a great deal of benefit from attending the meetings, but would also be valuable additions to the association. Their presence would in part tend to direct a portion of the papers and discussion in the direction of financial questions and broad matters of policy which are now among the most important of those which confront street railway companies, while, conversely, their representatives would derive considerable benefit from the discussions on practical operation in which they are not so well versed. From a personal standpoint also they would find it of benefit to become personally acquainted with the practical operators of the street railway systems of the country, as the latter are the men who will have to operate the roads which the bankers buy; while the operators will enjoy the equal advantage of meeting the men whose financial enterprises constantly require the engagement of good men in their conduct.

Of equal value as active members in the association are those large engineering firms which have given especial attention to electric railway work, and which are essentially a product of the last ten years. In horse railway days, and even in 1892, there were no firms of this kind of such importance and influence as would warrant any great effort on the part of the association to include them in its membership. At present, however, the facilities which these concerns have for the scientific investigation of electric railway problems, both technical and financial, their large corps of trained assistants who have been taken mainly from active railroading, and their opportunities for deriving knowledge and experience from diverse properties all over the world, would make them exceedingly valuable members of a national association. To many of these firms now is already committed the management of electric railway properties, while others devote themselves purely to the engineering side of the industry. We believe that many of these firms would welcome the opportunity of becoming members of the association.

The third class of firms to which we have particular reference as desirable for membership are the manufacturing corporations. There has been a sentiment in the past against the admission of these companies to any closer connection with the association than that which is provided for by their membership in the Manufacturers' Association. There are many reasons, however, why the representatives of manufacturing companies who attend the conventions should be given the same privileges of the floor as active operating officials. Electric railway engineeing is so broad a subject at present that those whose attention is being devoted to operation cannot, and should not, be expected to have the same knowledge of the fine points in the construction and design of apparatus as those who make a specialty of this work, and we believe that if the experts in charge of important manufacturing interests should be permitted and encouraged to participate in the technical discussions, it would greatly assist in elucidating many of the problems which are now engaging and will engage the attention of the electric railway managers. These gentlemen have in the past been called upon by the association in many cases to present papers, and if they have been admitted to the meeting in this way, there seems no reason why they should not be given the privilege of joining the association as active members.

In other words, is it not worth while considering whether in enlarging the scope of the association it would not be advisable to so broaden it as to make an active working organization of all the interests which are devoting their energies to developing and improving the industry? Street railway companies, bankers, engineering firms, manufacturing firms, technical publishers, consulting engineers, are all working for the same end, and a union of all of these interests would necessarily be stronger and productive of more good than one confined to a single class of workers only.

NEW STANDARD CARS OF THE CHICAGO CITY RAILWAY COMPANY

In the 200 cars purchased by the Chicago City Railway Company this year, a number of new features have been incorporated. These features were decided upon after considerable thought and investigation by the president, general manager and other officers of the company, in which they were ably assisted by Ford, Bacon & Davis, consulting engineers, as well as by suggestions of President Goodrich, of Minneapolis and St. Paul; President Roach, of the Chicago Union Traction Company, and other prominent railway officials. An enumeration of them, with the reasons why they were adopted, and a general description of the car, are therefore of interest.

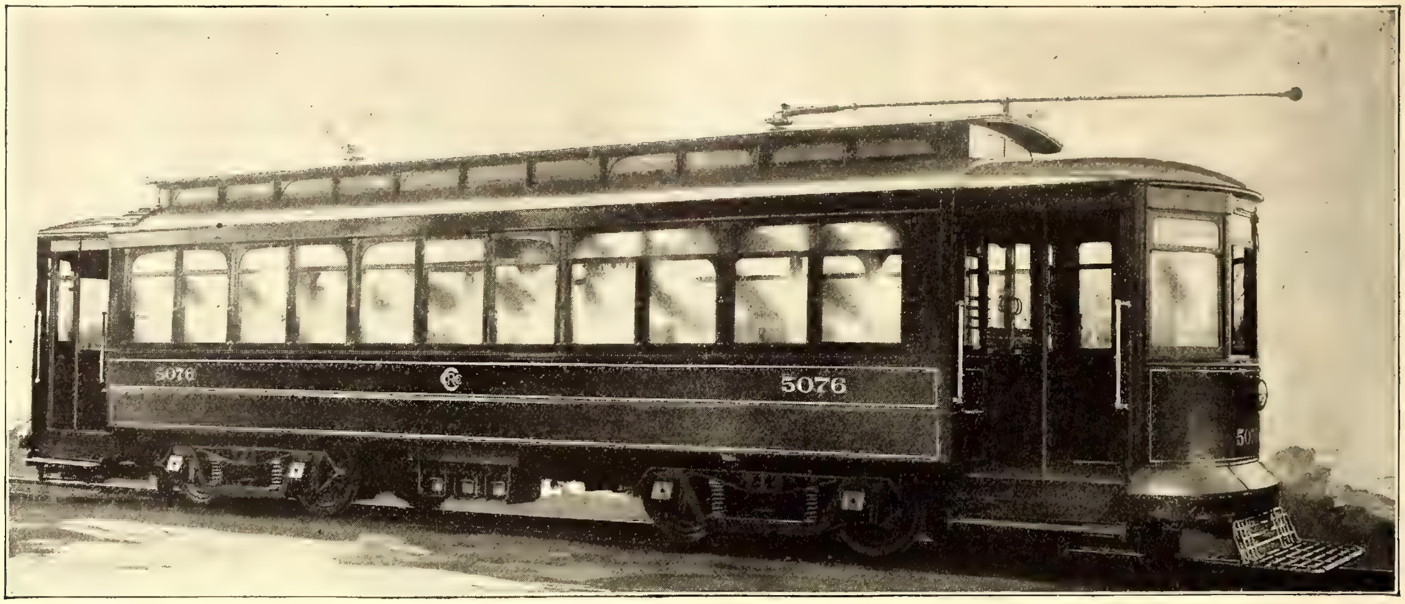


FIG. 1.—EXTERIOR OF CAR AS ARRANGED FOR WINTER SERVICE

TYPE OF CAR

The climate of Chicago is such that the period of time during which an open car (unprotected by windows) can be used satisfactorily during all hours of service is usually confined to the months of July and August, and even during this period cold rain storms, driving in from the lake, make riding in cars of this type at times quite uncomfortable. During the months of June and September there are many warm days, although usually the nights are so cold as to require cars used in evening service to be completely enclosed. These climatic conditions make it necessary that such cars as are used carry windows at all times. This prevents consideration of that type of car in which the windows are entirely removed during the summer months.

The car now adopted is of the general type known as the semi-convertible, which can be completely closed for winter use and made nearly open in the summer. It is believed, however, that, as designed, this car will more nearly approach the advantages of an open car in the summer, without interfering with its being changed into a comfortable winter car, than any of the semi-convertible cars heretofore used. The particular advantage of this type lies in the readiness with which it can be changed, in case of storm, from an airy open-door car to one completely enclosed, or vice versa. This change can readily be made by the train crew without inconveniencing passengers or interrupting service. Fig. 1 shows the exterior appearance of the car arranged for winter service.

FREEDOM FROM CONGESTION AT DOORS

An objection which has always been urged against a long car with cross-seats and center aisle is the slowness in loading and unloading, because of the congestion of passengers in the aisle, and especially at the ends of the car. This is avoided in the car in question by the employment of an extra wide car body, wide doors and platforms (see Fig. 2), and by the use for a distance of two windows from the door at the ends of the car, of longitudinal instead of cross-seats. This gives room for an ingoing and outgoing stream of passengers on each platform, as well as at both ends of the aisle. Thus four streams of passengers can board or leave the car at once. It is also easy for persons to pass each other anywhere in the aisle. In securing such a wide passage way, the width of the car was an important factor. A further statement of the reasons which led to the selection of an extra wide car body will be found later in this description.

FIG. 2.—INTERIOR OF CAR AS ARRANGED FOR WINTER SERVICE

STORM SASH

The car, as equipped for winter use in Fig. 1, has, in addition to the ordinary windows, a set of storm sash which are held in place by the same clamping device which holds a wire netting in summer to prevent passengers from sticking arms and heads out of windows. This is believed to be the first city car in the United States in the latitude of Chicago to be equipped with storm sash for winter. Such storm sash have been used with great success in Minneapolis and St. Paul, where extreme cold weather makes the heating of cars difficult. These storm sash,

together with an unusual number of electric heaters, render possible the maintenance of a comfortable temperature in the cars, even during the coldest weather experienced in Chicago.

HEATING

On account of the great number of stops per mile in service and the opening of doors at both ends of the car, necessitated by the heavy traffic, the heating of Chicago cars requires more than ordinary provisions and, in fact, is probably the most difficult heating proposition to be found in the United States. Electric heaters are located along the truss plank the entire length of the car occupied by cross-seats, and panel heaters are placed under the longitudinal seats at the ends of the car. There are twelve truss-plank heaters and eight panel heaters, all of the double-coil type, made by the Consolidated Car Heating Company. These heaters give three grades of heat. On the first point of the heater switch the smaller coils in each heater are in circuit, giving a very mild heat. On the second point the small coils are cut out and the large coil in each heater is put in circuit. On the third point, both large and small coils are in circuit in parallel, to give maximum heat. The current consumption of these heaters on 500 volts is as follows: First point, 7 amps.; second point, 12 amps; third point, 19 amps.

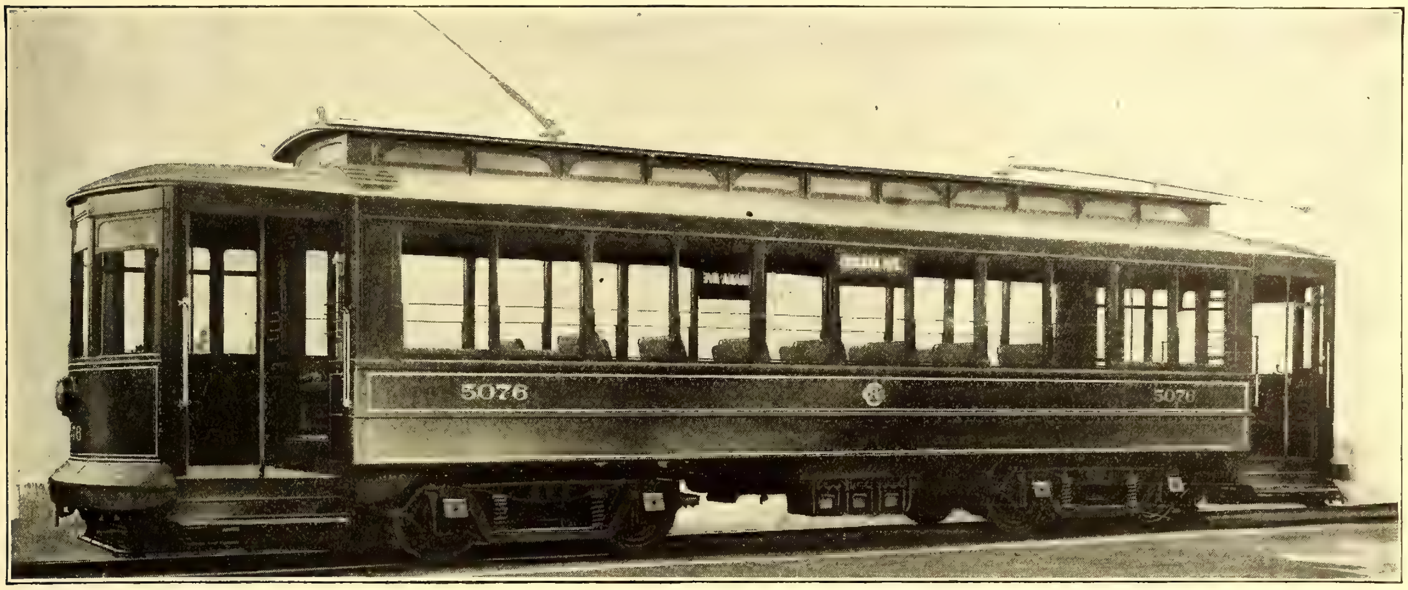


FIG. 3.—EXTERIOR OF CAR AS ARRANGED FOR SUMMER SERVICE

FIG. 4.—INTERIOR OF CAR AS ARRANGED FOR SUMMER SERVICE

It is a common mistake, in purchasing electric heater equipment for a car, to provide an insufficient number of heaters, thus giving too small radiating surface. This makes it necessary to work the heaters at a high temperature, which is detrimental to the life of the heater coils and does not produce as good results in heating the car as a larger number of heaters at lower temperature. The latter have a large radiating surface and distribute the heat well through the car instead of concentrating it at a few points under the seats, where it causes discomfort to passengers who happen to be sitting over the heaters. The manufacturer of the heaters guarantees that with this equipment a temperature of 50 degs. will be maintained inside the car in the coldest weather.

As some roads operating large cars have been using hot-water heaters, careful consideration was given to the question of hot water versus electric heaters. By providing a sufficient capacity of electric heaters, the company considered that the heating could be accomplished at least as satisfactorily with them as with hot water, so that the question was reduced to one of cost, cleanliness and convenience.

The estimates of the company were favorable to electric heaters as to cost of operation.

There were also other considerations which the company thought favorable to the electric heater, namely, the room taken up by the hot-water heater, the dirt and ashes connected therewith, the handling of ashes, the possibility of freezing, attention required by the conductor and the possibility of additional insurance on both cars and car houses.

SPRING AND FALL USE

For spring and fall use the storm sash are removed and wire netting guards placed along the windows. The windows can then be opened or closed according to the weather. The lower window sash drop into pockets in the side of the car, while the upper sash are raised into the roof pockets. By having only one sash drop, a saving of about 3 ins. is made in the available inside width of the car and at the same time the roof pockets need not be made unusually large. When the windows are closed, the covers of the pockets into which the sash drop cannot be raised by passengers, as there is a stop which prevents their being opened until the window has been raised out of its seat preparatory to lowering it into the pocket. This is to prevent passengers from raising the covers or flaps and using the window pockets as cuspidors.

SUMMER USE

For summer use (see Figs. 3 and 4), the car is made to approach more nearly an open car by removing the end doors and dropping the end windows. The doors slide between a drop sash which is outside the door and an inner sash, which is clamped on after the manner of a storm sash, and acts as a guard for the door, so that passengers cannot stick their fingers in the door pockets.

ENDS OPEN

The door being removed in the summer, this inner protecting sash can be removed also, thus doing away with the closed end, which has always been a disagreeable feature of the semi-convertible car, as it has a tendency to make a car seem close. In case of a storm the end windows can be raised to afford protection to passengers in the ends of car.

It is frequently the case in the operation of the semi-convertible car in summer that the motorman, in order to protect himself from draught, will close the car doors behind him, thus shutting off the circulation of air through the car, making a dead pocket in the end. By the removal of the doors, as explained, the motorman can have the vestibule window closed in front of him and yet a good circulation of air can be obtained through the side vestibule windows and the open end windows and doorways. The motorman's window has stops, so that he may put it at a height most comfortable for him.

VESTIBULE DOORS

The vestibule doors fold up against the front of the vestibule when open. When closed, a heavy horizontal bar serves the triple purpose of locking the doors, forming a solid support to keep them from rattling, and acting as a rail against which passengers so disposed can lean without danger to themselves or disturbing the doors. The horizontal bar pivots near its center on one of the vestibule doors, so that it is swung into a vertical position when the doors are to be opened. A guide is provided at the top of the doors so that they will fold themselves into proper position against the front of the vestibule without any attention on the part of the operator.

FIG. 5.—EXTERIOR OF CAR ON BLIND SIDE, SHOWING ABSENCE OF FOOTHOLDS FOR PASSENGERS

DISAPPEARING STEP

One of the novel and important features of the platform is the sliding, disappearing step arrangement, the invention of D. A. Faut, master mechanic of the company. The steps are mounted a fixed distance apart on guides under the platform. When the step on one side is out for use, the other one is under the car (see Fig. 9). The changing of the step from one side to the other is very quickly and easily accomplished at the end of the run by turning a shaft located beside the brake valve inside the vestibule, the controller handle being used for that purpose. By a half-turn of this shaft the steps are slid over and automatically locked in position. The adoption of this sliding step is but one of the several precautions which have been taken to render the car absolutely "hitch-on proof," and do away with the evil which is quite prevalent in Chicago of boys, and even supposedly responsible persons, riding on dangerous places that were never intended to be so used. The disappearing step also simplifies the question of providing a vestibule door which shall close the left-hand side of the platform without leaving a space over the step. The step is extra wide, being 11½ ins. with carborundum tread, so that passengers may obtain a firm and full length foothold when entering or leaving the car.

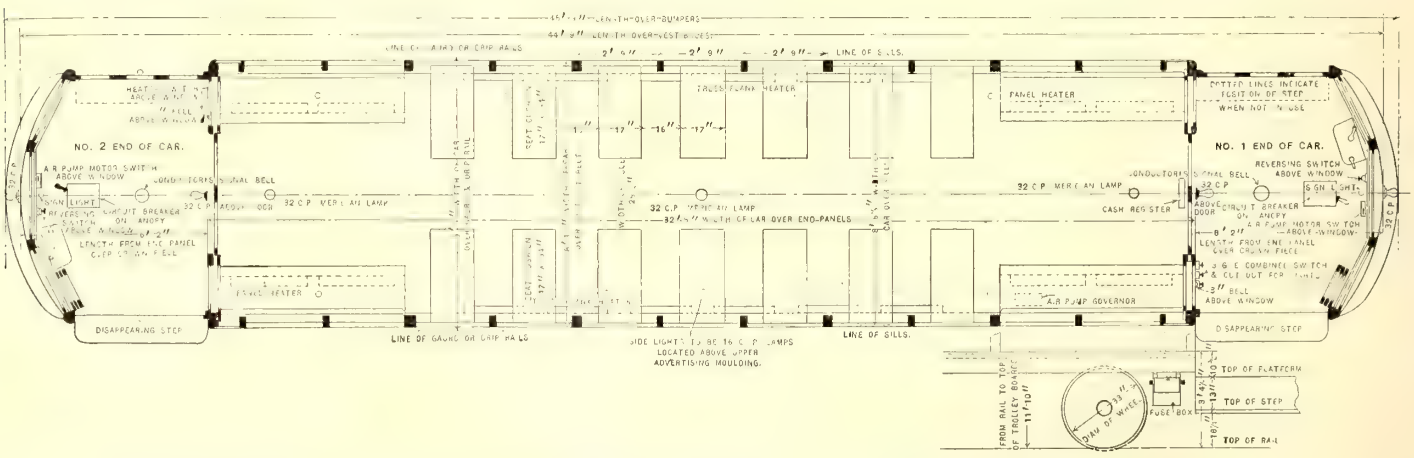


FIG. 6.—PLAN OF CAR, SHOWING DIMENSIONS AND LOCATIONS OF SEATS, HEATERS, SWITCHES, ETC.

BUMPERS

Sheet steel strips, or fillers, have been placed at an angle of 45 degs. above the bumpers (see Fig. 7) to prevent persons obtaining a foothold and riding thereon. This plan of covering the bumpers has been satisfactorily used by the International Railway Company in Buffalo, N. Y., where it was first suggested by its superintendent of transportation, C. A. Coons. On the whole length of the car on the "blind side," which comes next to the devil strip (see Fig. 5), there is no opportunity for "hitching on," the vestibule doors being closed and the steps withdrawn.

WINDOWS AND SIGNS

The windows have been so arranged that there is one window opposite each cross-seat. The top sash, having quarter oval panes, give the general appearance of a Pullman parlor car, except the middle window, where the top sash is occupied by a changeable destination sign, illuminated by the lights from the interior of the car. Fig. 1 makes this window arrangement apparent.

Besides the sign in the top of the middle window there is a similar illuminated sign in both front and rear vestibule windows, each supplied with lights placed directly back of the sign in a box provided for that purpose.

DIMENSIONS AND SEATING CAPACITY

Fig. 6 shows the general arrangement and dimensions of the car, which seats forty-four passengers, being eight less than the largest car previously purchased by the company. Part of this difference is caused by the shortening of the car body, and part by allowing more knee room between the cross-seats, so that the passenger next the aisle need not rise to let his neighbor get out. The cross-seats are 33 ins. center to center, instead of the usual 30 ins. Fifteen inches is allowed between the seat cushions. The aisle is of unusual width, 28 ins. The seats are also wider than ordinary, being 34 ins. in width. The dimensions of the car are: Length of body over end panels 32 ft. 5 ins. Length over all 45 ft. 9 ins. The width inside is 8 ft.. 2½ ins., and outside over all 9 ft. There are seven cross-seats on each side of the car and longitudinal seats in each corner, with ample room for four persons.

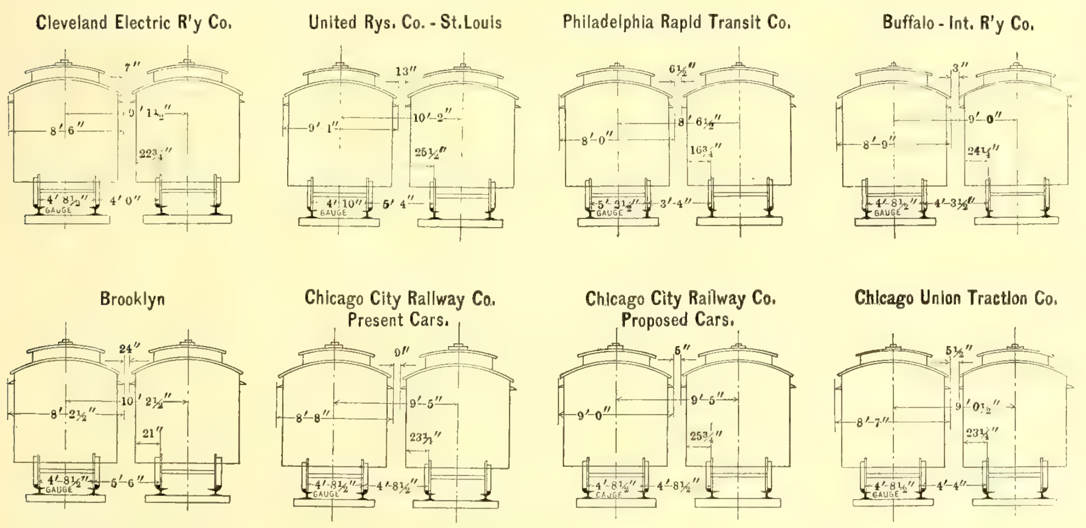


FIG. 8.—CONVENTIONAL DRAWING, SHOWING DIMENSIONS OF CARS AND CLEARANCES ON DIFFERENT ROADS

INVESTIGATION ON CAR DIMENSIONS

The dimensions of the car, especially the width, were matters of special consideration. In deciding upon this, the rolling stock of a number of the principal street railway systems of the country was investigated. The drawing (see Fig. 8) shows the dimensions of cross sections of the car bodies and the distance between tracks, with the eight representative types of cars investigated.

REASONS FOR HEIGHT AND WIDTH ADOPTED

The height of the car was determined by the subways through which it must operate. As to the width, it appeared desirable either to make the cars narrow enough so that a person could stand safely between cars when passing on a street, or to make them wide enough to get the full benefit of the space available between tracks and leave no possible question as to whether there would be room for a person to stand between cars. With a distance between cars of 11 ins. or 12 ins., there is greater likelihood that persons will attempt to stand between cars and be rolled or crushed to death than if there were but little clearance. This has been demonstrated in Chicago. As the car would necessarily have to be reduced to at least 7½ ft. in width to make it possible for persons to stand safely between cars, the impracticability of following out this plan was at once seen, and the other alternative was adopted. The width decided upon for the new cars was 9 ft. over all, leaving a 5-in. clearance when passing, as shown on the accompanying drawing, Fig. 8.

FIG. 7.—END VIEW OF CAR

VENTILATING

The car is ventilated by twenty-two transoms, in pairs, with half-oval sash corresponding to the half-oval top sash of the windows. Each pair of transoms is opened by means of a worm gear, which makes it possible to close the transom very tightly, or to leave it open at any desired angle. The transoms are fitted with wired glass, which reduces the possibility of

broken glass falling on passengers, and adds to the artistic effect. Rubber cushions and stops are used here and elsewhere to make the cars as noiseless as possible.

STEEL SHEATHING

The sides of the car have been given a slight curve, and present a graceful appearance. The sheathing, or side panels,

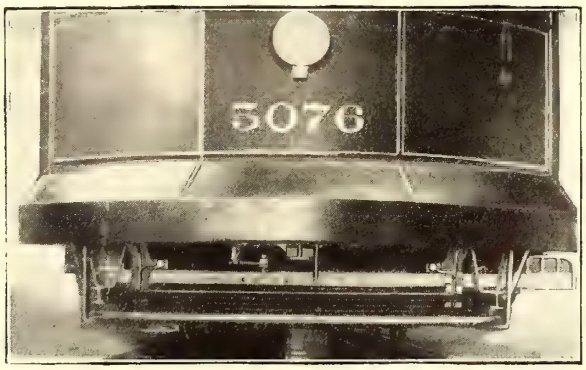


FIG. 9.—DISAPPEARING STEP (TAKEN FROM CAR-HOUSE PIT)

are of standard size sheet steel, thus making repairing easy. A rail at the bottom of the panel is so placed as to receive blows which would otherwise scratch the panel.

COLOR AND TRIMMINGS

The cars are painted dark green, the color scheme being that of the Chicago Union Traction Company. The trimmings are in orange, with the roof in light buff. As seen in the photograph, the trimmings are very plain, and the only lettering is the monogram of the company on the middle side panel and the number of the car on each end panel and on the dash boards. A simple aluminum stripe is all the decoration on the side of the car aside from the monogram and two car numbers mentioned.

SIMPLICITY OF INTERIOR FINISH

The interior woodwork of the car is cherry, the lower part of the woodwork up to the lower ventilator rail being rubbed to

simple seat pedestal selected, so that little obstruction would be presented to the cleaning of the car floor. In fact, the whole interior, including the windows, is of a character easily cleaned and least likely to collect dirt.

The hardware is of extra heavy oxidized brass, which it is believed will present a good appearance for long wear.

SEATS

The seats are rattan, the cross-seats being of the reversible type. A corner of the back of each seat next to the aisle has been cut away for a grab handle.

No straps for passengers have been provided, for the reason that when the car is crowded, it is not desirable to have pas-

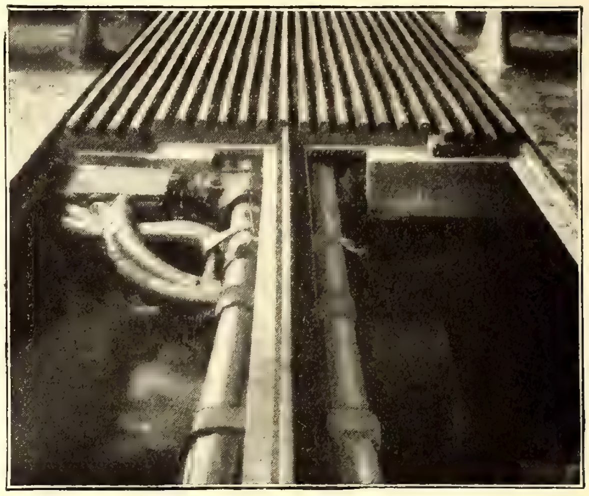


FIG. 10.—CONDUITS, JUNCTION BOX AND MOTOR LEADS

sengers stand near the ends and so obstruct the passage way. By standing in the middle they can obtain a support from the grab handles aforementioned. Furthermore, it will be the attempt of the company to keep the standing loads as low as possible by operating plenty of cars.

LIGHTING

Abundant provision has been made for artificial lighting.

GENERAL CAR WIRING.

2-K28 B Controllers; 4 Motors.

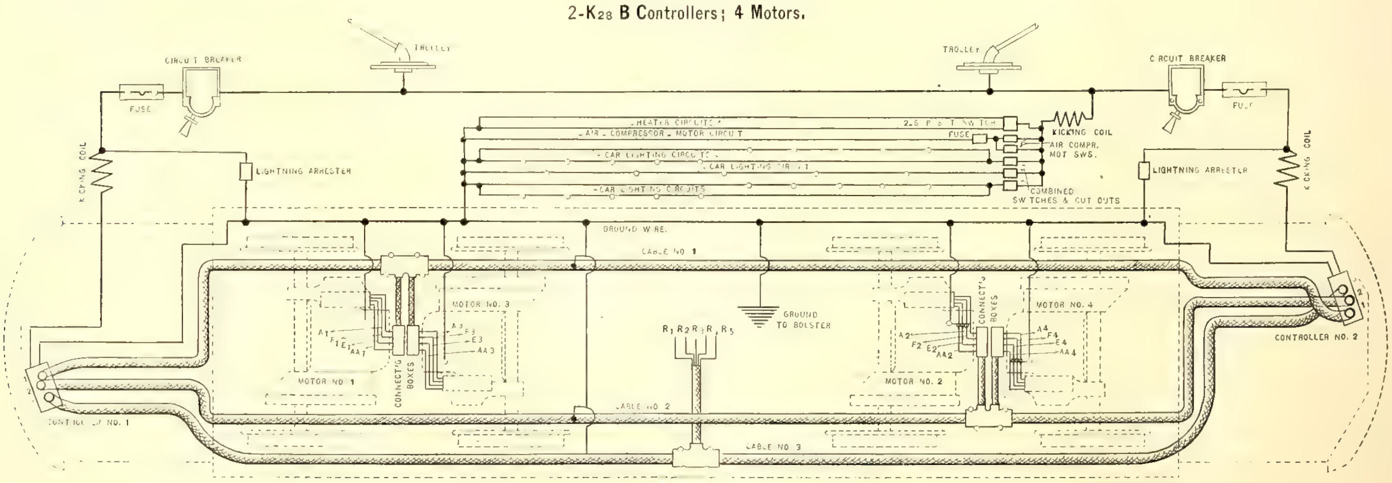


FIG. 11.—GENERAL CAR WIRING SCHEME

a dull finish, and the upper portion being left in a bright finish. In the interior design no attempt at elaborate ornamentation has been made, but, on the contrary, it shows throughout a careful deference to simplicity, harmony and dignity, in accordance with the present tendency of car building to finish a car in a manner which will look well for many years and will permit of few corners for the collection of dust. Such an interior can be kept in a presentable condition and wears well in the public eye. As can be seen in Figs. 2 and 4, all obstructions under the seats have been eliminated, and a very

Along each side, over the seats, is a row of nine 16-cp frosted lamps. Frosted bulbs were adopted partly on account of their more artistic appearance, but mainly because of the superior soft, diffused light obtained from them. The glare of the bare filaments on a row of incandescent lamps placed as these are produces a blinding effect, and makes reading in the car much more difficult than with the diffused light from the frosted lamp. Furthermore, the advertisements in the racks can be read past a frosted lamp much more readily than past a bare lamp, because of the blinding effect described. The rows of seat

lights are in circuit with the two lights used for illuminating the end signs. Three 120-watt, 32-cp Meridian lamps are placed in the ceiling, and are wired in series with a 32-cp headlight lamp and a rear platform light. Fig. 13 shows the car lighting circuits. All heat, light and compressor-motor switches and cut-outs are plainly labeled, so that the conductor and motorman do not have to experiment to learn which circuit a switch controls.

already in use on the Wentworth Avenue cars of the company, which are showing little evidence of wear after four years of extremely hard service. The truck frames, equalizers, bolsters and motor suspensions are of forged steel, all parts being machine fitted.

AXLES

A larger axle has been used than on previous cars, the dimensions now being as shown in Fig. 15, viz.: 4½ ins. at journal

CAR AIR-COMPRESSOR-MOTOR and HEATING CIRCUITS.

1 Air-Compressor with Motor and 20 Double-Heaters.

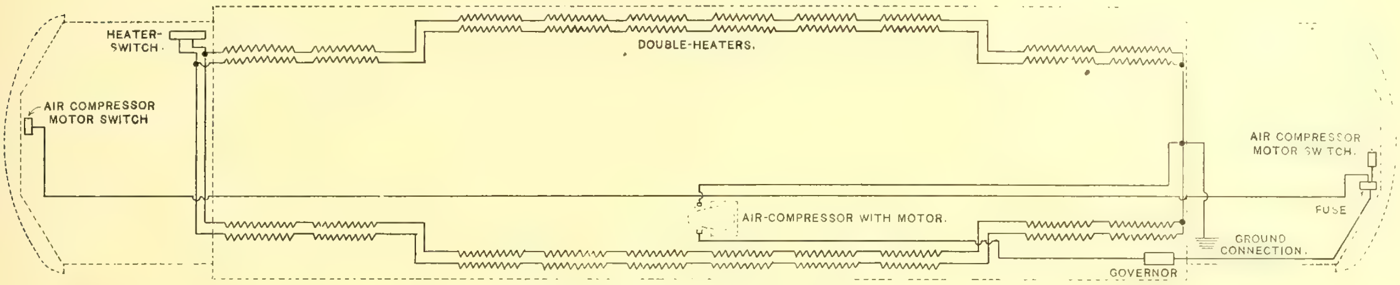


FIG. 12.—AIR COMPRESSOR AND HEATING CIRCUITS

HEADLIGHTS

The headlights have white enameled iron parabolic reflectors and bullseye glasses, mounted in a cast iron case. These headlights are believed to be as nearly indestructible as anything of the kind can be made, and project but 4 ins. beyond the line of the front vestibule.

COMPANY ANNOUNCEMENTS

Any announcements which the company may wish to make to passengers are placed in a space reserved for them in a quarter-oval frame over each end window.

REGISTERS

The International type of fare register is used. Register rods have been abandoned as being difficult to maintain in a

boxes, 5½ ins. at the wheel fit and gear, and 5 ins. at the motor bearings. A 500-lb., double-plate, 33-in. chilled cast-iron wheel is used, with ⅝-in. flange and 2 1-3-in. tread.

FENDERS

The fenders are of the Chicago Union Traction Company pattern, and are shown in Fig. 7. The upper part of the fender, which, when extended, is locked in position by the coupler, folds down on the lower part, and the whole slides back under the car when not in use. These fenders are carried at a fixed height above the track. As an additional protection, V-shaped fenders are placed in front of the wheels back of the regular fender. Attached to this V-shaped wheel fender are scrapers, which are operated from the platform, and are ar-

CAR LIGHTING CIRCUITS.

20-16 C. P. Lights and 7-32 C. P. Lights

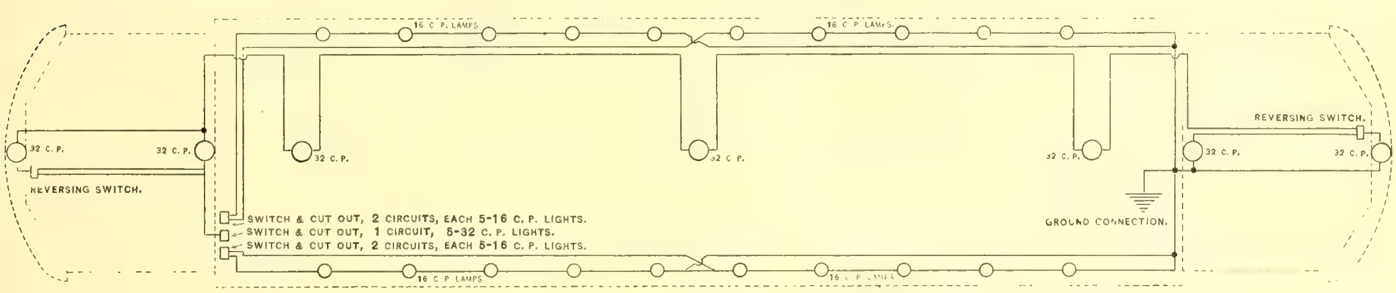


FIG. 13.—CAR-LIGHTING CIRCUITS

long car. In their place two cords are used, one on each side of the car. These cords are supported on pulleys carried in suitable brackets.

SIGNAL BELLS

Only one bell rope is used. It is hung from the center of the ceiling, and is for the use of the conductor only. Passengers signal the conductor by means of an electric bell circuit with push button at each seat.

LOCKERS

For carrying the trainmen's coats and packages, boxes have been provided under the longitudinal seats. A rack is also placed there for a broom, which is to be carried on every car, the intention being to keep all unsightly articles out of sight.

TRUCKS

The trucks are on the lines of what is commonly known as the M. C. B. passenger truck, being slightly modified from those

ranged to be dropped on the rail when necessary to clear away any obstruction, snow or dirt which may have gathered thereon.

COUPLINGS

The car has no permanent drawbar, and consequently there is nothing to interfere with the action of the fender. Instead of the usual drawbar a pocket has been provided under the bumper, into which a bar can be inserted in emergencies. This also serves as a lock for the fender when in use.

PROVISION FOR MINNEAPOLIS GATE

Provision has been made in the design of these cars for the adoption of what is known as the Minneapolis gate for the rear platform, should it seem advisable in the future. This is a gate opened and closed by the motorman, and is kept closed at all times except when the car is at a standstill. This gate has been used on the lines in Minneapolis and St. Paul for a num-

ber of years, and has effectually prevented a certain class of accidents. If such a gate should be adopted on these cars, it will be placed on the rear platform only, as it is thought that the motorman can easily watch the front platform. On a long car it is not always possible for a conductor to collect fares and see what is going on at the rear step. By the use of the Minneapolis gate on the rear platform, and a motorman's mirror, so placed that the motorman can see the rear step, the responsibility for this part of the operation can be shared by him. Furthermore, it is believed that after cars so equipped have been in operation a short time, it will have a tendency to cause those desiring to board cars to seek the front platform rather than await the opening of the gate. Those desiring to leave the car would, under such circumstances, naturally move to the rear, and thus avoid the incoming crowd. This would, it is thought, greatly facilitate the movement of the passengers on and off a car at crowded corners. This, however, is for the future. For the present, cars will be operated with front and rear platforms open on the right-hand side, as is customary in Chicago.

CAR WIRING IN CONDUITS

The car wiring has been given very careful attention by H. B. Fleming, chief engineer of the company, and is probably the finest piece of work of the kind ever put on a street railway car. It follows the practice recently adopted on a number of elevated roads of putting all wires under the car in iron pipe conduit. Fig. 11 shows the general scheme of car wiring. The motor wires between controllers are bunched into three cables. One of these cables contains the wires for motors 1 and 2, which motors are placed on one truck. The second cable contains wires for motors 3 and 4, placed on the other truck. The third cable contains wires going to the resistance grids. The compressor wiring is run in separate iron pipe conduit. The iron pipe conduit for the main cables runs along the center longitudinal sills of the car. The accompanying car wiring diagram (Fig. 11) indicates these cables and the wires leading to them, but is not intended to show the position of the conduits. Each cable conduit has all wires of different color, so there is no confusion of leads.

CONNECTION BOXES

Where the taps are taken off from the cable to the motor leads, a split cast-iron junction box containing the joints is bolted on the conduit. These taps are led to a connection box, which is an innovation in car wiring, and is intended to make it possible to quickly disconnect the motor leads without the inconvenience of disconnecting joints and removing joint insulation, as has been necessary heretofore when taking trucks from under a car. Fig. 10 shows a portion of the conduit and the connection box for motor leads. The taps from the cable are led into this connection box, where they terminate in switch jaws. Lugs soldered on to the terminals of the motor leads are made of such shape as to fit into these switch jaws, and when the lid of the connection box is fastened on they are secured firmly in place.

FUSES AND CIRCUIT BREAKERS

The controller at each end of the car is connected to the trolley lead through an automatic circuit breaker and a new type of fuse box. While the automatic circuit breaker can ordinarily be depended on, it is felt that a fuse should be provided to save the equipment when the circuit breaker sticks. This fuse box is arranged to take a copper strip fuse, the arrangement for clamping being very powerful and simple, so that the fuse requires no special terminals, being simply a length of copper ribbon.

CAR BELL CIRCUITS.
2 Batteries, 2 Bells and 24 Push-Buttons.

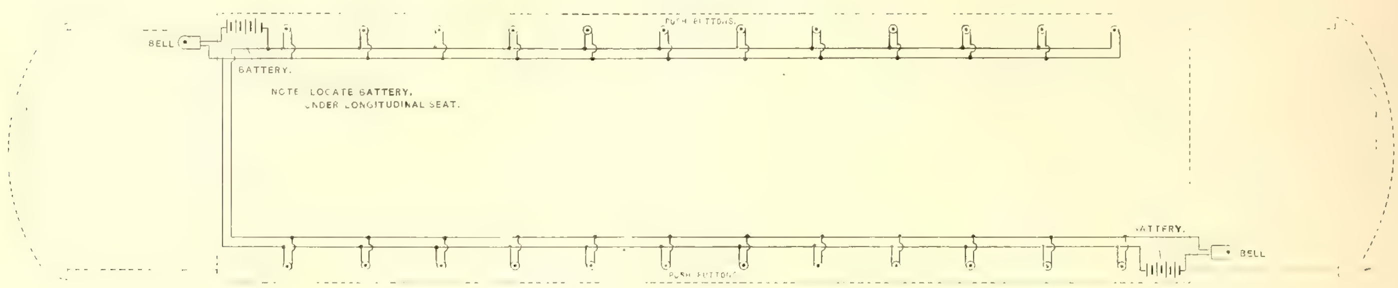


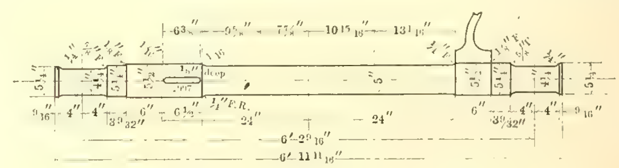
FIG. 14.—CAR-BELL CIRCUITS

AUXILIARY CIRCUITS

Figs. 12, 13 and 14 show the wiring of the lighting, heating, compressor and signal circuits. In addition to placing a kick coil in series with the main motor circuit, as is the usual practice, a kick coil has also been introduced in series with the auxiliary circuits for heating, light and air compressor motors, in order to prevent damage from lightning.

TYPE OF MOTOR

The motors are of a new type, called the GE 80, being practically of the same capacity (40 hp) as the GE 67, except that the commutator is larger and some other changes have have been made, notably an increase in the size of all bolts to a standard of 1⅛ ins. These motors open from the bottom. This is another point to which much thought was given. In view of the fact that pit work is being abandoned as far as possible by some companies, and that there has been a marked tendency in some quarters during the past few years to do all work on motors from above, the respective merits of motors that open from above and those which open from below were carefully considered. Visits were also made to some of the principal cities where motors are being handled in both ways. It was finally concluded, however, that under Chicago City Railway conditions, there were no material advantages in having a motor which would open from above and not from below, and there were some decided advantages in having it open from below. Armatures and fields can be removed and replaced through the pit at any car house without taking the car to the general repair shop if the motor opens from below. This in itself is a strong argument. On a large system, such as that of the Chicago City Railway Company, it was not considered advisable to select a type of motor which would make it necessary to take a car many miles to the general repair shops in order to remove armatures and fields. As to convenience of handling when making a general overhauling



STANDARD M. C. B. FILLETS IN ALL OFFSETS.

FIG. 15.—STANDARD AXLE

of a car equipment, it is practically as easy to lift a motor out of the trucks with the crane at the general repair shops, and turn it over, so as to get the armature out, as it would be to take it out of the trucks and remove the armature if the motor opened from above. The only difference is that the motor must be turned over by the crane, which is the work of but a few seconds.

CONTROLLERS

The K-28 controller is used. Just under the controller is a cast-iron box, in which the iron pipe conduits terminate, and through which the wires are led up to the controller by a bell mouth, but in such a way as to prevent water from the platform getting into the controller wires.

BRAKES AND SAND BOXES

Straight air brakes are used, supplied with a new type of Christensen AA-4 compressor, which has a capacity of 16 cu. ft. of free air per minute. Two air storage tanks are placed under the car. The governor for the air compressor is put under one of the longitudinal seats. In each corner of the car, under the longitudinal seat, is a sand-box with a Nichols-Lintern air sanding device. The valve for operating the air sander was devised by the company's engineers. It is placed directly above the stem of the air-brake valve, so that the motorman can operate the sander with his thumb while applying the brakes, making a very convenient arrangement. The hand brake, provided for emergencies, is the Peacock type, with which the car can be readily controlled should the air fail.

The car complete without passengers weighs 26 tons.

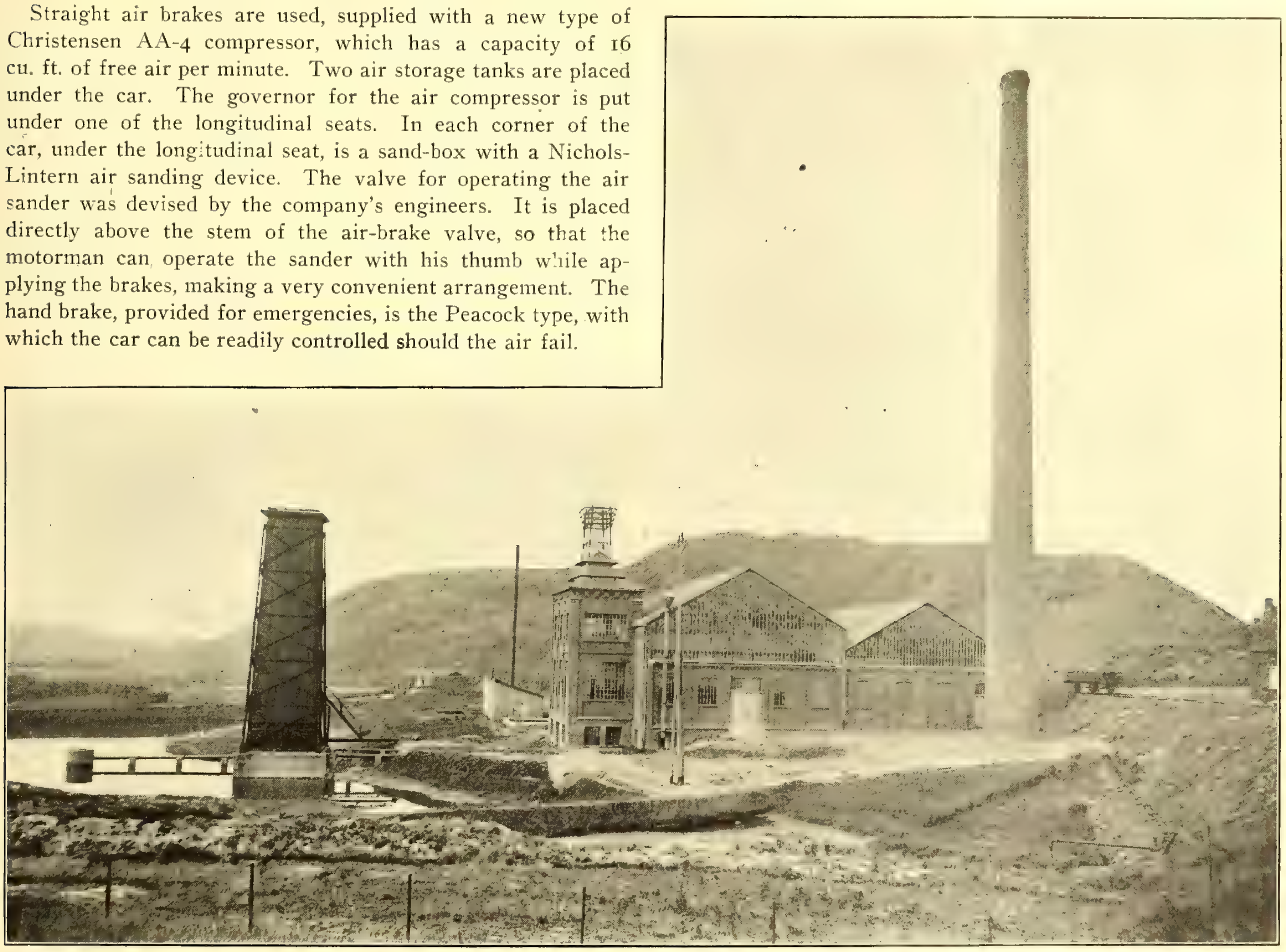
The car bodies were built at the works of the J. G. Brill Company, at Philadelphia and St. Louis, the trucks by the McGuire-Cummings Manufacturing Company, the air braking apparatus by the National Electric Company, the Peacock brake by the National Brake Company, the seats by the Hale & Kilburn Manufacturing Company, and the illuminated signs by the Hunter Illuminated Car Sign Company.

The West Penn Railways Company, of Connellsville, Pa., has adopted the Street Railway Journal as a text book at the regular meetings of its division superintendents. Some article is taken from a recent issue of the paper and used as a subject of discussion. At the last meeting the article considered in this way was that on accidents, by Dr. Rockwell, printed in the Street Railway Journal for August 5.

THE BORINAGE (BELGIUM) SINGLE-PHASE RAILWAY

Since April 6 the great Belgian coal mining district west of Mons, known as the Borinage region, has been served by the first single-phase railway in Belgium. The road is also said to be the second commercial single-phase railway in Europe. Like the other Belgian light railways, the line is owned by the Société National des Chemins de Fer Vicinaux, which is controlled by the government, and which operates over 2200 km (1320 miles) of track.

The National company has always pursued a progressive policy, and was one of the first in Europe to adopt electric traction. This has been done only on the five lines where the



THE POWER HOUSE WHICH SUPPLIES CURRENT TO THE BORINAGE SINGLE-PHASE RAILWAY, SHOWING ALSO COOLING TOWER ON THE LEFT

conditions have approached those of city operation, as direct current did not appear advisable for the lines with lighter traffic. Polyphase alternating-current traction was proposed for the Borinage line, but was not adopted. Finally, in March, 1903, the single-phase system, at that time being proposed by the Union Elektricitäts-Gesellschaft, now the Allgemeine Elektricitäts-Gesellschaft, was accepted. Work was begun at once, but owing to certain difficulties in securing the right of way the construction was delayed long enough to prevent the Borinage line from being the first of its kind in Europe.

The length operated at present is about 12 miles, but this eventually will be increased to 77 miles. The transmission voltage is 6600 at 40 cycles, and through the medium of step-down transformers placed along the line this voltage is reduced to the line potential of 600 volts. It is planned to use a higher line voltage on the extensions, to secure a saving in transformers, and no hesitation is felt about this increase because of

the safety afforded by the catenary suspension to be employed.

The greater part of the Borinage line is on the public streets, but part is also on the company's own right of way. The territory traversed is of a rough character, with a maximum grade of 7.1 per cent. Single track is common, with a number of turnouts of variable length. Ultimately, five lines are to be operated as follows: St. Ghislan-Frameries, 9.6 miles; St. Ghislan-Eugies, 6.3 miles; Quaregnon-Eugies, 6.4 miles; Quaregnon-Frameries, 7.4 miles; Paturage-Wasmes, 6.8 miles. On weekdays the first four lines will have an hourly service and the fifth half-hourly. One trailer will be used with each motor car during the rush hours. However, the motor cars are capable of hauling as much as two loaded passenger trailers or freight trailers weighing about 14 tons. In the urban districts 9.5 m. p. h. is the normal speed, but on the company's right of way trains are run at 24 m. p. h.

No operating troubles have developed, although cars have been running since last February. The trolley wheels have run over 2000 miles without lubrication, and the carbon brushes of the motors are still just as smooth as if direct-current motors had been used, thus proving the absence of sparking.

DOUBLE-TRACK SECTION ON THE BORINAGE SINGLE-PHASE RAILWAY

TYPE OF OVERHEAD CONSTRUCTION ADOPTED FOR THE BORINAGE SINGLE-PHASE RAILWAY

MOTOR CAR DRAWING TWO TRAILERS ON THE BORINAGE SINGLE-PHASE RAILWAY

POWER SUPPLY

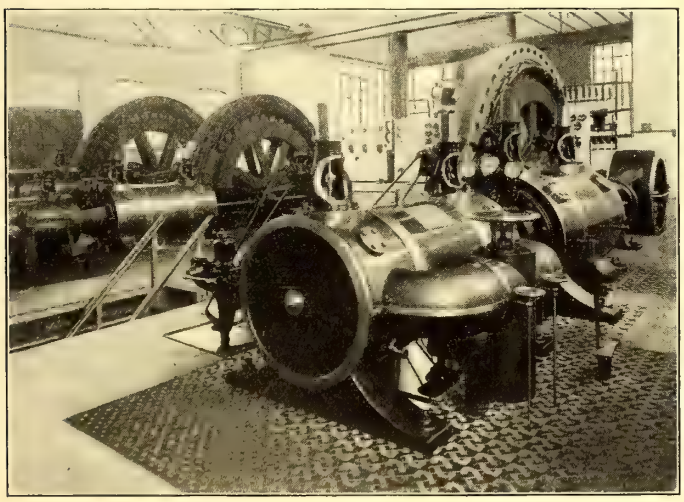
The railway company has no power station, but purchases current from the Société Intercommunale du Borinage, whose power house is located between La Bouverie and Wasmes. This generating station, which was equipped by the Allgemeine Elektricität-Gesellschaft, also supplies power and light to industrial undertakings in Paturage, Wasmes and La Bouverie.

This fact made it possible to secure cheaper current than from a separate station, and also explains the use of so high a single-phase railway frequency current as 40 cycles, since a compromise was necesary to give satisfactory service for both lighting and power. Again, it was necessary to install polyphase generating apparatus owing to the fact that polyphase motors are used on some of the circuits.

The boiler house contains two tubular boilers, a superheater above each boiler, economizer, feed water pumps, etc. The piping is arranged in two sections, the upper half being used for emergencies only. The feed water for the boilers is not of good quality, as it is necessary to take it from a neighboring coal mine. A pond has been constructed for the condenser cooling water.

There are three generating sets; two of these are made up of a 400-hp-600-hp compound tandem engine, running at 120 r. p. m., direct connected to a 40-pole, 375-KVA star-connected alternator; the remaining set is made up of a 220-hp-350-hp engine, running at 133 r. p. m., direct connected to a 36-pole alternator. The large generators are arranged to give 375 KVA single-phase current by using any two phases of the star-connection or 375-KVA polyphase current at 40 cycles. The smaller generator is also arranged for polyphase and single-phase work. When connected in delta all of the alternators are capable of giving 6600 volts. Each machine is of the revolving-field type, has a Tirrill automatic voltage regulator and carries its exciter on the free end of the shaft.

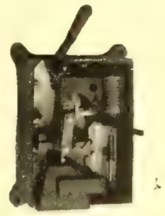
To carry out the object of the power house, namely, to supply both polyphase and single-phase current, the switchboard consists of three distinct divisions. The left end of the board carries the railway measuring instruments and switches; the middle, the apparatus for the generators and exciters, and the right, the controlling instruments for the lighting circuits. Two phases from each generator are taken for the railway circuits without the intervention of frequency changer or other machinery. From the switchboard the high-tension (6600-volt) wires are led directly to the distributing tower after passing through an intermediate receptacle containing lightning arresters and other high-tension protective devices.



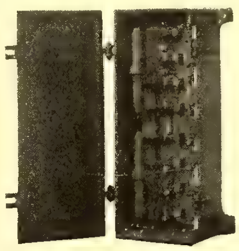
INTERIOR OF POWER STATION

Wooden poles are used for carrying the 6600-volt transmission wires, which divide into four double lines for each of the railway sub-stations. V-shaped iron castings are screwed into every pole for carrying the insulators. It will be noted from one of the illustrations that the poles carry an iron bow, which the law prescribes to prevent wires from falling in case of insulator breakage.

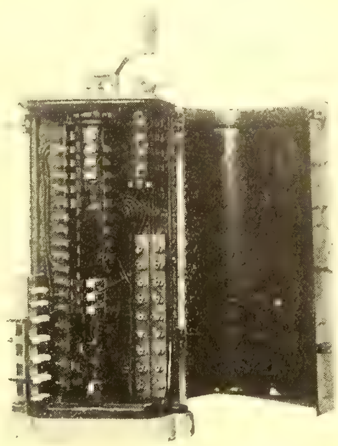
All of the four sub-stations, which step down the voltage from 6600 to 600, work in parallel on the system, consequently the stations do not form separate feeder sections, which would have required more stations than the parallel method. The standard size transformer adopted is 75 KVA, of which the Horny station contains one, Wasmes two, Frameries three and Quaregnon two. All of the stations are built of masonry, approximately 10 ft. 6 ins. x 7 ft. 10 ins. in area, and contain the necessary controlling apparatus in addition to the transformers. The entering high-tension wires are first led to a pair of hand switches and then through an oil switch to the primary bus-bars, whence they pass to the transformers. In each station wattmeters are placed at the entering side, so that the exact energy used, including transformer losses, is easily determined.



AUTOMATIC CUT-OUT



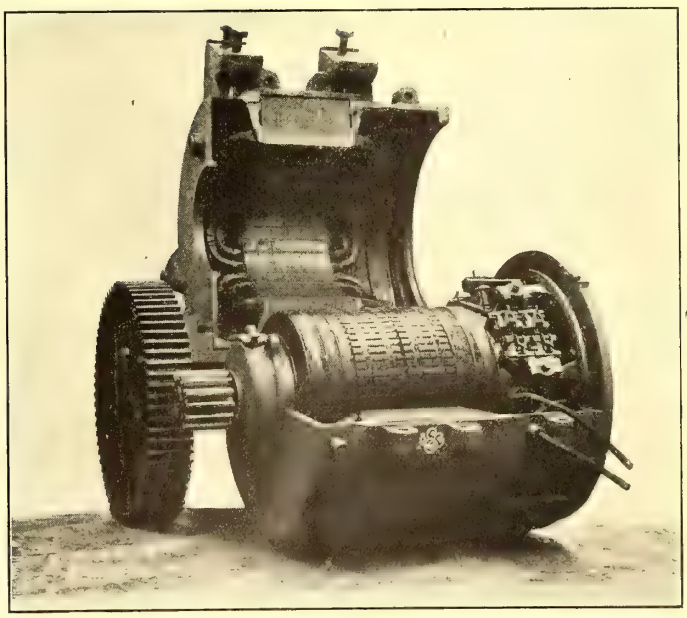
DOUBLE-POLE MOTOR SWITCH



RAILWAY CONTROLLER FOR SINGLE-PHASE SERVICE

THE RAILWAY LINE

Although one overhead wire is sufficient in single-phase operation, the company uses an additional wire for the return circuit, as a track return might have seriously disturbed adjoining grounded telephone and telegraph circuits. Earthed single-phase currents appear to disturb grounded telephone circuits, even when the former have as low a frequency as 15 cycles, and such disturbances can be avoided only by abolishing a grounded return for one of the two circuits. The two grooved overhead wires are kept 3 ft. apart, and usually about 19 ft. 8 ins. over the rails.

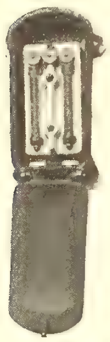


SINGLE-PHASE RAILWAY MOTOR, OPEN

Channel beams are used for the poles, wood being too short-lived and lattice or tube poles too expensive. Side-pole con-

struction is used wherever possible. The side arms are double V-shaped castings fastened to the poles by clamping. For single track these arms are 9 ft. 8 ins. long, and for double track 21 ft. For the latter length two guy wires are used instead of one, to avoid bending.

As the operating voltage is only 600, the wires are suspended in the usual manner. The wires are all clamped in. To provide the best possible insulation between the power and return wire, ball insulators are employed in addition to the regular bolt insulators. The section insulators are placed every 1640 ft., and are furnished with double-pole lightning arresters. Any section, however, may be cut out of circuit, leaving the others alive. At one undergrade crossing with a steam line the operating-current wire is only 11 ft. above the track—hence to avoid accidents to teamsters it is necessary to have this section dead except when a car passes through the tunnel. The special switch for this purpose is located on the car. On entering the motorman places the upper wire in circuit, and on leaving cuts it out.



DOUBLE-POLE LIGHTNING ARRESTER

REGULATING TRANSFORMER

ROLLING STOCK AND EQUIPMENT

At present the rolling stock consists of twenty motor cars and an equal number of trailers. The cars are plainly furnished, as the great majority of passengers is made up of miners and other workingmen. Each car body is a little over 15 ft. long, has a seating capacity of twenty and standing room for about twenty passengers more. The seats are longitudinal. The cars have no particular style of truck, but are mounted on double axles, which have leaf and elliptic springs. The wheel base is 8 ft., diameter of wheels 31½ ins., and truck gage 1 m (39.37 ins.)

STANDARD MOTOR CAR USED ON THE BORINAGE SINGLE-PHASE RAILWAY SYSTEM

Every motor car carries two Winter-Eichberg, type WE 31B motors, each capable of giving 40 hp for one hour's run without undue heating. They have six poles, and are built for single-phase, 40-cycle, 550-volt current. The gear ratio is 1:5.07. The motor casing has removable covers on top and bottoms, so that the commutator is made easily accessible. The two-part laminated stator has a side-pole, single-phase winding distributed in slots; there are two systems of short-circuiting and exciter brushes, whose position varies 90 electrical degrees. In all there are six brush spindles, four of which carry short-circuiting brushes and two carry exciter brushes. The efficiency and service curves of this motor are not so favorable as those obtained from a 25-cycle motor, but show that a 40-cycle, single-phase current satisfies all the usual railway conditions.

The motors are operated in series-parallel in connection with a regulating transformer. The only changes made take place in the stator windings, the rotor windings remaining permanently in series. Resistances are not used except in passing from series to parallel. The regulating transformer is air-cooled, and is placed under the center of the car body.

The controller employed is of the type B-19. The larger of the two controller handles serves for running and braking; has two series and three parallel positions for changing the connections of the regulating transformer; five positions for short circuiting, which leave the regulating transformer unaffected, but cause the motors to run as generators, and a sixth position for braking against the current. The smaller handle is used for reversing. The controller has no magnetic blow-outs, as these were found unnecessary.

Owing to the use of a return wire, every car carries two trolley poles. Both are mounted in the center of the roof, 3 ft. apart. The upper part of every pole is insulated with leather to prevent short circuits between adjacent poles should they come in contact. Each pole is protected from atmospheric discharges by the use of a lightning arrester and choke coil. The car is illuminated by six incandescent lamps, arranged in series. The weight of the standard car and equipment is about 10 tons. The motors weigh 1385 kg (3047 lbs.), and the regulating transformers 200 kg (440 lbs.) each.

CAR HOUSES

The present car house, which is temporary, is located on the Quaregnon-Eugies division, near the Paturage railway station. It consists of a wooden building for twelve motor cars, and a workshop containing the stock room and offices; the trailers are stored in the open air. The permanent car house is to be erected at the junction of the Quaregnon-Eugies and Eugies-Ghislain lines. It will have a room for twenty motor cars and twenty trailers, besides containing a repair shop, stock room and offices.

The Philadelphia & West Chester Traction Company's new station at Ardmore, Pa., has been opened to the public. It is one of the handsomest electric railroad stations in the country, and is situated on Lancaster Avenue, directly opposite the Pennsylvania Railroad station. The site has a frontage of 100 ft. on the avenue. Of this, 30 ft. is occupied by the building and the remainder will be laid out in lawns and walks. The building, which has previously been described in the STREET RAILWAY JOURNAL, is of Pompeiian brick, with Indiana limestone trimmings. The waiting room is finished in quartered oak, and the floor of the entire building is concrete. The train shed, which accommodates two tracks at present, is 40 ft. x 95 ft., with cement and concrete platforms running the entire length on each side. It is expected that the present running time of 24 minutes to Sixty-Third and Market Streets, Philadelphia, will be reduced to 17 minutes when the improvements are completed.

ATLANTA NORTHERN RAILWAY THE FIRST SINGLE-PHASE RAILWAY IN THE SOUTH

On July 17, 1905, the Atlanta Northern Railway Company opened its line between Atlanta and Marietta, Ga., and the largest interurban electric railway in the South was added to the steadily growing list of roads employing the single-phase alternating-current system developed by the Westinghouse Electric & Manufacturing Company. Since the commencement of service exceptionally large crowds have at times been transported, and the successful operation of the line is assured.

The company operates some 15 miles of track between the terminal cities of Marietta and Atlanta, and enters the latter city over the track of the Georgia Railway & Electric Company. The interurban line, however, is operated entirely independently and makes no attempt to conduct a local service.

Marietta, the northern terminus of the line, is located at the foot of the Kenesaw Mountain, made famous during the Civil War by one of the battles of Gen. Sherman, and now the site of a national cemetery. The intervening country is rolling, and is devoted largely to the raising of cotton. The line crosses the Chattahoochee River at Iceville, and passes through the villages of Smyrna, Gilmore and Butler. It is constructed over a private right of way which runs parallel to the track of the Western & Atlantic Railroad.

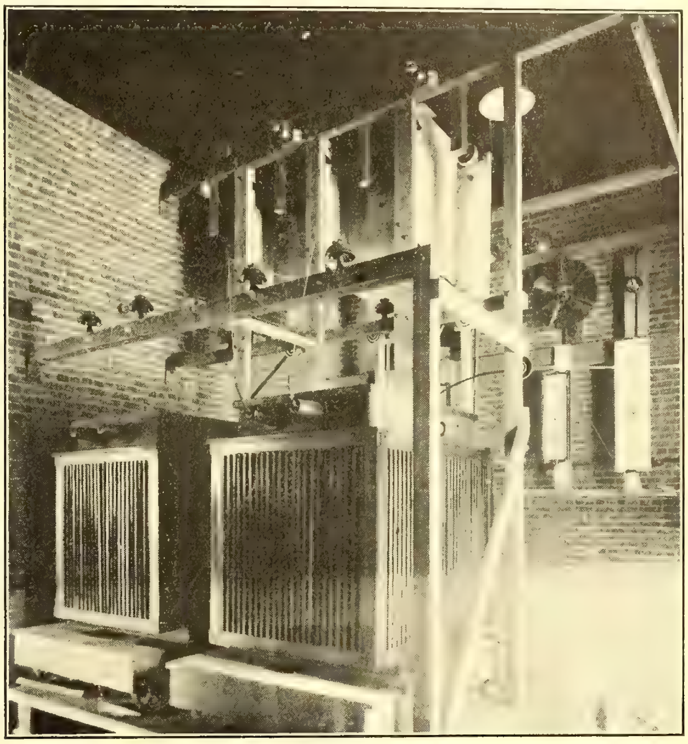
The track construction is exceptionally good, consisting of 70-lb. T-rails, laid on ties which are ballasted with slag shipped

A CUT ON THE MAIN LINE, SHOWING TRACK CONSTRUCTION AND OVERHEAD WORK

from the iron furnaces of the Birmingham district. The maximum grade is 3 per cent, and the shortest curve has a radius of 574 ft. The gage is standard, i. e., 4 ft. 8½ ins. Within the limits of Atlanta girder rails are used.

Except within the city limits of Atlanta a single No. 000 trolley wire forms the entire low-tension distributing system. This is fed with 25-cycle, single-phase alternating current, at a potential of 2200 volts. The trolley wire is suspended from cross spans secured to wooden poles, set 90 ft. apart on straight track, and about 45 ft. apart on curves. The construction is similar in general to that ordinarily used in direct-current practice, except that specially heavy insulators, suitable for the higher voltage, are employed.

The current supply for the new railway is obtained from the water-power station of the Atlanta Water & Electric Power Company, about 18 miles from Atlanta, and is transmitted at a potential of 22,000 volts. The power equipment at the water-power station includes Westinghouse three-phase, 25-cycle alternators, with an aggregate capacity of 10,500 kw. In case of accident to the water-power station, current may be obtained from a thoroughly equipped steam power plant which the Georgia Railway & Electric Company, which also obtains power from the water-power station ordinarily, has in reserve for the operation of its lines in the city of Atlanta in



TRANSFORMER STATION AT CAR HOUSE, WITH TWO 150-KW TRANSFORMERS

emergencies. Few railways in any part of the country are so well provided with duplicate power apparatus for maintaining the operation of the road at all times.

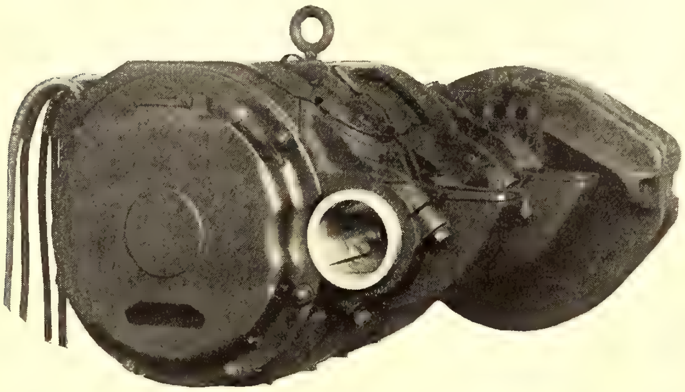
The trolley line is divided into three sections, each fed from one leg of the three-phase transmission system through oil-insulated, self-cooling transformers. There are two transformer stations in each section connected to the same phase, making a total of six stations, located approximately 3½ miles apart. One of these is in Atlanta, one in the car house near the limits of Atlanta, and the remainder at the towns of Bolton, Gilmore, Smyrna and Butler.

The transformer stations are well constructed of brick, and each is equipped with one 150-kw Westinghouse oil-insulated, self-cooling transformer, together with the necessary lightning arresters, choke coils, switches and fuses. The transformer in Atlanta and one of those in the car houses supply the 550-volt section of the trolley, and in order that all transformers may be interchangeable, all are wound so the secondary voltage of either 2200 or 550 may be used. Since these stations contain no moving machinery, no attendants are required. An occasional inspection of the stations is all that is necessary.

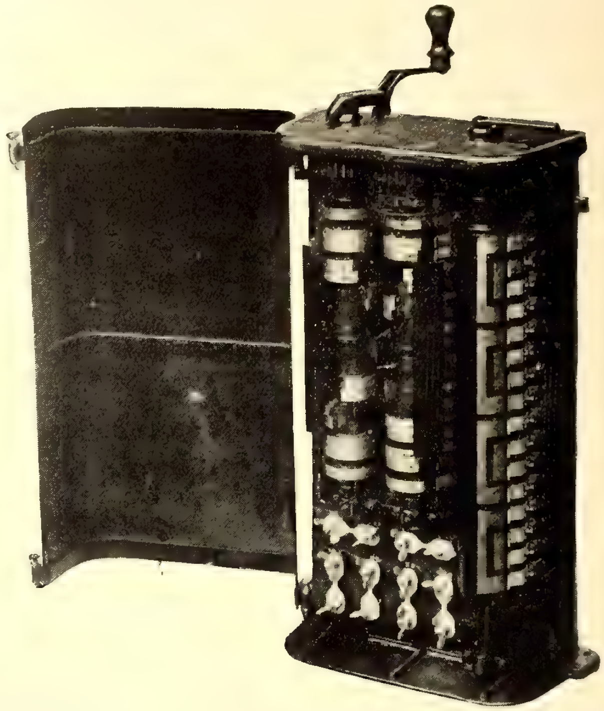
To insure regularity of service with a minimum of reserve capacity, each transformer is mounted on a low truck and is installed in the transformer station on a platform at the height of a standard flat car. A reserve transformer is held in the car house, mounted on a similar truck, and loaded upon a flat car, ready for instant transportation to any part of the line. This outfit serves as a reserve unit for all of the stations. In

case of a breakdown or other trouble at any station, the crew of the first car discovering the difficulty would notify the car house force, who would then have the flat car hauled to this point, and on arriving would roll the damaged transformer and its platform on to the flat car and replace it by the reserve unit. The arrangement is ingenious and well thought out, and indicates the ability of the engineers of the Atlanta Northern Railway Company, who have planned and constructed the system in so thoroughly modern a manner. As each transformer station is capable of carrying the entire load of its section, practically a duplicate installation has been made. With this arrangement and the reserve unit described above, there is little likelihood of cessation of service because of failure of the power supply.

The rolling stock comprises six passenger and one freight car, four cars being employed in regular service to maintain a half-hourly schedule between terminal points. The running time is 45 minutes each way, including some twenty stops. During the heavy rush hours 189 passengers have been carried on a single car.



SINGLE-PHASE 50-HP RAILWAY MOTOR USED ON THE ATLANTA NORTHERN RAILWAY

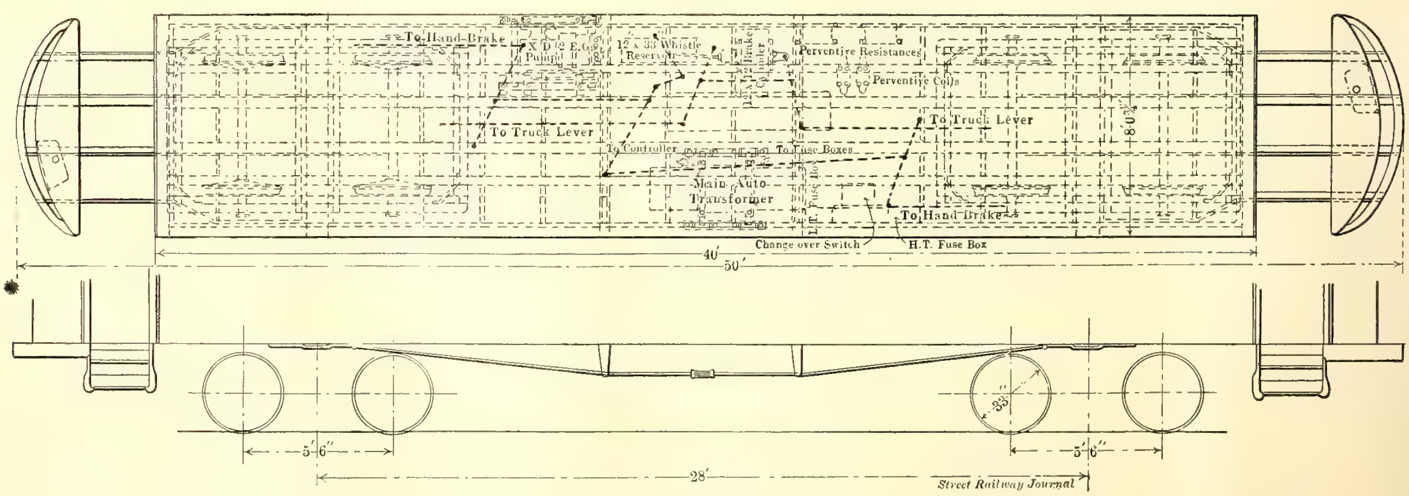


CONTROLLER FOR SINGLE-PHASE RAILWAY OPERATION

The passenger cars measure 50 ft. 6 ins. over all and weigh about 30 tons each. They have a seating capacity of fifty-six persons. The cars were built by the Cincinnati Car Company, and are mounted upon Brill 27-E trucks. The freight car was also constructed by the Cincinnati Car Company, and is mounted upon standard trucks of the manufacturers. All cars are of the double-truck type with 28 ft. between truck centers.

The passenger cars are equipped with quadruple Westinghouse No. 108 (50 hp) motors. The equipment of these cars is remarkable for its simplicity. The circuit from the trolley passes to an auto-transformer through a double-throw oil switch, which connects it to either one of two taps on the high-tension winding of the transformer according to whether 2200 volts or 550 volts is used on the trolley. After leaving the auto-transformer the circuit passes directly to the ground. The motors may be connected to various taps on the low-tension winding of this transformer, giving five different running points.

The connections are made by a drum-type controller, one controller being mounted on each platform. Each controller consists of three drums, one for reversing the relative connections of the field and armature coils of each motor, and the other two, which are directly geared together and operated simultaneously, for varying the voltage impressed upon the motors. The motors are of the conductively compensated type, and are connected permanently two in parallel, the voltage impressed upon each pair of motors being regulated by one of the controller drums mentioned above.



PLAN OF CAR, SHOWING POSITION OF ELECTRICAL APPARATUS

The feature of particular interest in connection with the operation of the controller resides in the means employed for preventing sparking in the controller when the connections are changed from one tap to another on the auto-transformer. There are on this transformer six intermediate taps corresponding to voltages 144, 174, 204, 234, 266 and 288, respectively. There are, however, only five running points corresponding to voltages 159, 189, 219, 240 and 277, respectively.

It will be noted that these voltages are in each case midway between the ones of the transformer taps. The running voltages are obtained from the neutral point of a so-called "preventive coil"—an inductive coil—which is connected across adjacent taps of the auto-transformer. The segments on the controller drums are so arranged that, in changing the preventive coil from one pair of transformer taps to the next adjacent pair, the circuit is never opened simultaneously at both ends of the coil. In parallel with the preventive coil is connected a preventive resistance through one-half of which flows the major portion of the current to the motor when the controller is being moved from one running position to another. The preventive resistance is so designed that it takes but little current when subjected to the small voltage between adjacent transformer taps (30 volts), and yet absorbs but little voltage when carrying the full current of the motor. It is evident, therefore, that the motor circuits are never completely opened during operation, and yet there is no direct short circuit produced between adjacent transformer taps. On the highest running notch of the controller the preventive resistance is cut completely out of circuit, so as to eliminate entirely the loss occasioned by the current due to the low voltage between adjacent transformer taps.

The freight car is equipped with four No. 108 motors similar to those used on the four passenger cars with hand control, but in order that this car may be operated on any part of the city system as well as over the company's own tracks, the control is arranged for operation on either direct or alternating current. There are, therefore, three operating conditions which can be met by this car. It can be run from a standard 550-volt, direct-current trolley, the 550-volt alternating-current trolley in Atlanta and the 2200-volt alternating-current trolley between Atlanta and Marietta. To meet these widely different conditions, a combination of rheostatic and voltage control is used instead of pure voltage control as on the passenger cars. The motors are connected permanently, two in series, and the two groups thus formed may be connected to any of three different taps on the transformer. In starting the car, the motors are connected first to the lowest tap, then to the middle tap through a resistance, next to the middle tap without the resistance, then to the highest tap with the resistance in circuit, and, finally, to the highest tap with the resistance short circuited. With this equipment three different running points are obtained.

When operating on direct current, the motors are connected all four in series and rheostatic control only is used. There are thus four resistance points in addition to the "full-on" position.

Current is collected from the trolley wire by means of wheel trolleys of the ordinary type except that these trolleys are mounted on porcelain insulators on account of the high voltage which is used. Each car carries two trolleys, one at each end, and is equipped with Westinghouse straight air brakes, the compressors for which are operated by series-wound motors similar in general to the main car motors. Nothing necessary to an equipment of the highest grade and to enable the company to maintain a safe and reliable high-speed service has been omitted. Great credit is due to the management of this company, which consists of P. S. Arkwright, president; T. K. Glenn, vice-president; G. W. Brine, secretary and treasurer, and A. Balsley, chief engineer, for the successful entrance of alternating current into the Southern railway field and for their pioneer work in this important development of electric transportation. The work of installation and construction has been done almost entirely by the company itself, including the track and overhead construction, which was conducted under the management of William Glenn, engineer of maintenance of way.

AUTOMOBILE BUSES FOR SMALL COUNTRY LINES

Many who have given the matter careful consideration are inclined to the belief that the automobile in some form will soon bear the same relation in the transportation game to the electric railways that the traction lines are now occupying toward the steam trunk lines; that is, they will take care of small business which cannot be profitably handled by the more costly conveyance, and will serve as feeders to the larger systems. Almost every electric railway operator can point to small towns and hamlets at distances anywhere from 5 to 20 miles off from his main line that would furnish considerable business if it could be brought in in a cheaper manner. It would not pay to build a spur line, because the cost of building the road and operating even a single car would be so great that the returns would be unprofitable, hence this business cannot be taken care of under present conditions.

A STOP AT A FARM HOUSE

Throughout the farming districts, particularly in the Middle West, there are thousands of hamlets and villages that would not support even the cheapest forms of traction lines or trackless trolleys, but which are begging for a better means of communication with neighboring cities and towns than is now afforded by horse-drawn vehicles. The question is, can these classes of business be handled satisfactorily and profitably by automobiles? Recent improvements have brought the gasoline vehicle up to quite a high degree of reliability, and the cost of operating such cars, when in good condition, is known to be very small. The great drawback is the deplorable condition of the majority of country roads, particularly in winter. Fortunately, these conditions are rapidly improving, and in some sections the main highways are in very fair condition all the year around. Grades and curves have but little effect upon the cost of operation, and such expenses as track and overhead maintenance, despatching systems, etc., are, of course, eliminated.

One of the first experiments with a project of this kind is being made at Springfield, Ohio, and it is interesting to note that the promoters are old electric railway builders and opera-

tors. John S. Harshman, who is at the head of the company, was instrumental in promoting two of the most important traction lines centering at Springfield. There are several routes out of Springfield over which traction lines have been projected, but the plans have fallen through owing to the insufficient population, which rendered it impractical to build a trolley road. The fine highways in this district prompted Mr. Harshman to try the automobile on these routes.

A company, which is known as the Commercial Transit Company, was formed in a modest way. It has a capital stock of $50,000, of which $20,000 has been paid in for preferred stock. It was decided to experiment with very small cars at first over the route from Springfield to Clifton, Cedarville and Jamestown, having populations respectively of about 500, 1500 and 2500. The distance from Springfield to Jamestown is 22 miles, along a fairly level highway, which is in excellent condition and built up with a good farming population. Service was started about six weeks ago. The original investment was for three cars at $2,200 each, a garage building and repair shop, for which an old building was remodeled at an expense of $1,000. In addition, the company spent about $1,200 in improving the highway, filling in holes and low places with broken stone and leveling and rolling the entire road. It made an agreement with the County Commissioners of the two counties through which the route passes to spend $100 per mile per year on road improvements, the Commissioners to do the same. This was purely voluntary on the company's part, as there is no law in Ohio to prohibit the use of the highway for such purposes or to compel them to make any special payment for the use of the road. It is believed that the only restrictions that can be placed against a project of this kind under present laws would be the special license in cities for automobiles. The State speed ordinance of 18 m. p. h. on highways and 8 m. p. h. on business streets of cities of course applies and will be regarded.

LEAVING SPRINGFIELD

THE JAMESTOWN TERMINUS

SOME LONG GRADES, SHOWING REPAIR WORK DONE BY THE COMPANY

A PASSING POINT, NO SWITCHES TO TURN

The cars were furnished by the Olds Motor Works, of Lansing, Mich. They are of this company's standard type, have double vertical cylinder motors rated at 16 hp, water radiating system, two speeds forward and reverse with maximum speed of 18 m. p. h., 30-in. wheels with 4½-in. solid rubber tires. There are two side seats, each seating five passengers, and space for two in front besides the operator. There is a canopy top with side curtains and swinging window in front. In stormy weather the car can be made perfectly tight. The company has made one or two changes in the cars, including the installing of small electric lamps in the body and electric headlight, the current being furnished by an Apple generator and storage battery, which also furnishes current for engine ignition. Windows will be placed in the curtains so that the interior will not be dark in stormy weather, and it is planned to run the engine exhaust line under the seats for heating in winter; it is believed the cars can be kept amply warm

by this method. Two cars at present handle the service with one for spare. On alternate days one makes 110 miles, or two and one-half round trips, while the other makes 88 miles, or two round trips. Cars leave either terminus at 6 a. m., 9 a. m., 12 m., 2 p. m., 4 p. m. and 6 p. m. Rates of fare are practically 2½ cents per mile, with rate of 50 cents from Springfield to Jamestown, 22 miles. The scheduled time is 1 hour and 45 minutes, or about 12½ m. p. h. There is a layover of 15 minutes at either terminal, so that if cars are late they can still start out on time.

Thus far there has been no difficulty in maintaining the schedule, despite the fact that unusual precautions are necessary to prevent scaring horses. The State law provides that an automobile must give a team two-thirds of the road, and if a driver raises his hand, the machine must be brought to a stop; if the horses are still fractious the motor must be stopped, which necessitates getting out to crank it again. A great deal of time is lost in this way. The farmers in many instances have been antagonistic to the venture, due to the scaring of horses, so that the company has issued orders to its men to spare no precautions to avoid accidents. This difficulty is being rapidly overcome, however.

It is, of course, too early to determine anything about the financial success of this proposition, although it looks very encouraging. The receipts thus far have been more than enough to pay operating expenses and interest, and allow for a reserve fund of 2 cents per car mile for repairs, which, of course, has been practically nothing up to the present time. Operators are paid 25 cents an hour. The operator collects the fares and records them on a register, and it is believed that a good operator can make a better showing in the way of wear and tear on the machine and saving in fuel than can be done by the operator of an electric car. On a round trip of 44 miles the cars average 4½ gals. to 5 gals. of gasoline, which in quantity costs 10½ cents per gallon; also 2½ to 3 pints of lubricating oil. This, of course, is in fair weather with good roads; what they will do on heavy roads and deep snow remains to be seen. It is believed, however, that they can be operated for from 4½ to 5 cents per car mile, everything included.

This is not the only project the company has in mind. As soon as possible it will start a similar line between Springfield, Catawba, Mechanicsburg, Milford and Marysville, a distance of about 35 miles. It has also ordered two cars of a larger type, having cross-seats for eighteen passengers, which will be used for 'bus service about Springfield. There are three large institutions near the city—the Knights of Pythias Home, Odd Fellows' Home and the Masonic Home—and these cars will be used for special parties with a rate of $5 per hour, and it is believed they will be very profitable.

The garage and repair shop has been fitted up in a very complete manner, and as it is the only one of any consequence in Springfield, it is thought there will be outside repair work enough to make the shop self-sustaining.

The results of this experiment will be watched with considerable interest, as it is known that there are a number of similar projects in Ohio and neighboring States.

During the month just past the motormen, conductors, guards and inspectors of the Brooklyn Rapid Transit Company, whose cars run into the Culver terminal at Coney Island, have been given free by the company more than $2,000 in lunches. These lunches are furnished the men during periods of heavy travel, and the company thereby is able easily to maintain its rush schedules, and the men to make considerable extra time. At the Culver terminal during the past month the company furnished the following immense amount of food: 46,965 sandwiches, 32,890 rolls, 5705 quarts of milk, 3860 quarts of coffee, 2000 crullers, 710 quarts of iced tea. This general bill of fare has also been served at the West End and other terminals.

PROGRAM OF THE AMERICAN RAILWAY MECHANICAL AND ELECTRICAL ASSOCIATION

The following program has been issued of the third annual convention of the American Railway Mechanical and Electrical Association, Philadelphia, Pa., Sept. 25-26:

MONDAY MORNING, SEPT. 25

Registration will commence at Convention Hall (South Building, Philadelphia Museum) at 8:45 o'clock.

Ten o'clock sharp, address of welcome, Hon. John Weaver, mayor of Philadelphia.

Address by Hon. W. Caryl Ely, president, the American Street Railway Association.

President's annual address.

Report of the executive committee.

Report of the secretary and treasurer.

MONDAY AFTERNOON, SEPT. 25 (1:30 O'CLOCK SHARP)

Paper, "Power Distribution," C. H. Hile, superintendent of wires, Boston Elevated Railway Company, Boston, Mass.; "The Power Station Load Factor as a Factor in the Cost of Operation," by L. P. Crecelius, chief electrician, the United Railways Company, St. Louis, Mo.; report of the committee on "Controlling Apparatus," chairman, J. S. Doyle, master mechanic, Interborough Rapid Transit Company, New York, N. Y.

TUESDAY MORNING, SEPT. 26 (9 O'CLOCK SHARP)

Report of the committee on Way Matters,—"Welding of Rail Joints," chairman, F. G. Simmons, superintendent of construction and maintenance of way, the Milwaukee Electric Railway & Light Company, Milwaukee, Wis.

Report of the committee on "Maintenance and Inspection of Electrical Equipment," chairman, William Pestell, New York, N. Y.

Paper, "The Power House," Fred N. Bushnell, chief engineer, the Rhode Island Company, Providence, R. I.

TUESDAY AFTERNOON, SEPT. 26 (1:30 O'CLOCK SHARP)

Paper, "The Track Brake," F. F. Bodler, master mechanic, the United Railroads, of San Francisco, Cal.

Discussion of the question box.

Reports of special committees.

Election of officers.

PROGRAM OF THE ACCOUNTANTS' CONVENTION

The following program of the ninth annual convention of the Street Railway Accountants' Association of America has been issued by the secretary:

THURSDAY, SEPT. 28, 2 P. M.

Annual address of president, W. G. Ross, Montreal, Canada. Annual report of the executive committee. Annual report of the secretary-treasurer. Appointment of convention committee on nominations. Appointment of convention committee on resolutions. Report on proposed reorganization of the American Street Railway Association.

FRIDAY, SEPT. 29, 10 A. M.

Annual report of standing committee on standard classifications of accounts, C. N. Duffy, secretary and auditor, Chicago City Railway Company, chairman. Annual report of standing committee on standard form of report, W. F. Ham, comptroller, Washington Railway & Electric Company, chairman. Report of committee on international form of report, C. N. Duffy, secretary and auditor, Chicago City Railway Company, chairman. Report of committee to attend convention of National Association of Railway Commissioners, held at Birmingham, Ala., Nov. 15, 16, 17, 1904, C. N. Duffy, secretary and auditor, Chicago City Railway Company, chairman. Report of committee to attend convention of National Association of Railway Commissioners, held at Deadwood, South Dakota, Aug. 15, 16, 17, 1905, W. F. Ham comptroller, Washington Railway & Electric Company, chairman. Reading and discussion of questions and answers in the question box. This includes those published and any other that may be presented.

2 P. M.

Paper—"The Cost of Carrying a Passenger," C. L. S. Tingley, second vice-president, American Railways Company, Philadelphia, Pa. Paper—"Interurban Fare Collections," Irwin Fullerton, auditor, Detroit United Railway, Detroit, Mich. Paper—"Interurban Ticket Accounting," J. H. Pardee, general manager, Rochester & Eastern Rapid Railway, Canandaigua, N. Y. Paper—"Accounting with Four Departments," H. M. Beardsley, secretary and treasurer, Elmira Water, Light & Railway Company, Elmira, N. Y.

SATURDAY, SEPT. 30, 9:30 A. M.

Unfinished business. Report of convention committee on resolutions. Report of convention committee on nominations. Election and installation of officers.

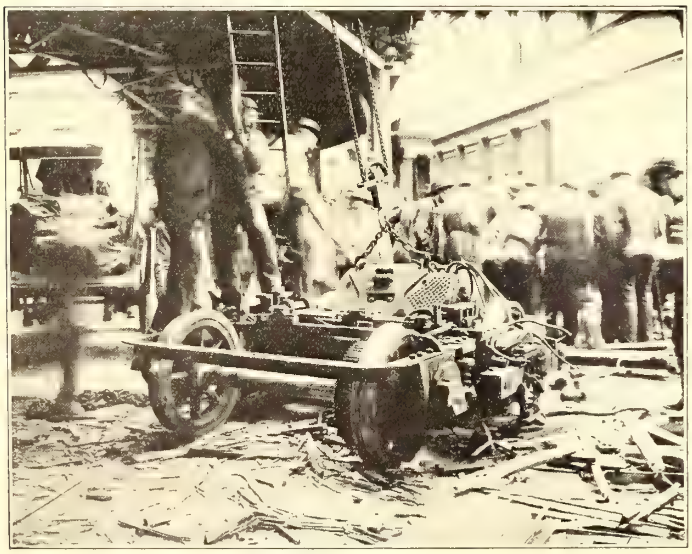
SERIOUS ACCIDENT ON THE NEW YORK ELEVATED

Twelve persons were killed and forty-two injured, five of them mortally, a few minutes after 7 o'clock Monday morning, Sept. 11, by the plunging of a car of a southbound Ninth Avenue train of the Interborough Rapid Transit Company, of New York, from the elevated railroad structure, at the curve at Fifty-Third Street and Ninth Avenue, where the Sixth and Ninth Avenue lines diverge. The train that was wrecked consisted of six cars, all well filled with passengers. It left the Fifty-Ninth Street station about 7 o'clock. Speeding up, as all Ninth Avenue trains do at this point, so as to gain momentum for the grade to the next station, the train took the switch at Fifty-Third Street, which it seems by mistake was set for a Sixth Avenue train. The first car cleared the curve. Then there was a grinding and crunching of timbers, and the second car slewed around and was torn off its trucks. The third car, with the weight of the remaining two behind it, bumped with full force into the one ahead and sent it flying from the tracks into the street below. As the car fell it turned completely over, and its forward platform struck the sidewalk with a crash. The rear platform remained suspended against the framework of the elevated road. The trucks of the third car were hurled from the track through the bottom of the second car, adding to the havoc, and the bodies of the first and third cars came together with a crash. The car which had been thrown from the structure remained suspended at an angle of 45 degs., and the passengers in it were hurled to the forward end, which rested on the sidewalk. The third car of the train, hurled forward by the weight of those behind it, was shoved over the elevated structure and its forward end was forced through the window of the dwelling on the corner. This car finally settled, its forward end held by the sill of the window and the fire escape, and hung suspended like a bridge across the street.

THE SCENE OF THE ACCIDENT

An examination was made by the officials of the company soon after the disaster, and it was found that on the first car of the train the signals were set for Ninth Avenue. In the switch tower the signal was set for the approach of a Sixth Avenue train. The coroner and the officials of the road are said to agree that Motorman Kelly should have seen that the tower signals were set for Sixth Avenue, and as he was running a Ninth Avenue train should have stopped until he got the proper signals to proceed down Ninth Avenue. That the signals were set for Ninth Avenue when the officials and the coroner reached the first car is not significant, according to Vice-President Bryan and General Manager Hedley. They said that Kelly might have turned the signals to Ninth Avenue when he saw his error. Both officials are said to stamp as nonsense a report that when the man in the switch tower saw that the train was making the curve at full speed, and knowing that an error had been made, he threw the switch, thus derailing the cars. They said that it would have been impossible for the towerman to throw the switch while the cars were on the track.

The towerman surrendered to the authorities soon after the accident, but the motorman fled and up to the time of going to press had not been located. Until the motorman is apprehended and gives his version of the accident, there is only the testimony of the towerman as to the facts in the case. He says positively that the destination of the train as shown by the signals it displayed was Sixth Avenue..

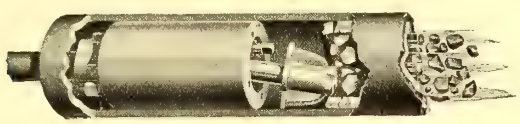


REMOVING THE TRUCKS THAT FELL TO THE STREET

CLEARING AWAY THE WRECK

AN EFFICIENT BOILER-TUBE CLEANER

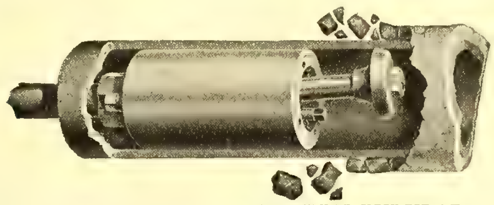
Although the Dean boiler tube cleaner has been in wide use for some time it may not be amiss to present an illustrated description of the constructional features and methods of ope-



BOILER-TUBE CLEANER FOR WATER-TUBE BOILERS

ration of this device, which is manufactured by the William B. Pierce Company, of Buffalo, N. Y.

The cleaner is remarkably simple in construction, and is worked either by steam or compressed air. In the type used for return tubular boilers the hammer head, vibrating with a pressure of 40 lbs. to 70 lbs., strikes the tubes 3500 to 4500 times a



BOILER-TUBE CLEANER FOR RETURN TUBULAR BOILER

minute, thus setting up a vibratory motion through the steel and dislodging the scale on the outside. In the water-tube boiler the hammer head is changed slightly, and as the cleaner is forced through the tube it breaks the scale up into small pieces, which are blown out of the tube in front of the cleaner. Since the cleaner fits snugly into the tube, it must remove all scale before it can pass any point.

One might imagine that with a stroke of 4000 times a minute there must be a considerable blow struck against the tube, but tests performed by the well-known engineer, Prof. W. H. Kavanaugh, of the University of Minnesota, show that the blow is very slight, and that it is the rapidity of the blow rather than its force which accomplishes such satisfactory results.

INTERESTING TYPE OF STEAM CAR FOR COLOMBIA

The interesting type of steam car illustrated has just been completed by the J. G. Brill Company for the Ferro Carril de Antioquia, of Colombian Republic. There are two compartments to the car, one for first-class passengers and one for those traveling second-class. A hardwood partition with a single sliding door 24 ins. wide, separates the compartments.

STEAM CAR FOR THE FERRO CARRIL DE ANTIOQUIA

A toilet room is provided at the end of the second-class compartment, and in an alcove is a water cooler. Thirty passengers may be comfortably seated, the seats being of spring cane in the first-class compartment while slat seats are used in the second-class compartment. In the first-class compartment, only the middle seat is reversible, the seats next to the partition being stationary and the corner seats also stationary. The windows have double sashes, the lower sash to raise and

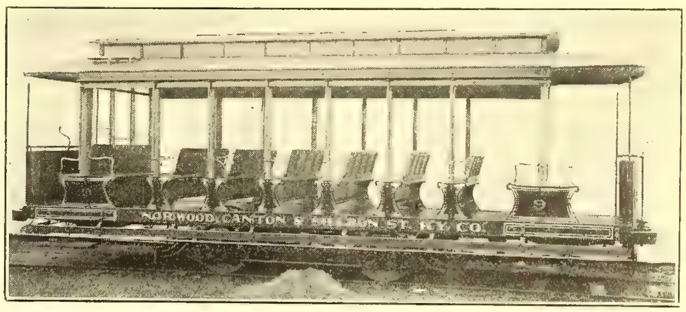
INTERIOR OF COLOMBIAN CAR

the upper sash stationary. Blinds are also used. The interior finish is of cherry and ash with birch ceilings.

The length over the end panels is 21 ft., and over the crown pieces 28 ft. The distance from the panel over the crown piece is 3 ft. 6 ins. The width over the sills and the sheathing is 7 ft. 10 ins. The width over all is 8 ft. Distance between the centers of the posts is 2 ft. 5 ins. The trucks are the company's No. 420 type, with 4-ft. wheel base and 24-in. wheels.

EQUIPMENT FOR THE NORWOOD, CANTON & SHARON STREET RAILWAY

A number of ten-bench open cars have lately been delivered to the Norwood, Canton & Sharon Street Railway Company, Massachusetts, by the American Car Company. The cars will be used on the line connecting the three towns, and which also reaches Massapoag Lake. The new cars measure 21 ft. over the end panels and 7 ft. ½ in. over the posts at belt. The seating capacity is fifty passengers, and the seats are re-



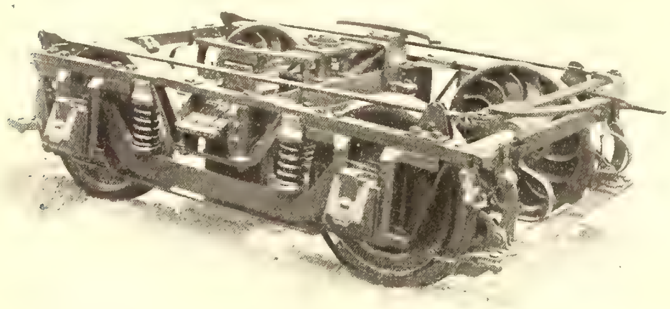
OPEN CAR FOR THE NORWOOD, CANTON & SHARON STREET RAILWAY COMPANY

versible with the exception of two at each end. The sashes in the bulkheads are arranged to drop into pockets between the seats. Curtains are provided which may be drawn to the floor, the Brill round-corner seat-end panels, which are used, being so arranged in connection with the grooves in the posts as to permit the curtains to come down over the post outside of the panels, a continuation of the grooves of the posts being formed in the exterior surface of the panel. The panel also provides for easy entrance, as there are no sharp projecting corners. The interiors are in ash, with ceilings of three-ply birch veneer.

The length over the crown pieces is 28 ft. 8⅜ ins., and from the panel over the crown, 3 ft. 10 3-16 ins. The width over the sills, including the facing, is 6 ft. 3 ins. The sweep of the posts is 5 ins. Distance between the centers of the posts, 2 ft. 8 ins. The side sill size is 3¾ ins. x 7 ins. The sill plates are 7 ins. x ½ in. The thickness of the corner posts is 3⅝ ins., and of the side posts, 2¾ ins. The height of the steps is 15½ ins., and of the risers, 18⅛ ins.

A NEW MOTOR TRUCK

The Dorner Manufacturing Company, of Chicago, Ill., and Logansport, Ind., is just bringing out its improved M. C. B. motor truck No. 20, which follows the lines of the so-called M. C. B. passenger trucks commonly used on steam roads, with



NEW MOTOR TRUCK FOR HIGH-SPEED SERVICE

the necessary improvements and changes to suit it to electric traction. This truck is specially designed and adapted for high speed, interurban and elevated railroad service. The top frame is one continuous welded piece of 3½-in. x 1¾-in. steel, machine fitted like a locomotive frame and with ends half turned, making them vertical like a joint in a floor, and much better adapted to the vertical strain caused when the brakes are applied than if the ends were not thus turned. The arch bars which carry the bolster are 3-in. x 1⅛-in. steel, and run the full length of the frame over the pedestals, with braces from the end of the truck frame to the bottom of the pedestal. The pedestals are cast steel with machine-faced tops and sides.

The journal boxes make a fairly tight fit in the pedestal, so that there is little lost motion horizontally. The equalizer bars are 6-in. x 2-in. forged steel, with the ends flattened and grooved to fit well on the journal boxes. On the equalizer bars rest the spring seats for double spiral springs. The journal boxes are made to M. C. B. standards, of malleable iron, McCord pattern. The springs, which are graduated according to the weight of car body to be carried, are double spiral on the equalizers and triple elliptical on the bolster. The latter are carried on a swinging spring plank. The bolster is of forged steel, 8 in. x 1⅛ in., in the form of a truss, the ends being turned with a boss to prevent sagging and take the strain off the bolts. The transoms are of 10-in. x ¾-in. steel, 11¾ ins. wide, fastened to the top frame and arch bars by a combined malleable corner post and swing-hanger casting, which is reinforced by ½-in. shear steel plates, securely riveted to the transoms and the top frame. The stiffness of the transoms and corner plates keeps the frames from getting out of square and causing sharp flanges on the wheels.

The spring plank is suspended from the sides of the transom by steel hangers, held up by 2-in. turned steel pins. The steel plank has a lateral swing of 1¼ ins. The top seats of the elliptic springs are of cast steel with the sides machine faced to the exact width of the transoms, thus eliminating lost motion at this point. The brake beams are 4¼-in. x 1⅛-in. steel, and the rods 1¼-in. round steel. The adjustment is by turnbuckles in the center. The Christie brake-shoe head and standard flanged brake-shoe are used. The side bearings, which are raised and riveted to the top of the elliptic spring seat, are made of forged steel, 3 ins. x 1 in., 30 ins. long, with the ends turned. The axles are hammered steel with standard M. C. B. journals, and the journal boxes are fitted with standard M. C. B. brasses. In fact, all wearing parts are interchangeable with steam railroad trucks of the same capacity.

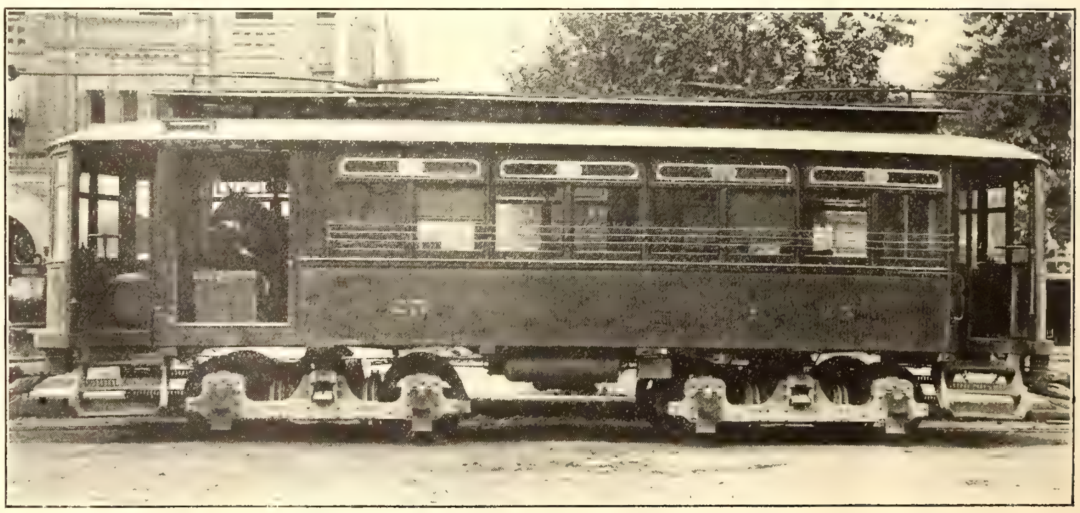
As stated before, this truck is built for the heaviest electric service, including that under electric locomotives. The whole design of the truck is such as to avoid as far as possible any shearing strain on bolts or rivets. All the holes are reamed and the bolts turned, so as to make a driving fit. These points make it adapted to heavy service and prevent rattling after they are put in service.

OUTING OF ST. LOUIS STREET RAILWAY MEN

One of the largest picnics ever held in the neighborhood of St. Louis was the outing of the employees of the United Railways Company, at Creve Coeur Lake, Aug. 30 and Sept. 1. That every conductor and motorman might have a good time it was made a progressive picnic, one set of men running double time, taking out the regular cars on the regular runs, besides the extra cars that conveyed the picnickers to the lake where the big outing was held. The next day the pleasure-seekers changed places with the men who were on duty. The United Railways Company made arrangements to give transportation to the car men and their families. The men received badges which entitled them to transportation and picnic privileges. A white badge was recognized the first day and a yellow badge the second. Thirty events were arranged for during the two days' carnival and many handsome prizes were awarded to the winners. Capt. Robert McCulloch provided an ox for an old-fashioned barbecue each day of the picnic.

TRANSPORTING HORSES BY ELECTRIC CARS ON THE SPRINGFIELD & URBANA RAILWAY

One of the possibilities for shipping freight over traction lines is shown in the accompanying illustration. The Dayton, Springfield & Urbana Railway, of Springfield, Ohio, the other day accepted for shipment a small horse, destined for Akron, Ohio. It was crated in a good stout crate, and was handled in a combination car without any difficulty, except that it took several good, strong men to get it in and out of the car.



CARRYING A HORSE IN COMBINATION CAR ON THE SPRINGFIEL & URBANA RAILWAY

Several of the Ohio roads have done quite a business in transporting horses in this way.

FINANCIAL INTELLIGENCE

Wall Street, Sept. 13, 1905.

The Money Market

The feature of the money market this week has been the decided weakness in the sterling exchange market. The heavy offerings of bankers' bills, together with a liberal supply of exchange against the shipments of cotton, carried the rate for prime demand sterling off about a cent on the pound to 4.8505, a point which permits the importation of gold from Europe at a profit. So far only $1,200,000 gold has been engaged in London for shipment to New York, but the opinion appears to be quite general among foreign bankers that additional consignments of the yellow metal will be received at this center from Europe. The importation of gold, however, has not had the slightest influence upon rates for money. The outflow of funds to interior points for crop-moving purposes continues on a large scale, which, together with an increased demand for all classes of accommodations, has held the market decidedly strong. Money on call loaned at 2¼ to 3 per cent, the average rate being about 2¾ per cent. Lenders reported a better inquiry for time money, especially for the short maturities, which command 4 per cent, as against 3½ per cent a week ago. The demand for over the year maturities has not been urgent, but bankers generally are holding the rate firm at 4½ per cent. Specialists in commercial paper report an increasing supply of good names at the ruling rate of 4½ per cent for the best names. The European markets have displayed a firmer tendency, the Bank of England advancing its discount rate to 3 per cent, while the Imperial Bank of Germany's rate was raised to 4 per cent. The bank statement, published last Saturday, showed a decrease in cash of $10,958,800, which was much larger than had been generally expected. The decrease in loans of $30,237,300 resulted from the shifting of loans from the banks to other institutions. Deposits were smaller by $41,165,100. The reserve required decreased $10,291,275, resulting in a decline in the surplus reserve of only $667,525. The surplus now amounts to $4,831,350, as against $38,438,250 in 1904, $15,372,200 in 1903, $715,050 in 1902, $7,110,550 in 1901, and $26,056,250 in 1900.

The Stock Market

Trading in the stock market has been upon a somewhat smaller scale this week, and although prices continued to show decided irregularity, the general tone of the market was considerably stronger. In the early dealings the market was under heavy selling pressure, both from local and foreign account, which carried prices off sharply, but toward the close the market grew stronger and in many instances sharp recoveries were recorded. The early selling was caused largely by the uncertainty regarding the immediate future of the money markets both here and abroad. The local banks continue to ship large amounts of funds to the West and South for crop-moving purposes, but the opinion prevails in banking circles that while rates for both call and time loans may work a little higher, there is not the slightest danger of a money stringency. The foreign money markets have displayed a hardening tendency, the Bank of England and the Imperial Bank of Germany both raising their discount rates to 3 and 4 per cent, respectively. During the latter part of the week, the market responded to the continued activity in iron and steel, and to the continued improvement in general trade conditions. Railroad earnings with few exceptions were extremely favorable, and reports from the Western traffic managers were very encouraging for a continuation of the heavy movement of freight. The government crop report, which was extremely favorable, predicted record-breaking crops for both wheat and corn. The sharp decline in the price of sterling exchange to 4.85 for prime demand bills, and the subsequent engagement in the London market of $2,000,000 gold for shipment to this side, also imparted a decidedly better feeling This is the first engagement of gold for import this year, and it is generally believed that the movement of the yellow metal in this direction will assume larger proportions in the near future.

At the beginning of the week, the steel stocks and amalgamated copper were under pressure and declined sharply, but in later dealings there were sharp recoveries in all of their issues. Other strong issues at the close were Great Northern, Northern Pacific, St. Paul, Chicago & Northwestern, St. Paul, Reading, and Missouri Pacific, and in the specialties, Tennessee Coal & Iron, and American Smelters. Erie ruled decidedly strong throughout the week, upon rumor that the company was to secure control of the C., H. & D., Pere Marquette system, but no official confirmation of the report was forthcoming,

The local traction stocks ruled quiet and generally lower.

Philadelphia

Dealings in the traction stocks continued upon an extremely small scale this week, but prices, with one or two exceptions, have displayed decided firmness, notwithstanding the irregularity in other quarters of the market. Philadelphia Company common furnished the principal feature, both as regards activity and price movements. From 45¾ at the opening the price sagged off to 45½, but later advanced to 46⅛, and closed at the highest. About 2300 shares changed hands. Of the preferred stock 100 shares were traded in at 47½. Philadelphia Traction displayed strength early in the week, about 400 shares selling at 101, but toward the close sales of odd lots were recorded at 99 ex the dividend. Consolidated Traction of New Jersey held firm, upwards of 900 shares selling at 83⅞ to 83¾. Philadelphia Rapid Transit opened at 28½, and on the exchange of several hundred shares the price eased off to 28⅛. Fairmount Park Transportation sold at 17 to 16¾ for 200 shares. American Railways brought 53¼ and 180, Rochester Railway & Light preferred brought 104½.

Baltimore

The United Railway issues continued to furnish the principal feature of the Baltimore market. Dealings in the stock and the incomes have been upon a much larger scale, and the impression prevails that more than one interest is seeking control of the company. The free stock sold to the extent of about 4500 shares, at prices ranging from 16 to 16¾, while upwards of 4000 shares of the deposited stock brought from 16½ to 17. The free incomes were in good demand, and about $150,000 sold at from 65⅞ to 66½. The trust receipts, representing income bonds deposited, brought 65 for $28,000. The 4 per cent bonds ruled quiet but steady, $40,000 of them changing hands at 93 and 92¾. Virginia Electric Railway 5s were fairly active and strong, $12,000 bringing 99¾. Washington City & Suburban 5s sold at 105¼ to 105½ for $5,000. Other transactions included $2,000 Norfolk Railway & Light 5s at 94, $1,000 Baltimore City Passenger 5s at 106¾, $9,000 Macon Railway & Light 5s at 99⅝ and 99¼.

Other Traction Securities

The Chicago market has been quiet and absolutely featureless. Metropolitan Elevated common sold at 25 and 24½ for 200 shares, while 270 of the preferred stock brought from 68 to 67, the final transaction taking place at 67½. South Side Elevated ruled steady, with a sale of 150 shares at 98. Chicago & Oak Park brought 5, and the preferred sold at 18. Northwestern common changed hands at 21½ and 21⅜, and the preferred at 61½ and 61. The Boston market has been dull and heavy, the feature being a drop in the price of Massachusetts Electric from 17½ to 16 on the exchange of a little more than 500 shares. The preferred stock was relatively firm, with sales at 59½ and 60. Boston Elevated sold at the opening at 154½, and later broke to 153, but at the close there was a recovery to 153⅞. Other sales recorded were Boston & Worcester at 24½, the preferred at 74. Boston & Suburban at 21 and the preferred at 67. West End common held firm, 250 shares changing hands at 99, while small amounts of the preferred sold at 113½ and 113. In the New York curb market, Interborough Rapid Transit displayed early strength, sales taking place at between 220 and 218½, but later there was a drop to 213½, caused by the accident on the Ninth Avenue Elevated line. At the close there was a recovery, 216. Upward of 5700 shares were traded in. New Orleans Railway stocks ruled strong, the common bringing 37½ and 37 for about 900 shares, while 800 shares of the preferred brought from 78½ to 80¼. The 4½ per cent bonds brought 91 and 90⅞ for $22,000. Washington Railway & Electric common sold at 42½ and 43 for 300 shares, and $25,000 of the 4s brought 90½ and 91. Other sales included $28,000 Jersey City, Hoboken & Paterson 4s at 76½ and interest, $50,000 Public Service certificates at 69¾ to 70¼ flat, and $25,000 public Service 5 per cent notes at 97⅛ and interest.

Aurora, Elgin & Chicago common had another pronounced gain last week. Early in the week it declined to 24⅞, and since then it has been in strong demand, with a steady upward climb, reaching 28½ the fore part of this week. It is understood that certain Cleveland interests are endeavoring to buy sufficient of this stock to

secure a place on the board. The fine increases in earnings, however, and the prospects of a freight contract for business in Chicago are causing it to be tipped for further increase. Lake Shore Electric voting trust certificates were firm at 12½ to 13. Cleveland & Southwestern common is showing an upward tendency, and advanced from 9¾ to 11, Northern Texas Traction has moved up to 73, on reports of an increased dividend. Cleveland Electric was firm at 79¾.

Cincinnati Street Railway was active at Cincinnati, and made a fractional gain to 147. Cincinnati, Dayton & Toledo sold at 23¾, and was in good demand on the statement that dividends are soon to commence. Cincinnati, Dayton & Toledo 5s, to the amount of $63,000, sold at 96 to 97¼. Detroit United sold at 94. Toledo Railway & Light at 34½.

Security Quotations

The following table shows the present bid quotations for the leading traction stocks, and the active bonds, as compared with last week:

	Sept. 6	Sept. 13
American Railways	53½	52½
Boston Elevated	154	153½
Brooklyn Rapid Transit	69¼	67½
Chicago City	190	a195
Chicago Union Traction (common)	8⅜	8
Chicago Union Traction (preferred)	—	—
Cleveland Electric	80	79
Consolidated Traction of New Jersey	—	82
Consolidated Traction of New Jersey 5s	109½	109
Detroit United	93⅜	93¼
Interborough Rapid Transit	219	215¾
International Traction (common)	34	32½
International Traction (preferred) 4s	73½	73
Manhattan Railway	164	165
Massachusetts Electric Cos. (common)	17	15½
Massachusetts Electric Cos. (preferred)	60	59½
Metropolitan Elevated, Chicago (common)	24½	22⅝
Metropolitan Elevated, Chicago (preferred)	67	68
Metropolitan Street	129⅛	127
Metropolitan Securities	82¾	81
New Orleans Railways (common), W. I.	36½	37
New Orleans Railways (preferred), W. I.	78⅝	80
New Orleans Railways, 4½s	90½	90½
North American	98¾	98¼
North Jersey Street Railway	—	28
Philadelphia Company (common)	45¾	46¼
Philadelphia Rapid Transit	28¼	28
Philadelphia Traction	101	—
Public Service Corporation 5 per cent notes	96¾	96½
Public Service Corporation certificates	69¼	69¼
South Side Elevated (Chicago)	a98	a99
Third Avenue	127	127½
Twin City, Minneapolis (common)	115½	117½
Union Traction (Philadelphia)	61¼	61¾
West End (common)	99	99
West End (preferred)	113	113

a Asked. W. I., when issued.

Iron and Steel

The "Iron Age" says a review of the whole iron industry justifies the general statement that it is enjoying great present activity and a brilliant promise for the future. The usual doubts as to an adequate amount of work for the winter months have not even arisen this year, and the outlook is for work at high pressure well into next spring. Added to this come reports of a distinct improvement in England, whose business has been lagging until lately, the Continent having sent cheerful reports since the summer, There have been further heavy purchases of steel rails, the Pennsylvania Company leading with over 170,000 tons distributed among the mills on the line of the road. It is understood that the New York Central is negotiating for 160,000 tons, and there are besides in the market one system for 35,000 tons, and another for 50,000 tons. It is reported that negotiations will be closed for the sale to the Steel Corporation of from 10,000 to 15,000 tons of Bessemer pig iron for September delivery. During the past week smaller interests have taken moderate amounts at the range of $14.85 to $14.90 valley furnace, and some fair sized lots of basic pig have also been placed.

The City Council has offered to grant the Toledo Railways & Light Company a five-year franchise over the route which it desires to build to connect with the new line to Ottawa Park, which has been built by John Kumler. The city company is not inclined to accept this grant.

BUFFALONIANS SECURE OPTIONS ON OHIO PROPERTIES

W. Caryl Ely, formerly president of the International Railway Company, of Buffalo, and president of the American Street Railway Association, has secured options on the electric railways of East Liverpool, Wellsville and Rock Springs, Ohio, and Chester, W. Va., together with the electric lighting plants of all these places. The East Liverpool system on which Mr. Ely has secured an option has the right to construct an additional line from Wellsville to Steubenville, Ohio. The road that he has optioned running from East Liverpool to Chester, W. Va., owns the suspension bridge across the Ohio River at this point, which is included in the option. Along with the other options secured are an application for a charter for a new line from East Liverpool to Beaver, Pa., and a very fine summer park at Chester. The properties on which options have been secured are owned by divergent interests. In the event of their purchase Mr. Ely will combine them all into one company.

STONE & WEBSTER GET NORTHERN TEXAS TRACTION

From Cleveland comes the statement that Stone & Webster, of Boston, have arranged to purchase the Northern Texas Traction Company from the Ohio interests that are in control of the property. The terms of the sale are said to provide that the Northern Texas Traction Company turn over to the syndicate enough stock to give it control. This majority of stock is to be paid for on the basis of $75 a share. The syndicate also agrees to buy the balance of the stock at the same figure when it is put on the market. The capital stock of the company is $2,500,000. The authorized bond issue is $2,500,000. The company owns 27½ miles of line in Fort Worth and a line of 30 miles from Fort Worth to Dallas, and a pleasure resort half way between the two places.

TROLLEYS AND FINANCES

The continuous and striking development of trolley systems, etc., and the need for new money in their development, is thus noted by the "Wall Street Journal:"

Fourteen corporations, either operating street railways or connected therewith directly, have taken from the Wall Street market in the four months ending Sept. 1, nearly $48,000,000 of cash. The total does not include the dozens of small railways in various districts which have come to the New York underwriters for small amounts of cash for extensions, etc.

The list is bigger than for the four months ending May 1. While the steam railways have checked their financing, the street railway industry seems to have taken a new lease of life. There was but one item of importance in the street railway underwriting of the first third of the year, while the second third brought four items of $5,000,000 or over. The list is as follows:

Brooklyn Rapid Transit	$1,000,000
Consolidated Railways of Connecticut	1,000,000
Detroit United	6 585 000
Havana Electric	5.000,000
Interborough	10,000,000
International Traction	1,000,000
Indianapolis & Southeastern	1,000,000
Philadelphia & Western	1,600,000
St. Louis Transit	1,000,000
Street Car Consolidation	11,000,000
South Side Elevated	2,500,000
Toledo & Western	2,500,000
United Railways of Baltimore	1,000 000
West Penn	2,500,000
Total street railways	$47,685,000

It will be noted that the largest item is the $11,000,000 for the organization of the street car trust. This is but part of a bigger capitalization in stock. The underwriters have supplied the cash to combine practically all the big manufacturers of street cars, along the lines followed by the steam railroad equipment consolidations in 1900-1903. This is an important development, with its principal bearing, so far as Wall Street is concerned, in the fact that the street car business is now regarded by financiers as so far assured that it warrants a combination of this kind. It is but a few years since the electric street railway industry in this country was experimental.

Brooklyn Rapid Transit is credited unofficially with an additional $2,000,000 of bonds. The item listed is official. In the first quarter the company issued nearly $6,000,000 of its refunding bonds to the $1,000,000 in the second period. The Interborough kept up the reputation of New York City tractions for spending money by the issue and sale of the $10,000,000 of notes to pay for extensions. The big issue of Detroit United bonds was largely in the nature of refunding.

MODIFIED PLAN FOR CAR MERGER

The syndicate, of which Kean, Van Cortlandt & Company, of New York, are managers, formed to finance the merger of the street car manufacturing companies, has virtually acquiesed to the demand of G. Martin Brill, who will be the president of the new company, to provide about $2,000,000 more cash for working capital than was provided by the original plan. In consequence, the syndicate managers will issue a modified plan in about a week. The plan promulgated early in August held in reserve $2,000,000 of 5 per cent bonds out of the total issue of $13,000,000.

It is understool that under the new plan this $2,000,000 will be sold at once, the proceeds to be appropriated as working capital. The new arrangement will give the company more than $4,000,000 working capital as against about $2,000,000 under the original plan. The various companies that are to make up the new combine are preparing detailed reports of their affairs, to complete which will require some time. These companies are conducting their business in such a way as to facilitate, as much as possible, the carrying out of the merger. Orders are being taken subject to execution by the combine, if it is consummated before the independent concern can execute them.

The new company has not yet been incorporated, but it will be just as soon as the details in connection with the merger are all worked out.

ANNUAL REPORT OF THE BROOKLYN RAPID TRANSIT COMPANY

The annual report of the Brooklyn Rapid Transit Company for the year ending June 30, 1905, has just been made public. It reviews briefly the general condition of the property and notes additions and improvements that have been made during the past year. The record of earnings of the company for the year follows:

Gross Earnings	1905	1904
Passenger	$15,649,400	$14,429,546
Freight, mail and express	219,640	127,260
Advertising	123,510	132,655
American Railway Traffic Company	340,892	65,696
Total earnings from operation	$16,333,444	$14,755,158
Operating Expenses		
Maintenance of way and structure	$816,275	$615,669
Maintenance of equipment	1,655,622	1,206,325
Operation of power plant	1,356,620	1,501,745
Operation of cars—trainmen's wages	2,768,860	2,673,863
Operation of cars—other expenses	1,213,708	1,129,711
Damages and legal expenses	999,526	987,634
General expenses	552,068	537,264
Freight, mail and express—expenses	139,515	45,893
American Railway Traffic Co.—expenses	301,672	62,330
Total operating expenses	$9,803,870	$8,760,438
Net earnings from operations	$6,529,574	$5,994,719
Income From Other Sources		
Rent of land and buildings	$59,741	$56,711
Rent of track and structure	101,504	103,071
Miscellaneous	90,890	35,620
Total income	$6,781,709	$6,190,122
Deductions		
Taxes	$827,951	$748,258
Interest and rentals—net	4,350,540	4,052,956
Total deductions	$5,178,491	$4,801,214
Net income	$1,603,218	$1,388,907
Special appropriations	453,284	383,706
Surplus	$1,149,933	$1,005,201
Surplus June 30, 1904	$1,594,189	
Total surplus	$2,744,123	....
Of this amount there has been appropriated in adjustment supply accounts	$12,600	....
For discount on bonds sold	1,746,800	....
Total	$1,759,400	....
Balance surplus	$984,728	....

CONSOLIDATED GENERAL BALANCE SHEET, JUNE 30, 1905

ASSETS

Cost of road and equipment (properties owned in whole or in part by Brooklyn Rapid Transit Company)		$103,360,104
Advances account of construction for leased companies		6,974,817
Brooklyn City Railroad Company	$6,496,140	
Prospect Park & Coney Island Railroad Company	478,676	
Construction expenditures, constituent companies (to be reimbursed by issuance of Brooklyn Rapid Transit 1st refunding gold mortgage 4 per cent bonds, upon deposit with Central Trust Company, trustee, of certificates of indebtedness to cover)		2,154,924
Guaranty fund (securities and cash)		4,005,755
Treasury bonds		2,417,000
Brooklyn Rapid Transit first refunding gold mortgage 4 per cent	$2,307,000	
Other issues	110,000	
Treasury stock		146,228
Current assets		2,831,047
Cash on hand	$1,430,495	
Due from companies and individuals	445,557	
Construction material and general supplies on hand	804,137	
Real estate mortgages	6,500	
Prepaid accounts	144,357	
		$121,889,876

Note.—The certificates of indebtedness issued by constituent companies, aggregating $12,964,989.24, against which Brooklyn Rapid Transit bonds have been issued, do not appear separately on this consolidated balance sheet, as the property purchased appears as an asset under the head of "Cost of Road and Equipment," and "Advances Account Construction for Leased Companies," and the liability is represented by the bonds of the Brooklyn Rapid Transit Company, issued from time to time as such certificates of indebtedness are acquired and deposited with the Central Trust Company, trustee.

LIABILITIES

Capital stock		$45,956,605
Brooklyn Rapid Transit Company	$45,000,000	
Outstanding capital stock of constituent companies	956,605	
Bonded debt and real estate mortgages		72,160,680
Brooklyn Rapid Transit Company	$26,307,000	
Bonded Debt of Constituent Companies		
Brooklyn Heights Railroad Company	250,000	
Brooklyn, Queens County & Suburban Railroad Company	6,624,000	
The Nassau Electric Railroad Company	15,000,040	
Sea Beach Railway Company	650,000	
Brooklyn Union Elevated Railroad Company	23,000,000	
Real estate mortgages	329,640	
Current liabilities		2,713,589
Audited vouchers	$1,239,905	
Due companies and individuals	88,658	
Taxes accrued and not due	694,906	
Interest and rentals accrued and not due	636,713	
Interest accrued on real estate mortgages and not due	1,977	
Insurance reserve fund	51,428	
Contractors' deposits		37,500
Long Island Traction Trust Fund		9,440
Accounts to be adjusted		27,337
Surplus		984,723
		$121,889,876

President Winter in presenting the report reviewed briefly the condition of the property and noted additions and improvements that have been made during the past year. The latter extend to all departments of the company. President Winter said in part:

During the year the increase in maintenance of way and structure item amounted to $200,606.07, or 32.58 per cent, and was prin-

cipally due to repaving between tracks, bonding rails and the renewal of a large amount of wornout track and special work.

Maintenance of equipment shows an increase for the year of $449,296.92, or 37.25 per cent, in part attributable to radical power station machinery overhauling, but principally on account of standardizing and fire-proofing the elevated cars and partially rebuilding surface cars.

The work of rebuilding and fitting the elevated steam cars from electric operation, since the use of locomotives was abolished, has been delayed by tardy delivery of materials. This work will, however, be completed within the present year.

There have been added to the equipment 100 new elevated motor cars and 87 convertible surface cars. In further addition, 100 elevated and 114 convertible surface cars are to be received during the present summer. The surface cars have a seating capacity for 48 passengers, are convertible to winter or summer service, and are fitted with air brakes and four 40-hp motors.

The new Williamsburg power station building is approaching completion. One 7500-kw turbo unit and one 5500-kw unit, will be installed about the end of this year, and a third unit of 7500-kw capacity during the summer of 1906. Additional units will be installed from time to time according to the requirements of the company's business. This station is designed for an ultimate capacity of 100,000 kw or 130,000 hp.

The work of reinforcement of various sections of the elevated structure is progressing satisfactorily. Myrtle Avenue structure, between Hudson Avenue and Adams Street, is completed, and the Adams Street structure, between Myrtle Avenue and Brooklyn Bridge, is more than half finished.

The bonding of the elevated structures to enable their use for return circuit has been completed.

All platforms on the Fifth Avenue and Lexington Avenue lines have been lengthened to accommodate six-car trains. The same will be done with the balance of the elevated system.

The general rearrangement of the elevated station, storage yard shops, and shop yard at Thirty-Sixth Street and Fifth Avenue, was commenced by the construction of a four-track station, the laying of new side-tracks, and new tracks connecting with surface lines leading to Coney Island and other outlying districts.

On the site of the yard at Thirty-Sixth Street, heretofore used for storage of track materials, and on adjoining land of the company, construction of a yard of large capacity for elevated cars was commenced, and eight concrete inspection pits put in in advance of the repair shop, for which plans are now in preparation.

A new elevated yard, with capacity for 327 cars, has been well advanced, together with elevated car repair shop under construction at East New York. This plant, consisting of tracks divided into sections by fire walls, shops, inspection sheds, with a capacity for 48 cars, storehouse and appurtenances, will be ready for service by the close of the present year, or shortly thereafter.

Under the act for elimination of grade crossing on the Brighton Beach line, the elevated structure has been extended from St. Marks Avenue to Sterling Place, abolishing grade crossings at Prospect Place and Park Place. A station at Park Place has been built.

A new line constructed through Wyckoff Avenue and McKibbin Street, from the intersection of Myrtle and Wyckoff Avenues, at Ridgewood, to Broadway, 3.41 miles of single track—opening a new section to Williamsburg Bridge; the extension of the double-track Kingston Avenue line, from Douglass to Carroll Street; of the Union Street line, by single track, from Court to Hamilton, and the construction of a new single-track line through Varick Avenue, from Metropolitan Avenue to the company's Newtown creek dock, .264 miles, were completed during the year. A number of new spurs and side tracks were also laid, the total representing 8.982 miles of single track. In various parts of the city thirty new pieces of special work were installed. At power stations, shops and depots, 6300 ft. of single track were laid for the better handling of supplies and equipment.

A large amount of track re-bonding was done, fifty pieces of old special work were replaced with new, and 4½ miles of single track relaid with standard girder rail. There were welded by electricity 14,851 joints, and tracks thoroughly repaired. Upwards of 93,000 square yards of first-class pavement was laid, covering about 50,000 ft. of double track.

Car storage yards were constructed at the following points, of the capacity indicated:

Wyckoff Avenue, Ridgewood..................	52 cars.
Fifth Avenue and Twenty-Third Street........	89 "
Flatbush Avenue and Duryea Place	222 "

The surface car yard, covering the block between Ninth and Tenth Avenues and Nineteenth and Twentieth Street, is partly completed. It is intended to cover this yard as early as practicable, and provide facilities for light repairs.

The Brighton Beach Hotel property was overhauled and repainted, the bulkhead partly rebuilt, and material changes and additions made in the track arrangement of the terminal yard in order to meet the requirements arising out of new developments at that point.

An instruction room has been provided in the Fifty-Eighth Street depot, fitted with apparatus necessary for the thorough schooling of trolley men, and a school car equipped for the instruction of elevated trainmen.

The ten-story addition to the general office building is completed. With the interior rearrangement of the old building now nearly finished, all departments heretofore occupying leased quarters in different parts of the city will be brought under one roof.

With an increase of upwards of $500,000 insurance carried by this company, an annual saving in premiums of $12,000 was effected through the institution of improvements, and by the systematic exercise of protective measures, at a comparatively light cost.

Trolley service over the Williamsburg Bridge to Delancey Street, Manhattan, was inaugurated in November last, and has been continued up to the limit of the capacity afforded by the wholly inadequate terminal provided by the city of New York at the Manhattan end of the bridge.

Within the last fiscal year the aggregate bonded debt and real estate mortgages show an increase of $4,836,500, represented by the issuance of $4,849,000 Brooklyn Rapid Transit first refunding gold mortgage 4 per cent bonds, and the payment of $12,500 real estate mortgages.

As shown in the previous year's report, there were outstanding June 30, 1904, Brooklyn Rapid Transit bonds to the amount of $21,458,000, with $5,724,000 bonds in treasury; while June 30, 1905, the total of these issues is $26,307,000, with $2,417,000 bonds in the treasury.

The sales during the year consist of $8,156,000 Brooklyn Rapid Transit refunding gold mortgage 4 per cent bonds.

Since our last report, the validity of the special franchise tax has been established, although there remains for final adjudication the question of offsets, which our counsel advise the company is entitled to under the special franchise tax law, but which the city has thus far refused to allow. Pending determination of this question, payment has been made of all past years' taxes, less such offsets, except in the borough of Queens for the years 1901 to 1904, where the assessments are grossly excessive and being contested on that ground. The amounts paid have been charged against the tax reservation fund set aside for this purpose.

THE PENNSYLVANIA AND OHIO CONSOLIDATION

The date of the plan and agreement of merger of the Youngstown-Sharon Railway & Light Company and the Pennsylvania & Mahoning Valley Railway Company, as the Mahoning & Shenango Railway & Light Company, announced by Sanderson & Porter, of New York, was extended until Sept. 6, at which time it is understood that a large majority of the owners of the stock of the Youngstown & Sharon and the Pennsylvania & Mahoning Valley Companies had given formal assent to the plan of consolidation.

As stated in the STREET RAILWAY JOURNAL of Sept. 2, in which the plan of the merger was fully outlined, the Mahoning & Shenango Railway & Light Company, capitalized at $10,000,000, of which $4,000,000 is 5 per cent cumulative preferred, and $6,000,000 common, has been formed under the laws of Pennsylvania to effect the consolidation. Of the capital stock of the new company, $1,600,000 par value of the preferred stock and $2,400,000 par value of the common stock are set aside for the acquisition of the Youngstown-Sharon Railway & Light Company, and $2,400,000 par value preferred stock and $3,600,000 par value common stock are set aside, for the acquisition of the Pennsylvania & Mahoning Valley Railway Company.

The new company will also authorize and provide for an issue of $10,000,000 of ten-year first consolidated refunding 5 per cent gold bonds, of which bonds to the par value of $3,000,000 are to be made available for extensions, betterments and improvements of the properties of the new company, and the acquisition of new properties. Two million eight hundred thousand dollars par value of the said bonds will be reserved by the trustee under the mortgage for the purpose of taking up and retiring a like amount of underlying bonds of the Youngstown-Sharon Railway & Light Company. One million three hundred and twenty-five thousand dollars of the bonds will be used in the acquisition of the Pennsylvania & Mahoning Valley Railway Company, and $2,875,000 will be reserved by the trustee under the mortgage for the purpose of taking up and retiring a like amount of underlying bonds of the Pennsylvania & Mahoning Valley Railway Company.

ROCK ISLAND MAY HAVE TO ABANDON INTERURBAN SERVICE

It now develops that the Rock Island Railroad, which has established suburban service between Iowa City and Cedar Rapids, Ia., in order to compete for passenger traffic with interurban lines connecting those cities, and also between Des Moines and Indianola with the idea of shutting off the construction of a proposed interurban line connecting these two points, may be compelled to abandon its plan of competing with interurbans which touch points within its territory. A few weeks ago the Rock Island established a half-fare round trip rate between Cedar Rapids and Iowa City, and also put on several extra suburban trains, in order to regain some of the passenger traffic which had been diverted to the interurban line connecting those points. The company at the same time also put on several extra trains and made a cheap round-trip rate on the branch line from Des Moines to Indianola, Iowa. The question has arisen, can the Rock Island or any other steam railroad under the laws of Iowa establish a lower rate on a part of its system than upon the whole? The law provides one exception to the provision prohibiting a lower rate per mile on a part of its system, and that is in cases of excursions. The Rock Island, of course, now maintains that the rates provided for the section of the line between Iowa City and Cedar Rapids, and between Des Moines and Indianola are excursion rates, although the rates are maintained constantly from day to day. The matter will no doubt be decided in the courts, as parties living in Cedar Rapids have decided to make a test case of the matter. They have demanded the same rates per mile for passenger fare over the road for points beyond Iowa City, and having been refused have brought suit against the company to compel it to give the same rates per mile. While the matter is in the courts, the Rock Island will maintain the cheap rates.

NEW HAVEN PLANS TROLLEY LINE

The New York, New Haven & Hartford Railroad Company, which recently purchased the New York & Stamford Electric Railway, is negotiating for right of way for an electric railway extension from Port Chester to White Plains. When completed this link will be the most important of the entire system of Westchester County, as it will shorten the distance between Port Chester, Rye Beach and the county seat at White Plains, 40 minutes to an hour. It is proposed to construct a double-track road, which will guarantee a high-speed schedule. One of the chief obstacles to the road was the opposition of Whitelaw Reid, whose large estate, Ophir Farms, abuts on nearly a mile of the highways of the town of Harrison. Ambassador Reid held that an electric railway in front of his place would depreciate its value, and refused to give his consent. Another large interest which blocked the way was the estate of the late Joseph Park, head of the firm of Park & Tilford. It is said that by the recent purchase of the electric railway by the New Haven railroad corporation, these interests have been placated and the extension made possible. The extension will be about 7 miles in length, and will connect with the Union Railway, of New York, at White Plains for Tarrytown and the Hudson River towns, giving them a quick route to Rye Beach. A large part of the route will be over private right of way.

TRANSFER SWINDLE IN PENNSYLVANIA

A scheme has been unearthed at Allegheny, Pa., by which the Pittsburg Railway Company is understood to have been swindled out of considerable money through the manipulation of transfers. Postoffice clerks, letter carriers and small trades people are implicated. Already one letter carrier has been formally dismissed from the service and more are likely soon to go. Arrests, it is said, may even follow where there is hope of convicting the culprits. Postal inspectors discovered that in Allegheny it is not an unusual thing for men to carry their own street car punches for transfers. It was found that a barber shop was giving a transfer with every shave. The patron indicated to what point and at what hour he wanted to use the free transportation, and the barber made the necessary punch marks. In some way the letter carriers secured a large number of transfers and some of them were equipped with punches similar to the ones used by street car conductors. There was also a system of exchanges among the carriers. The Allegheny postoffice is located near a general transfer point of the railway company. A carrier coming off his route would exchange transfers good for a line on which some other carrier lived, the exchange taking place at the postoffice. If the time limit had expired a new punch mark would be made. In case the conductor lifting the transfer complained, he was told the conductor issuing the slip had made a mistake and had to use his punch a second time.

DECISION AFFECTING STONE & WEBSTER WASHINGTON INTERESTS

The Supreme Court of the State of Washington has just handed down a decision in favor of the Tacoma Industrial Company, a Stone & Webster property, and adverse to the Baker interests of Seattle in the White River Company, an adjunct of the Snoqualmie Power Company—now the Seattle-Tacoma Power Company. This decision, after prolonged litigation, gives the Stone & Webster interests practical control of ample sources of water supply to provide all the electric power that can be used in Seattle and Tacoma for many years to come in connection with the electric railway and lighting properties in which they are largely interested, as well as for general power purposes.

THE TROLLEY IN A POLITICAL CAMPAIGN

Governor Myron T. Herrick, who is prominently identified with some of the traction interests of Ohio, will use the electric railway almost exclusively in his campaign for re-election this fall. Arrangements have been made with the manager of practically every electric railway in the State to handle the Governor's special car. The start will be made Monday, Sept. 25, and meetings will be held in every town on the Cleveland & Southwestern. Then the Lake Shore Electric system will be worked, and so on over the roads out of Toledo and the numerous roads in the western and southern portions of the State, finishing with trips through the central and eastern portions of the State. Over two-thirds of the county seats, and hundreds of small towns are accessible by electric railways. An ordinary trolley car will be used with no suggestion of palace or parlor car effects. The seats will be removed and tables and chairs installed. Only in cases of emergency will meals be served on the car, and no sleeping accommodations will be provided. The car will be plentifully stocked with campaign literature, and wherever possible, in small hamlets and villages, stops will be made and platform speeches made. In this campaign the Governor aims to touch elbows with the people, and he thinks he can do it better this way than by any other means.

AN ATTRACTIVE WALL TIME-TABLE

An unusually attractive street railway time-table is in use this summer by the lines of the New Hampshire Traction Company. The poster form was adopted, so that the time-table could be used on walls at hotels, resorts and other public places along the company's lines. The time-table is, roughly, 3 ft. high and 2 ft. wide, and in very readable form it gives all the important facts about the system which the traveler desires to know. The quality of the paper is far ahead of the ordinary poster, and the typography and arrangement of the information printed are excellent. The design was made under the direction of E. P. Hulse, advertising manager of the company. The central feature of the time-table is a map of the system, which appears in the middle of the poster. The company's lines are known as the "Gilt Edge Lines," and they comprise 135 miles of track in the Merrimac Valley and along the New Hampshire coast. The routes are shown in a heavy gilt line on the wall map, and connecting lines are shown in dotted gilt. There are three divisions on the system—the Eastern, Western and Northern. The cities and towns of Haverhill, Lowell, Lawrence, Nashua, Portsmouth, Exeter, Hampton, Rye, Seaboard, Salisbury and Hampton Beaches and other centers are connected.

An interesting feature is the comparison of running times with those of other parallel roads. The regular time between the various cities is given, and stress is laid upon the accessibility of these great seacoast resorts of New England by the company's tracks. Another interesting point is the outline of the system's physical and operating characteristics, shown in a telling paragraph at the right of the map. Among the features mentioned are the character of roadbed and track, rolling stock and power stations, equipment, use of arc headlights, block signals, despatching and telephone system, etc. Travelers are reminded that they can escape the smoke, noise and cinders of the steam roads by taking the comfortable cars of the New Hampshire Traction Company, passing through beautiful scenery with greater frequency than the steam roads, and in almost as quick time, as well as at a lower rate of fare. The lower half of the poster is devoted to clearly printed time-tables of the Hampton Beach and Canobie Lake Park lines, while at the top and bottom several photographs of the scenery en route are shown. Perhaps the most striking point about the time-table as a whole is the sectional presentation of a great variety of information in such a manner that one can quickly find the desired fact and yet escape nothing of importance on the balance of the poster. Possibly a tabulation of fares and transfer points would add still greater usefulness to the time-table, but aside from that there is little to suggest in the way of improvement.

NO STRIKE IN NEW HAVEN

After a careful discussion, extending over a period of nearly 2 hours, the employees of the Consolidated Railway in New Haven, at 4 o'clock Thursday morning, Sept. 7, voted to accept the increase in wages offered by the company, which is much smaller than that demanded. The increase really ranges from half a cent an hour to a cent and one-half, according to length of service. New men will be paid 20½ cents an hour, second-year men will receive 21 cents, third-year men 22 cents and older employees 22½ cents. Overtime and snowplow work will be paid for at the rate of 25 cents an hour, as at present. The men asked for 50 cents an hour for overtime work and 25 cents for regular work. In discussing the probability of a strike, one of the men declared before the meeting opened that the action of the road in sending supplies to the various car houses unnerved most of the men, the majority of whom are married and could ill afford a strike.

INCREASING THE MEMBERSHIP OF THE A. S. R. A.

The membership committee of the American Street Railway Association, which was appointed by President Ely at the last convention of the American Street Railway Association, and of which H. H. Vreeland, president of the New York City Railway Company, is chairman, has been and is taking active measures to increase the membership of the association. It is thought by the committee that if most of the companies which are outside of the association at present thoroughly understood the plans of the association and the advantages which are now available, a large increase in membership would follow. For this reason the chairman of the committee is sending a personal appeal to all non-member companies, and is enclosing a copy of the proposed constitution and by-laws of the American Street & Interurban Railway Association. Attention is called in Mr. Vreeland's letter to the advantages to companies of large mileage of having a central bureau of information from which technical and other data can be secured. This will relieve many of the companies of large mileage of supplying the same information of this kind at frequent intervals, and will insure the receipt of prompt and complete information by companies of smaller mileage. A cordial invitation is also extended to all non-member companies to attend the meeting at Philadelphia on Sept. 27 and 28, to become better acquainted with the proposed plans of the association.

SPRINKLER FIRE LOSSES

In view of the growing interest in automatic sprinkler protection, the experience of the Manufacturers' Mutual Fire Insurance Company, of Boston, during ten years, will be interesting. In reporting on fires in sprinkler-equipped plants, this company gives its experience as follows: "In the ten years ending June 1, 1905, this company has paid 1652 claims for loss, averaging $500.23 each, amounting to a total of $826,389.03. Of this number 1622 claims claims averaged $183.60 each, amounting to a total of $296,888.51, thirty claims in excess of $5,000 each averaged $17,650, making a total of $529,500.52. In thirty claims in excess of $5,000 each, eight fires originated in parts of mills or works over which sprinkler protection had not been extended, with a loss of $200,759.70. Thirteen claims were for losses on unsprinkled storehouses, amounting to $183,486.99. When the average loss of $17,650 on risks partially protected or without sprinklers is compared with the average loss on fully protected risks of only $182.60, the attention of members whose works or storehouses still need sprinklers will be called to the necessity of taking immediate action thereon. This experience of ten years sustains the only safe rule: Wherever a sprinkler can be put, put one, especially in the places where fire may be the least likely to originate. It was in such a place that most of the fires registered above occurred, and especially the case in the one in which we met the largest loss."

THE NEW YORK ELECTRICAL SHOW

The announcement has just been made that an electrical show is to be held at the Madison Square Garden, New York, Dec. 11 to 23, inclusive. When one stops to consider how every show that is given in the Garden attracts bigger and bigger crowds each year, the chances of large public patronage are indeed bright. The directors of the show will, however, leave nothing to chance.

The date of the show itself leaves nothing to be desired. Not only is December the height of the season for New Yorkers, but conservative estimates place the transient population at fully 750,000 for that month. With these enormous sight-seeing throngs to draw on, the only requisite to certain success is enough publicity to acquaint the public with the attractions of scientific and popular interest which are to be seen at the Garden. This phase of the work has been given elaborate attention; already a competent advertising department has been established. This department has been given an exceedingly generous appropriation for advertising, and it is certain that the Madison Square Garden Electrical Show will arouse as much public enthusiasm as has the automobile show.

From the exhibit end of the show come equally encouraging reports. Dr. George F. Sever, of the department of electricity of Columbia University, is director of exhibits, and he has already secured enough exhibitors to make the show an attractive one. While considerable space has been secured, some of the best positions are open. Any manufacturer seeking this opportunity to acquaint the public with his product would do well to get in communication at an early date with the company. The office address is 26 Cortlandt Street, New York; telephone 6190 Cortlandt.

REPORT ON THE CHICAGO TRANSPORTATION PROBLEM

The report prepared in 1902 by B. J. Arnold on the Chicago transportation problem for the city of Chicago, has been in such wide demand from engineers, city authorities and students of transportation matters in general, that the author has decided to authorize a reprint of the report and to have it placed on general sale. This has been done by the McGraw Publishing Company. Undoubtedly this is the most important engineering report ever issued on the broad problems of street railway construction, operation and management in a large city. Originally, only a very limited edition was issued for the use of the officials of the city of Chicago, and no copies were offered for sale. An abstract of the report was printed in the Street Railway Journal shortly after it was made public. The complete report as now issued is in two volumes, with 310 pages of text, fifteen folded plates and fourteen large maps. The price of the report complete is $5.

ELKINS-WIDENER AFTER APPLEYARD PROPERTIES

It is understood on good authority that the so-called Widener-Elkins syndicate is negotiating with the bondholders of the Appleyard properties with a view to taking over these lines to form a part of the great system which the syndicate is building in Ohio and Indiana. This report is strengthened by the announcement that the syndicate has practically closed a deal for acquiring the Columbus, Newark & Zanesville and the Columbus, Buckeye Lake & Newark properties.

EARNINGS OF EAST RIVER BRIDGES

While no equitable comparison can be made of the earnings and the cost of maintenance of the Brooklyn Bridge and the new Williamsburg Bridge, still the report of the Bridge Department of New York, covering these structures for the quarter just ended, is of interest as foreshadowing the part each plays in the transportation situation. The receipts of the Brooklyn Bridge during that period amounted to $123,173.47, and the expenses took all but $17,937.18 of the receipts. The Williamsburg Bridge showed expenses of $13,915 for the same period, while the receipts were $30,077.74. The report shows that to July 1 bonds to the amount of $20,438,067.40 had been issued for the construction of the Williamsburg Bridge.

The report shows an average daily travel of 385,265 persons over the Brooklyn Bridge, of which the surface cars carry 156,539, and the elevated cars 194,405, with 19,434 for vehicular and foot travel. The train service on the Brooklyn Bridge averaged 570 elevated trains, or 1728 cars, with 303 bridge local trains of 1212 cars. The surface car service, the commissioner reports, has averaged 3950 cars each 24 hours, varying from 30 cars per hour in the slack time, to 280 cars in the busy hours.

One interesting fact pointed out by the figures regarding traffic over the Brooklyn Bridge is that the bridge crush has driven a certain amount of traffic to the ferries. The average daily travel of passengers from Brooklyn to Manhattan was 199,920, while from Manhattan to Brooklyn it was only 170,558, a difference of more than 29,000. These 29,000 people are the ones who travel daily to Manhattan over the Brooklyn Bridge and return by other routes, whether by the ferries or by the Williamsburg Bridge, to avoid the Brooklyn Bridge crush.

PROF. B. V. SWENSON

As Prof. Bernard V. Swenson, of the University of Wisconsin, is being prominently mentioned for the new office of secretary of the American Street & Interurban Railway Association, his portrait and some particulars of his experience in electric railway engineering are presented in this issue.

Prof. Swenson is a native of Chicago, where he was born May 3, 1872. After a preliminary education in the public schools of Chicago and at the Chicago Manual Training School he was graduated from the latter institution in 1889. Prof. Swenson then entered the engineering school of the University of Illinois, from which he was graduated in 1893, completing both the courses in mechanical and electrical engineering, and receiving the degree of bachelor of science in each course. He then engaged in instructional work in the university from 1893 to 1898, the last three years as assistant professor of electrical engineering. During this time he spent the summer of 1894 in travel in Europe and the summer of 1895 in graduate study at Cornell.


B. V. SWENSON

Prof. Swenson was appointed assistant professor of electrical engineering at the University of Wisconsin in 1898, and has been connected with this institution up to the present time, although he has been on leave of absence for the past year on account of his work as assistant superintendent with the Electric Railway Test Commission. He received the master's degree in mechanical engineering from the University of Illinois in 1901, and the master's degree in electrical engineering from the University of Wisconsin in the same year.

Besides his important work with the Electric Railway Test Commission, in which he has been associated with Prof. Norris, of Cornell University, and Prof. Goldsborough, of Purdue University, Prof. Swenson was a member of the International Jury of Awards at the Louisiana Purchase Exposition, and secretary of one of the electrical sections of this jury. He is joint author of "Testing Electro-magnetic Machinery," Vol. I., by Bernard V. Swenson and Budd Frankenfield; the Macmillan Company, 1904; 420 pages octavo. The second volume of this book is now in preparation. He is also joint editor (with Prof H. H. Norris, of Cornell University) of the "Report of the Electric Railway Test Commission," which report is now in press. He has also been a frequent contributor of papers and articles for the technical and semi-technical press. Prof. Swenson has also acted as consulting engineer in the design and on the superintendence of construction and testing of electric light and power plants and of electric railways, during the past ten years, when not occupied with other duties.

Prof. Swenson is a full member of the American Institute of Electrical Engineers and of the American Society of Mechanical Engineers, and is an associate member of the National Electric Light Association. He has also served as chairman of the local branch of the American Institute of Electrical Engineers, at Madison, Wis., for two years, and is a member of Tau Beta Pi, an honorary engineering fraternity, and also of the Phi Delta Theta Fraternity.

Prof. Swenson's intimate acquaintance with the electric railway business, his readiness as a writer, his high standing in the electrical engineering profession and the experience derived by him in his consulting work with the commercial features of the industry, as well as its engineering aspects, render him well fitted for the office of secretary of the new association. In all the work which Prof. Swenson has undertaken he has established a reputation for hard and conscientious work as well as an ability for securing results. Personally, he is of medium height and weight, of good physique, and popular with all who know him.

Y. M. C. A. INTERNATIONAL CONFERENCE IN DETROIT

The twelfth international conference of the Railroad Department of the Young Men's Christian Associations, of North America, will be held in Detroit, Mich., Sept. 28 to Oct. 1, 1905. All steam and electric railroad men, whether from organized or unorganized points, are invited to attend and participate in this conference. Beginning Thursday afternoon, Sept. 28, sessions will be held morning, afternoon and evening of each day, the day sessions in the Central Methodist Church, Woodward and Adams Avenues, and the evening sessions in the Light Guard Armory, East Larned Street, corner Brush Street. A large number of important railroad officials from different parts of the country, as well as a number of leading association workers, will be present and address the conference. Col. John J. McCook, chairman of the International Railroad Committee, will preside at all sessions. Although no great advance has yet been made in the association work on electric railway lines, some branches have been started, and it is expected that the subject will have attention and discussion at the Detroit conference.

STREET RAILWAY PATENTS

[This department is conducted by Rosenbaum & Stockbridge, patent attorneys, 140 Nassau Street, New York.]

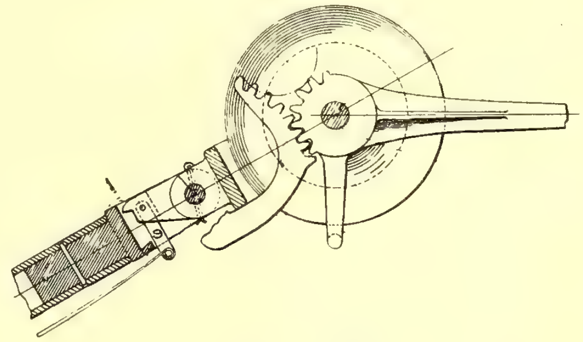
UNITED STATES PATENTS ISSUED SEPT. 5, 1905

798,593. Fender; William J. Birchell, Phoenix, Ariz. App. filed March 6, 1905. A frame comprising upper and lower spaced and substantially V-shaped bars, having cushioned rollers located between and journaled in the bars, the front portions of the rollers projecting in advance of the frame.

798,673. Trolley; Robert G. Griswold and Charles C. Willits, Quincy, Mass. App. filed Oct. 13, 1903. The trolley harp is hinged to the pole and spring-spressed to move the wheel forward in case the latter leaves the wire. A pair of guide-fingers are simultaneously thrown into position to assist in repositioning the wheel.

798,691. Trolley Finder; Jerry Morrow, Wellston, Ohio. App. filed July 6, 1904. Relates to an improvement of the above and has particular reference to the guide-fingers or horns, which in this instance are made integral with a bail or loop whereby their construction is strengthened.

798,744. Railway Crossing; Edward F. Meisner, San Francisco, Cal. App. filed April 4, 1904. Comprises sections of track at the intersections upon which the wheel flanges run, thereby raising the wheel treads above the rails, the change from a tread bearing to a flange bearing being made gradually to prevent pounding or concussion.


PATENT NO. 798,673

798,872. Fender; Louis Carlson, Brooklyn, N. Y. App. filed April 3, 1905. By this invention the height and position of the fender may be readily adjusted to meet varying conditions.

798,891. Means for Applying Breaks to Vehicle and Other Wheels; Gustav Eisenkramer, San Francisco, Cal. App. filed May 6, 1905. Relates to that class of brake in which the braking force is derived from the movement of the vehicle wheels themselves.

798,911. Car Fender; Paul Luther, Allegheny, Pa. App. filed May 12, 1905. A counterweighted fender which tips up in front when an obstruction is encountered, thereby having a tendency to raise the object and drop it back upon the apron of the fender.

798,968. Life Guard to be Applied to Electric Tramcars; Harry Labelle, Middlesborough, England. Details of construction.

PERSONAL MENTION

MR. N. K. SMITH has been succeeded as superintendent of the Ft. Wayne & Wabash Valley Traction Company at Huntington, Ind., by Mr. Frank Hardy, chief despatcher of the system.

MR. MALCOM MACDONALD, who, for a number of years has been assistant supervisor of the Camden & Suburban Street Railway Company, and later with its successor, the South Jersey division of the Public Service Corporation, has just been appointed assistant superintendent of the Northern Michigan Traction Com-

pany, of Manistee, Mich. The control of this company has recently passed to J. G. White & Company.

MR. T. D. MACGREGOR, for four years connected with the "Syracuse Herald," has resigned to become special representative and advertising manager for the Syracuse Northern Traction Company.

MR. JAMES C. HAIN has resigned as engineer of masonry construction for the Chicago, Milwaukee & St. Paul Railroad, and is now associated with J. G. White & Company, of New York, as superintendent of masonry construction with headquarters in New York.

MR. W. KESLEY SCHOEPF has succeeded Mr. F. J. J. Sloat as president of the Southern Ohio Express Company, which operates the express business on the line of the Cincinnati, Dayton & Toledo Traction Company. Mr. C. S. Cooper has been elected secretary; Mr. A. L. Kasemeier, treasurer; Mr. J. R. Randall, general manager, and Mr. W. J. Boyle, auditor of the company.

MR. C. E. PATTEN, chief clerk of the manager of the operating department, Chicago division, of the Chicago, Burlington & Quincy Railroad, has entered the service of the Metropolitan Elevated railway as assistant to General Manager Hetzler of the company. Mr. Patten entered the employ of the Burlington seventeen years ago, and has been with it continuously ever since.

MR. D. R. COLLIN, formerly architect of the Brooklyn Rapid Transit Company, of Brooklyn, N. Y., is now architect of the New York Central Railroad Company, with headquarters in the Grand Central Station, New York. Mr. Collin was with the Brooklyn Company five years. Before that he was with the Cataract Construction Company at Niagara Falls, New York, and later was associated with Mr. George Cary, in work for the Pan American Exposition.

MR. CHARLES O. KRUGER, second vice-president and general manager of the Philadelphia Rapid Transit Company, was married last Thursday evening at Oley, Pa., to Miss Elizabeth C. Kauffman, of that place. The ceremony was performed at the home of the bride's parents and only the immediate family were present. Mr. and Mrs. Kruger are spending their honeymoon at Eagles Mere. They will be at home after Oct. 1, at Abington, Montgomery County.

MR. WILLIAM F. RABER, for the past two years manager of the Mansfield Railway, Light & Power Company, of Mansfield, Ohio, which includes the Shelby-Mansfield Interurban Railway, has resigned to go to Enid, Oklahoma, to take charge of a gas and electric lighting plant for H. M. Byllesby & Company, of Chicago, who are interested in the Mansfield property. Mr. Raber will be succeeded at Mansfield by Mr. R. L. Rand, who has been assistant to Mr. Raber at that place.

MR. WALTER H. WHITESIDE was elected president of the Allis-Chalmers Company at the directors meeting in Jersey City, succeeding Mr. Benjamin H. Warren. Mr. Henry Woodland, of Milwaukee, succeeds Mr. William L. Chalmers as treasurer. Before the directors meeting the stockholders elected Mr. Edward D. Adams, Mr. Mark T. Cox, Mr. Edmund C. Converse, Mr. Joseph S. Neafe, and Mr. Edwin Reynolds to the board. Mr. Converse is well known in connection with the National Tube interests of the United States Steel Corporation.

MR. W. S. MENDEN has been appointed general superintendent of the Metropolitan West Side Elevated Railway Company, Chicago. Mr. H. M. Brinckerhoff, general manager, having resigned, the office of general manager has been abolished, and the duties of the position will now devolve upon Mr. Menden. Mr. Menden has been for a number of years chief engineer of the company, and some of the company's most notable work recently has been of his design and carried on under his supervision, including the extension of the Garfield Park line and the moving over of the entire structure after it was completed. To his credit also is the design of the company's new all-steel car.

SIR CHARLES EUAN-SMITH, K. C. B., of London, chairman of the board of directors of the Campania Limitada de Tramvias Electricos de Mexico, of the Lisbon Electric Tramways, Ltd., of the Cape Electric Tramways, Ltd., and who also is interested in electric railway properties other than those mentioned, left New York on Monday for Boston, from which port he sailed on Tuesday en route from Mexico to England. Sir Charles is accompanied by Lady Euan-Smith. After participating in the recent International Railway Congress, in Washington, Sir Charles went to Mexico City, where he spent several weeks in conference with W. W. Wheatly, the resident manager of the tramway system there, in regard to the operation of the system. As a result of his visit it is known that several important projects are under way, in the interest of which Mr. Wheatly will visit New York the latter part of this month. One of these has to do with increasing the power facilities of the company, and Mr. Wheatly while here will contract for considerable sub-station machinery.

MR. GUY F. KELSEY, electrical engineer and master mechanic of the Western Ohio Railway, has resigned to become electrical engineer of the Indiana Union Traction Company, succeeding Mr. A. S. Richie, who, as previously noted in the STREET RAILWAY JOURNAL, has been elected to the chair of electrical railway engineering at Worcester Polytechnic Institute, Worcester, Mass. Mr. Kelsey has long been regarded as one of the most practical men in charge of the mechanical end of a high-speed interurban property, and his activity at the meetings of the Ohio Interurban Railway Association was doubtless largely responsible for his deserved promotion to this most responsible position.

MR. BRAFTON UPTON, of Everett, Mass., has been named by the Massachusetts Railroad Commissioners as a member of their corps of railroad inspectors for the term of three years, beginning Oct. 1. This is a reappointment, as Mr. Upton has served the board as an expert inspector ever since his retirement from the position of master car builder for the old Fitchburg Railroad, from which position he came into the employ of the commonwealth. Mr. Upton has three confreres in the work of inspection, so chosen as to cover all branches of railroad and railway construction and equipment. Mr. Daniel M. Wheeler, of Worcester, whose term expires Oct. 1, 1906, is a specialist on roadbeds and the problems of surveying and civil engineering concerned with railroad and railway locations and construction. The problems of the street railways are considered in the light of the expert knowledge furnished by Mr. Lewellyn H. McLain, of Melrose, who is an old street railway man, and was superintendent of the Newton & Boston Street Railway before coming into the service of the commission. Mr. John Q. Hennigan, of East Milton, contributes special knowledge with reference to locomotive engineering and construction matters, in which department he served when in private employ some years ago. Mr. McLain's term expires at the same time as Mr. Wheeler's, and Mr. Hennigan's comes to an end on Oct. 1, 1907.

MR. W. S. DORAN, formerly associated with the British Westinghouse Electric & Manufacturing Company, Ltd., has just been appointed manager of the power department of Allis-Chalmers Company, in which capacity he will have complete charge of the company's commercial affairs pertaining to reciprocating steam engines, steam and hydraulic turbines, condensers, gas engines, blowing engines for iron and steel blast furnace service, and rolling mill engines, with headquarters at the general offices of Allis-Chalmers Company, Milwaukee, Wis. Mr. Doran started on his business career with the Southwark Foundry & Machine Company, Philadelphia, where he remained for five years in drafting and shop work. After spending some time with the United Gas Improvement Company, of Philadelphia, in the construction and management of water-gas plants for that company, he became connected with Mr. H. R. Worthington, having headquarters in New York, Chicago and Philadelphia. In addition to his engineering duties, he had charge of the branch offices, and while located at Chicago had complete charge of the entire Western business. In 1899 he joined the Worthington Pumping Engine Company, Ltd., with headquarters in London, England, where he took charge of its various branch offices and the important negotiations in Great Britain and Ireland. In 1901, Mr. Doran became associated with the British Westinghouse Electric & Manufacturing Company, Ltd., and since then has been establishing its branch offices and supervising their sales. Notable among the large contracts secured by Mr. Doran, may be mentioned the complete installation of the power and lighting plant for the Midland Railway Company at Heysham Harbor, comprising buildings, gas engines, generating plant producers, transmission lines, electric cranes, etc. The new Belfast, Ireland, tramways and several large iron and steel works plants were successfully negotiated by him. As an evidence of the high esteem with which Mr. Doran is regarded by his business associates, a banquet was tendered him on the eve of his departure from England, attended by many railway officials, manufacturers, engineers, and representatives from practically all the large electrical manufacturing concerns in England.

W. S. DORAN

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Of this issue of the Street Railway Journal 10,000 copies are printed. Total circulation for 1905 to date, 311,750 copies, an average of 8204 copies per week.

The Philadelphia Convention

As this issue goes to press the final arrangements are being made for the Philadelphia convention of the street railway interests. The preparations for this year's gathering are most complete, and there is every reason why all features should be most successful. The hotels in Philadelphia are excellent, the hall in which the exhibits will be shown is well adapted for the purpose for which it will be used, the papers and reports announced for the different meetings are on topics of great interest to the industry, and the city railway system of Philadelphia, with its many novel features and economical operation, will furnish a valuable opportunity, for all those who will, to study its methods. At no previous period in its history probably has any convention offered greater inducements for attendance than that which will be opened next Monday at the South Pavilion of the Philadelphia Museum.

No other convention, also, has been of such importance from an association standpoint as that which will be held next week. After an existence of twenty-three years under one name and constitution, the executive committee has recommended a change in both, which, in its opinion, is absolutely necessary to meet the requirements of the present day. In this opinion we concur, and we also believe that the proposed plan will appeal strongly to many companies which up to this time have remained outside of the association. It is inevitable that any new plan should be viewed with some trepidation, especially where there are various interests involved and so many traditions as cluster around the history of the past. But we are living in the present, not in bygone days. This day and this century are essentially those of the consolidation of energies and of organization along scientific lines, and where this principle of combination is recognized by the individual members, in the case of their own properties, it seems pre-eminently desirable where co-operative action is concerned. The American Street and Interurban Railway Association should be able to care for the interests of all the street railway companies of the country better than one or four associations have done in the past, and to carry out new lines of work which will be of the greatest practical benefit to all.

The convention will also be a notable one from the fact that it is the first in which the exhibit feature will be conducted by the American Street Railway Manufacturers' Association. This association, as is well known, was organized to take charge of a number of matters in connection with the annual conventions which could properly be delegated to it, but especially to manage the exhibit features, which heretofore had devolved, for the most part, upon representatives of the street railway company in the city where the convention was being held. The Manufacturers' Association comprises in its membership practically all of the principal manufacturers of street railway apparatus in this country, and has been officially recognized by the Street Railway Association as an allied organization, so that its co-operation in future conventions of the association is assured.

Philadelphia, the Convention City

Those who attend the Philadelphia conventions will find a number of methods and practices on the Philadelphia Rapid Transit system that may properly be termed distinguishing characteristics. From a transportation standpoint, perhaps the most interesting of these is the system of selling "exchange tickets." Before the final consolidation of the various independent companies in Philadelphia, which resulted in the formation of the Union Traction Company, a passenger who wished to go from one portion of the city to another frequently had to pay two or sometimes three 5-cent fares to reach his destination. Several years before the consolidation in 1895, a number of the independent operating companies by joint agreement issued what were known as exchange tickets for 3 cents, in addition to the 5-cent fare. These tickets gave a continuous ride upon connecting lines for 8 cents. When the new management took over the various independent properties many of the routes were changed, so that it is now possible to reach the downtown districts from virtually every part of Philadelphia for a single 5-cent fare. If, however, a passenger wishes to pass through the central portion of the city and continue his ride in another direction, the "exchange" system per-

mits him to do so by paying 3 cents additional. The exchange tickets differ from the transfers used in other cities, in that there is no time limit on them, and it is a common sight to see passengers, when asked for their fare, take out a number of old exchanges and sort out one good on the particular line they are using. Visiting street railway managers may differ as to the wisdom of providing a system whereby the patrons of the road can secure two separate and distinct rides for 8 cents. Nevertheless, the sale of these exchange tickets results in a number of desirable conditions. One of these is that many of the objections to the usual transfer system disappear when 3 cents is charged for the exchange. Again, it is evident that the reduction given by selling the two rides for 8 cents is available only to those persons who are regular and frequent patrons of the line, and this is the class that should be most favored by a street railway company if any distinction is made. The transient visitor to the city as well as those who ride only occasionally, and those to whom the reduction of only 1 cent is no object, pay the 5-cent fare. Moreover, the arrangement is conducive to short-distance riding. It would appear that in the selling of 8-cent exchange tickets the Philadelphia Company has evolved a solution of the vexatious transfer problem—satisfactorily to the public as well as to the company.

Two other practices, which are described in our Philadelphia Souvenir section, should meet with careful consideration by the visiting officials. These are the system of handling the fire insurance question and the practice of charging off at stated periods certain amounts for depreciation. The Philadelphia Rapid Transit Company carries three funds to take care of depreciation, namely, depreciation of roadway and track, depreciation of power plants, and accident account. At present the respective sums charged off to these items are 7 per cent, 6 per cent and 5 per cent of the gross receipts. The charges to depreciation account are not carried in the balance sheet, but the sums are expended each year and charged up to operating expenses.

Visiting superintendents of transportation and those having traction matters directly in charge will be particularly interested in the method of arranging and posting schedules. In Philadelphia, as far as this matter is concerned, the actual car numbers are disregarded, and the cars are operated and the crews are assigned in accordance with what are termed "block numbers." In this connection, the block number may be defined as the day's work for a car in distinction to the run number, which represents a day's work for a crew. The chief aim of the method of handling schedules is to give all the men, including the regulars and extras, a chance to perform a full day's work, and this is accomplished by dividing the block numbers, or "day's work for a car," into sections and then combining these sections into ten-hour periods. The scheme for arranging schedules does away practically with tripper runs, and the extra men know if they are assigned to a run at all they will earn as much as the regular men. In execution, the block numbers are designated by two small wooden signs about 2 ins. x 6 ins., which are painted black, with the block number in white figures. Two of these small block signs are hung on each car, one over each platform, just under the hood, where they can be easily seen. The principles upon which the schedules are formed are very fully explained in the Philadelphia section.

To those interested in the mechanical side of electric railway work, much will be found in the convention city to command attention and study. The system of generating and distributing power has been a sort of evolution, and has been largely influenced by the various mergers and consolidations of independent systems. The methods by which the different underlying properties have been welded into a homogeneous and self-contained whole, so that the generation and transmission of power could be handled upon a reliable and economical basis, contain many valuable lessons. Many of the results secured have been worked out under stress of necessity, and, as in other large cities, the engineers of the company have executed well-laid plans, only to find that almost before their arrangements had been perfected, conditions that no one could foresee would arise and new and greater problems would be presented. So far as the matter of power is concerned, the company is now working out an elaborate and comprehensive scheme, the details of which are set forth in our convention issue, and which will merit the closest investigation by those who are now facing—and their number is many—the problem of securing additional power facilities.

In regard to track construction and details of handling way and roadway matters, Philadelphia is a veritable store room of pointers and suggestions. The P. R. T. standard 137-lb. girder-rail section has received a great deal of attention in the columns of the technical press, and has been adopted directly or in a modified form in many other cities. The convention will afford good opportunities for seeing the rail in actual service under exacting traffic conditions. The new concrete track work that is being put in on Market and other of the heavy traveled downtown streets possesses many features of merit and is worthy of careful inspection. The departure from accepted types of concrete construction lies in the use of yokes or frames, which are imbedded in a concrete beam, and which serve the purpose not of supporting the rail, but of anchoring or holding the rail down to the surface of the concrete structure so that there can be no pounding of the rail upon the concrete. This does away with the disintegration and crumbling that have so frequently doomed concrete construction to failure. Many of the detail standard in methods, plans and processes followed by the track department, and described in our convention issue, afford solutions to problems that are still bothering the engineers in other cities.

From a distinctively engineering point of view, the new subway and elevated plans for relieving street congestion in Philadelphia and affording means of quick transit to the suburbs are of prime interest. The first section of the subway, from the City Hall west to the Schuylkill River, is practically completed as far as the subway structure itself is concerned, and the erection of the elevated structure west of the Schuylkill River has been commenced. As the subject of subway lines is being broached in several cities, and will soon receive the attention of a number of city as well as interurban companies, the opportunity will undoubtedly be grasped by those attending the convention of studying what Philadelphia has accomplished and is planning to do in this connection.

Convention Issues

In this connection, we hope that we shall be pardoned if we refer briefly to the subject of convention issues. The policy of issuing a special number of the STREET RAILWAY JOURNAL just previous to the annual convention of the American Street Railway Association has been followed by this paper since its establishment, but it has been only since 1894 that the big souvenir number has been a feature of the convention. Although this issue has been the largest each year of any technical paper in this country, it is not upon its mere bigness that the publishers prefer to dwell. Each number has been com-

piled along some dominant idea which at that time seemed to be of greatest interest to the electric railway industry, and each consequently contains within its covers practically all of the material available at that time relating to that particular topic. Thus, in 1894, when the convention was held in Atlanta, the souvenir number was devoted to the electric railway development in the entire South, and in 1895, at the time of the Montreal convention, the electric railway interests in Canada were the topic considered. For four years the street railway system of the city in which the convention was being held was made the principal subject. This was in 1886, 1887, 1888 and 1901. In 1899 and 1900, which were the years following the great impetus to electric railway construction abroad, the souvenir issues presented reports of different aspects of this condition. In 1902 advantage was taken of the fact that the convention was being held in Detroit, to describe not only the important city and interurban roads there, but other recent railways of the same type, and this issue was entitled "The Interurban Number." In 1903 our souvenir number was devoted largely to city railway practice, and in 1904 we published our anniversary number, which described the developments of the last twenty years, and also the system of the Interurban Rapid Transit Company, which had just been put in operation.

In view of the important construction work and remarkable economical results of operation which are in existence in Philadelphia, we believe that no excuse need be offered for devoting the souvenir portion of this issue to the Philadelphia Rapid Transit system. A special effort has been made in this issue as to typographical appearance. An entirely new face of type is used, and all of the half-tone illustrations are upon especial inset paper in the form of plates.

Another feature introduced this year in our souvenir issue for the first time is a dictionary of electric railway apparatus. This dictionary occupies some seventy pages, and is by far the most complete compilation of the kind ever prepared. The items are classified alphabetically by subjects, and the information has been furnished directly by the manufacturer or has been prepared from his trade catalogues. Its aim is to give to the busy buyer a succinct and authoritative statement of the street railway apparatus available at this present time in the different departments of the industry.

If this number is of assistance to the visitors in Philadelphia in their study of the methods and practice of the Philadelphia Rapid Transit Company, and to those who remain at home, in their daily work, the publishers have accomplished their purpose.

Single-Phase Railways

Although the single-phase alternating-current railway motor is decidedly new as yet in this country, it can now be considered as well out of the experimental stage. The operation of the first two commercial interurban roads in this country to be equipped and operated with single-phase alternating-current motors exclusively (which have now been opened for periods of six and eight months, respectively) has been such that we are convinced, after investigation of the matter and visits to these properties, that if there are any inherent difficulties in the way of success of a single-phase alternating-current railway system, they are too small to show themselves in eight months of operation, and are hence too small to be worth serious consideration.

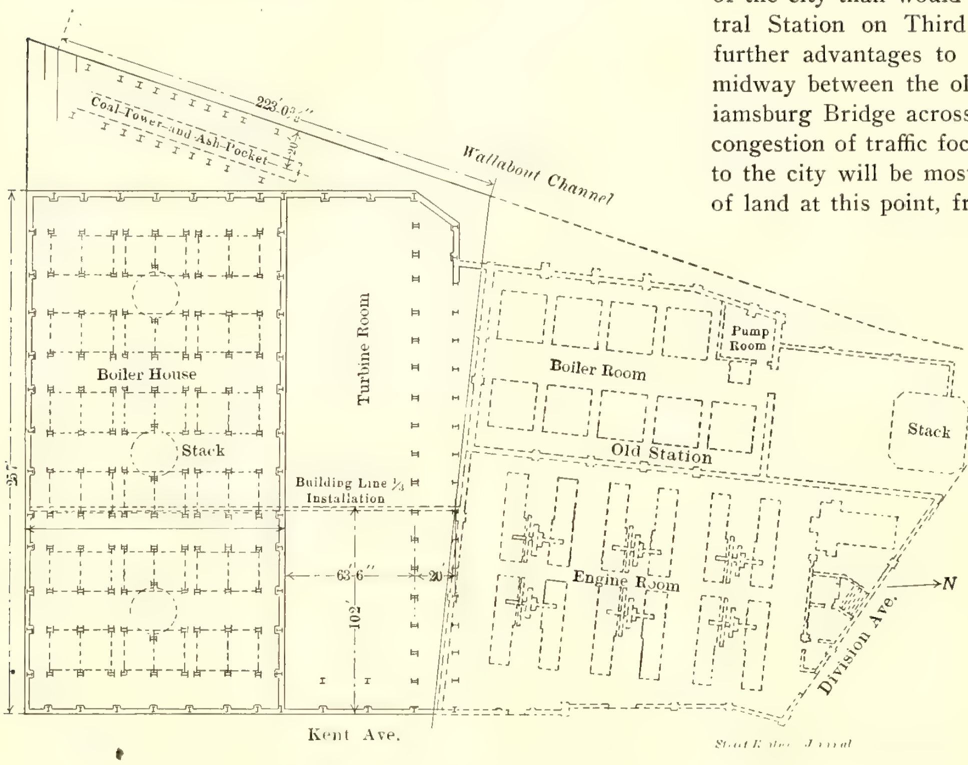
The two roads upon which fate decreed that the single-phase alternating-current motor should be first tried in every-day service in America are decidedly different in character. The Indianapolis & Cincinnati Traction Company's line between Indianapolis and Rushville represents the higher type of high-speed, heavy interurban railroading. As regards high speeds with heavy cars, the conditions are as severe as are to be found on any American interurban road. On the Pontiac-Odell line, on the other hand, the physical requirements, as far as weight and speed of car are concerned, were very moderate, the chief restrictions in this case being on the cost of construction. On both roads are to be found certain conditions favoring the selection of alternating-current equipment. On the Rushville line, where a large amount of energy must be delivered to each moving car and the speeds are high, the possibilities of the bow trolley and low distribution costs were very attractive as against the third-rail equipment and heavy sub-station investments which would have been necessary had direct-current motors been used. It was a question not only of cost, but of a practicable method of current supply, and both considerations were favorable to the alternating-current motor supplied from a substantial trolley line well out of danger. At Pontiac it was mainly a question of keeping down the cost of construction so as to build a road which could show profits in operating through a sparsely settled country.

The Rushville line has been in operation since the first of this year, and the Pontiac line since March 15 this year. On both roads the claims of the manufacturers that single-phase commutating motors can be built which will give almost as sparkless commutation as direct-current motors have been fully substantiated. It would seem that the question of sparkless commutation of such motors is now thoroughly settled; that there is little more to fear from commutator wear on a. c. motors than on d. c. motors. A road which can operate day in and day out for several months and maintain a regular schedule with one car and no reserve, as at Pontiac, cannot have very serious motor troubles. While there have been various rumors of burn-outs on the Rushville line, a closer investigation shows that what troubles have occurred are not in any sense to be taken as due to the fact that single-phase motors were used. Our friends at Rushville unfortunately had to start their road with motors intended for operation on a purely a. c. system at considerably lower voltage strains than those to which they are subjected in a combined a. c. and d. c. service. While the results have been annoying, and especially so since the eyes of the electric railway world are upon the performance of that road, there is nothing in the incident to give the advocates of the single-phase commutating motor any anxiety. The motors seem to be working well within the heating limit, and commutating well. The difficulties that may have been experienced because of insufficient insulation are easily remedied, and there is no reason to expect anything but satisfactory operation from now on.

Equally gratifying with the success of the a. c. motor is the satisfactory performance of the sliding contact bow trolley on the Rushville line. It was hardly to be expected that the bow trolley on such a high-speed line as this would give so little trouble from the start. In fact, nearly all anticipated that considerable experimentation would be necessary on this feature, and have been pleasantly disappointed. There is no doubt still some chance for improvement, but the performance of this trolley and the life obtained from the contact plates is satisfactory enough so that there is no great urgency about making improvements. A successful trolley that cannot leave the wire in service is as necessary to the success of the alternating-current railway in many cases, where it is desirable to employ it, as the alternating-current motor itself.

THE NEW WILLIAMSBURG POWER PLANT OF THE BROOKLYN RAPID TRANSIT COMPANY

In his last annual report just rendered, and published in this paper last week, President Winter, of the Brooklyn Rapid Transit Company, refers at length to the plans for increased power of the company. This requirement is a logical result of the greatly increased service during the last two or three years, on the surface lines in Brooklyn and the transition from steam to electricity as a motive power upon the elevated lines of the company. Although the company's power output has increased rapidly, the demands for power have grown in even a greater ratio, so that even the addition to the system of the new Central Power Station of the company, with a capacity of



PLAN OF NEW AND OLD POWER STATIONS AT WILLIAMSBURG

over 30,000 hp., has rendered the stations entirely inadequate to meet the requirements. The management realized nearly three years ago that greatly increased power facilities would soon be required, so that even before the Central Power Station was completed, plans were commenced for a large new steam turbine power plant to be installed in the Williamsburg district of Brooklyn. This station is now being completed, and will not only soon provide relief to the present heavily burdened power system, but will also provide liberal facilities for extension to cope with further developments. This new station will embody many interesting features, principal of which is the use of steam turbine generating units.

Previous reference has been made in the columns of the STREET RAILWAY JOURNAL to the extensive power generating and distributing system of the Brooklyn Rapid Transit system, to which this new station will make a very important addition. The power system involves at present five independent generating stations, four of which, however, the old Third Avenue, the Fifty-Second Street, the Thirty-Ninth Street and the Kent Avenue stations, are exclusively direct-current stations of earlier design and of comparatively small size, while the large new Central Station at Third Avenue, now in operation for about three years, is of modern design, with 4000-hp vertical-engine generating units, and has formed the nucleus of a comprehensive and interesting high-voltage three-phase distribution system. The latter embraces seven important sub-stations, from which the network of surface and elevated lines of the company are supplied with direct-current, and several additional sub-stations are contemplated.

LOCATION

In spite of the fact that the load center of the company's lines has gradually been moving backward from the river front, it was decided that the new station should be located near the river or bay, both for a condensing water supply and for coal shipment direct by boat. Land fronting on the Wallabout Canal of the East River, and adjacent to the present Eastern District Station at Kent Avenue and Division Avenue, was found available, and was considered desirable in that it would afford, in addition to the above advantages of a river-front site, greater proximity to the rapidly growing eastern sections of the city than would be possible in the vicinity of the Central Station on Third Avenue. This location also offered further advantages to the distribution system in that it lies midway between the old Brooklyn Bridge and the new Williamsburg Bridge across the East River, so that the enormous congestion of traffic focusing at these two important entrances to the city will be most easily handled. Accordingly, a tract of land at this point, fronting 199 ft. on Kent Avenue, southward from the old Kent Avenue station, and 239 ft. upon the Wallabout Canal, near the Brooklyn Navy Yard dock, was secured for the new station site.

FOUNDATIONS

The building is divided by a partition wall at right angles to the Kent Avenue front, into an 83-ft. turbine room next to the Kent Avenue plant, and a 125-ft. boiler house to the south. For the foundations it was necessary to underpile the entire area occupied by the building. The upper 10 ft. to 25 ft. below the surface of the ground consisted of loose filling, below which was sand. All the column footings were heavily underpiled individually, as were also the wall foundations; 12-in. and 14-in. piles were used, cut off at about mean low water level. An interesting feature of the foundation work was the condenser circulating water tunnels, one of which was installed for inlet and another for the overflow. They are both 10-ft. horseshoe-shaped conduits, built one above the other in concrete, and are in turn carried upon a solid mass of piles throughout. These conduits enter beneath the turbine room basement and pass longitudinally the length of the room, so as to provide convenient and direct inlet and overflow connections for each condenser.

GENERAL ARRANGEMENT

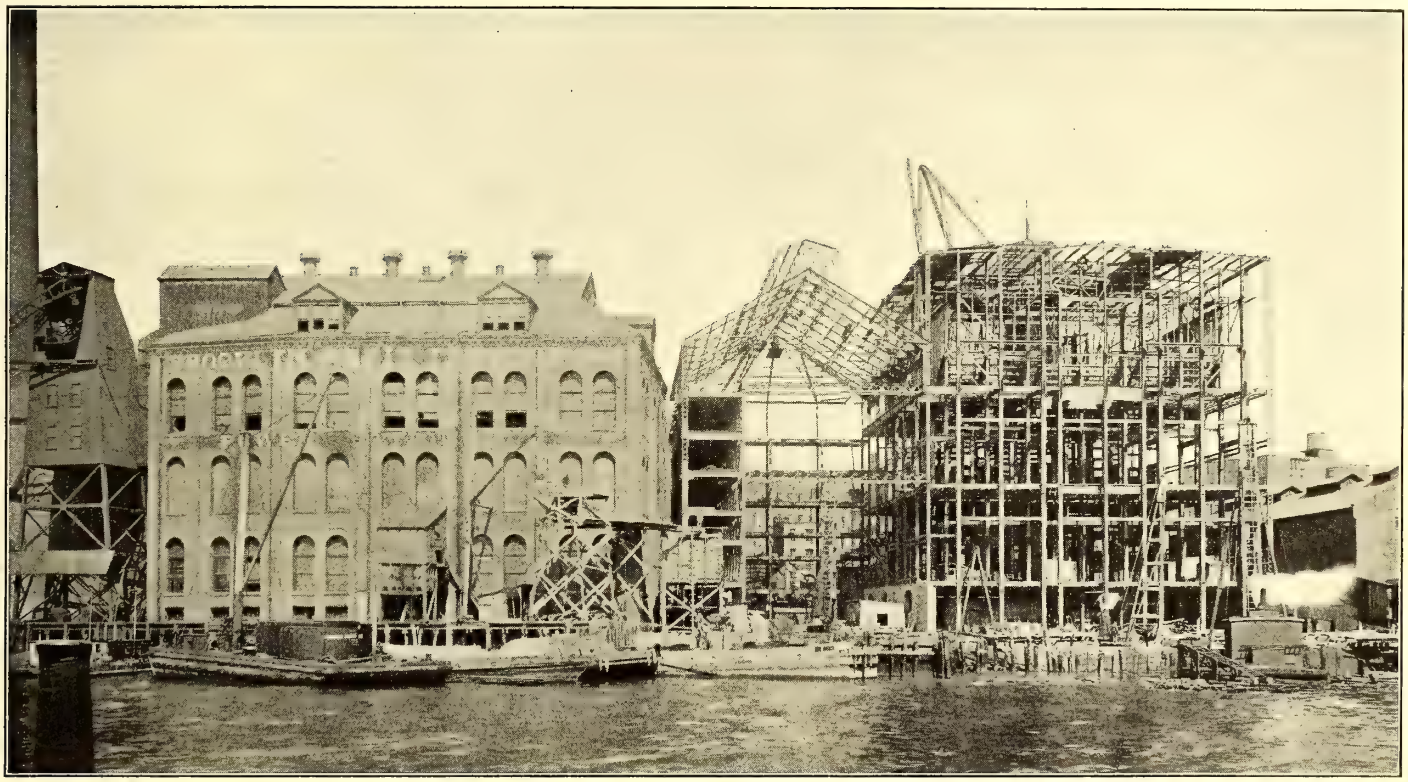
The plan layout of the new station, shown herewith, is interesting on account of the small relative floor area required by the turbine generating equipment as compared with that required by the reciprocating engine equipment in the Central Station. In the latter, the engine room occupies nearly 60 per cent of the total ground plan, and boiler room section only 40 per cent, whereas in the new station this proportion is exactly reversed. A boiler room space 125 ft. x 257 ft. in size will be secured ultimately in the completed plant, while the turbine room space will be 83 ft. x 257 ft., of which 20 ft. in width on the north side is devoted to the galleries for accommodating the bus bar compartments, oil switches, and other electrical apparatus.

The boiler room section consists of a 17-ft. basement, two 33-ft. stories for the boilers, and above this a space of 47 ft.

up to the general roof level, which is devoted to the coal storage bunkers; the coal-handling system will be accommodated in the roof monitors. The turbine section involves an 18-ft. basement for condenser apparatus and a main turbine room with a clear height under roof trusses of 83 ft. The group of electrical galleries on the north side of this room consists of five mezzanine galleries above the main floor for the electrical switching equipment and storage-battery equipment. Across the Kent Avenue front of the turbine room there is also a row of mezzanine galleries to be devoted to offices, locker and toilet rooms, and mechanical and electrical laboratories.

The architectural treatment of the Kent Avenue front of the power house has tended toward ornamentation, and a very pleasing result has been obtained. The wall begins with a base of granite rising to the height of the first floor, above which are the walls of red pressed brick, with terra cotta trimmings and cornices. All the window trimmings are also of terra cotta, while the roof monitors are of copper finish. The roof of the boiler house is covered with Spanish roll tile on the mansard front, while the flat sections of both turbine and boiler room roofs are of slag concrete construction, surmounted by flat tiles. A feature of the exterior is to be noted in the window treatment, all windows being surmounted by a terra cotta architrave which rises from an entablature of terra cotta surrounding the structure.

The building, which is now nearly completed, is of steel frame and brick and concrete construction, and is absolutely fireproof. An accompanying cross section shows the principal details of the steel work and roof and coal bunker structure. The main boiler room and turbine room floors are of heavy construction, designed for uniform loadings up to 600 lbs. per square foot, while the less important floors are designed for 250 lbs.; the floors are all of concrete upon the Roebling system. In addition, the structure is designed ultimately to carry, above the boilers, four large coal bunkers designed to hold a total of 15,000 tons, when all filled. The coal bunkers are of reinforced concrete construction, with vertical stiffeners of I-beams embedded at intervals. The roof structure above the turbine room is carried by Fink roof trusses, of 83 ft. span, surmounted by a 20-ft. monitor for lighting and ventilation; the boiler room roof, monitors and coal handling apparatus are carried by a series of three-span trusses of special construction. The turbine room is traversed by a 50-ton Shaw traveling crane of 62 ft. span between runway rails.

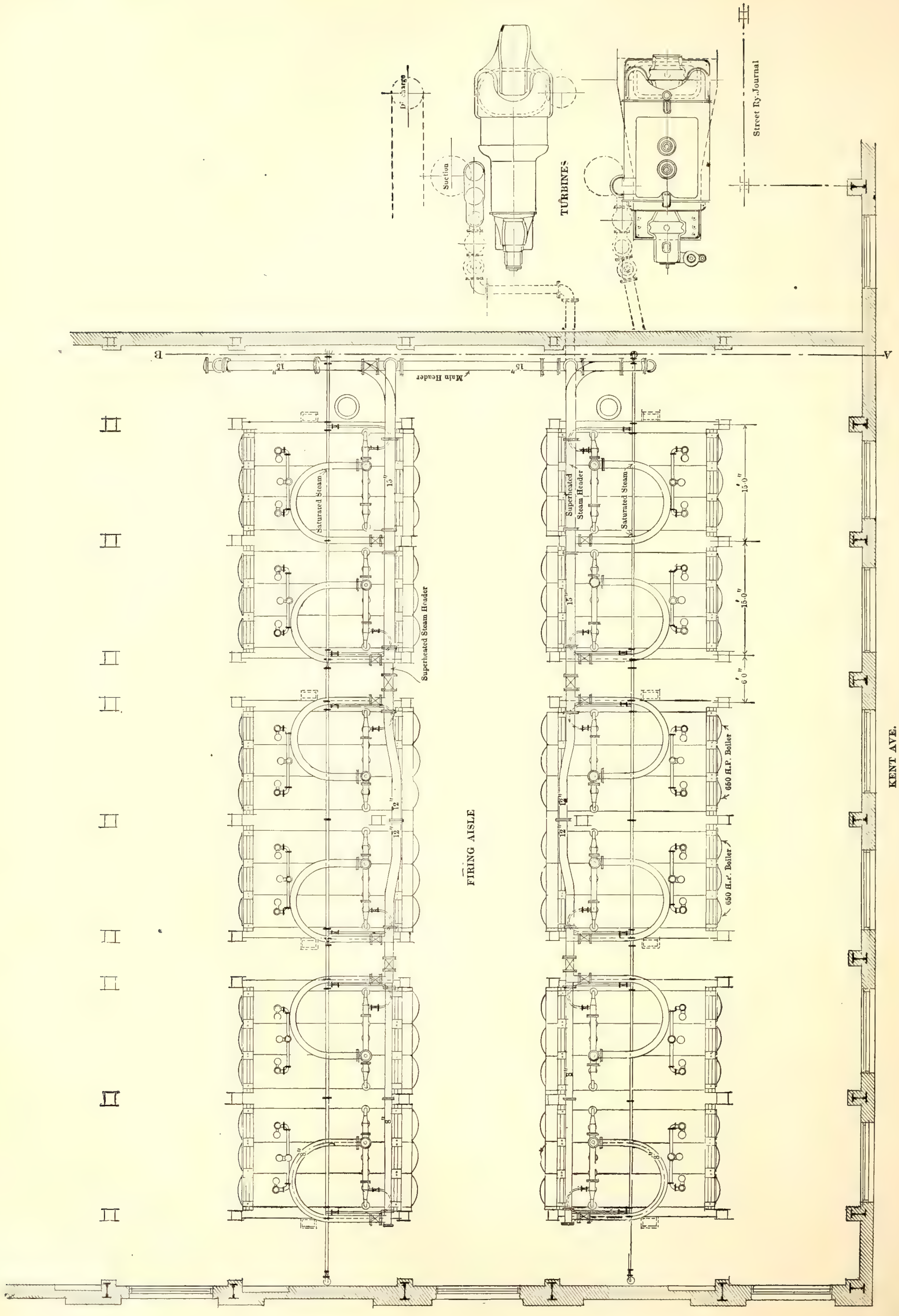


VIEW FROM RIVER OF NEW POWER STATION UNDER CONSTRUCTION.—THE OLD KENT AVENUE POWER STATION OF THE BROOKLYN RAPID TRANSIT COMPANY SHOWN AT THE LEFT

BOILER AND ARRANGEMENT

It will be noticed that the arrangement of boilers adopted is upon the cross-fire-room plan, which has become typical of the more recent large turbine stations in this country. It has usually been found preferable to concentrate the firing rooms as much as possible, with the result of a less convenient arrangement of stacks, but in this plant a division of fire rooms was selected which, as may be noted in the accompanying plan, is more advantageous for the flue, stack and coal bunker arrangements. The ultimate plan provides upon each boiler floor two main firing rooms, each having upon each side a row of three batteries of two boilers each, and at either end of the building a half firing room with a single row of six boilers. This arrangement permits of the use of only three stacks, which will be symmetrical in design. Each stack will thus operate twelve boilers upon either floor, or twenty-four in all. The objection to the arrangement of half fire rooms will not here prove serious, as owing to the magnitude of the plant it will be an easy matter to divide the work at all times between the boilers to the best advantage of firemen.

The boilers will be of the well-known inclined water-tube type of the Babcock & Wilcox Company, and will be equipped with the new Babcock & Wilcox single superheaters. The station is designed for thirty-six boilers upon each boiler floor, or seventy-two in all, although for the initial installation only thirty-six will be installed, together with two stacks. Each boiler unit will be of 650-hp capacity, designed to deliver steam at 200 lbs. pressure and with a superheat of 100 degs. F. above saturation. Each boiler consists of three 42-in. steam drums and has 294 tubes, 4 in. O. D. by 18 ft. long, arranged 21 tubes wide and 14 tubes high, thus presenting a total heating surface of about 6500 sq. ft. The vertical rows of fourteen



PLAN OF FIRST FLOOR OF THE NEW WILLIAMSBURG STATION OF THE BROOKLYN RAPID TRANSIT COMPANY

tubes each deliver into a continuous wrought-steel header of a new design which materially simplifies the construction. The trimmings and fittings for each boiler are of extra heavy design, for the purpose of securing a maximum of reliability in service. The boilers will all be fitted with Gibson dumping grates to the entire exclusion of stokers.

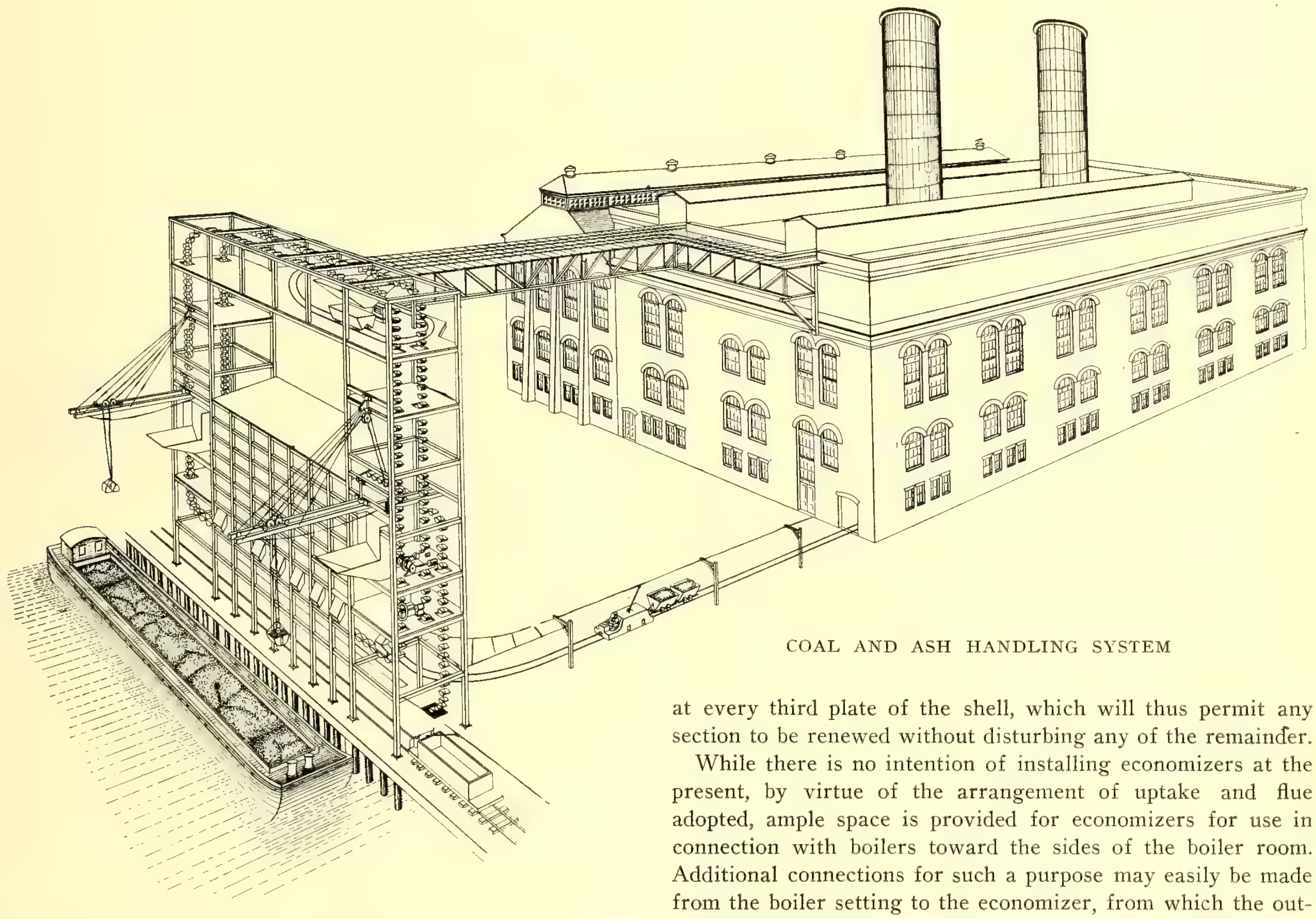
FORCED DRAFT

Both natural and forced draft will be provided, the latter permitting an advantageous flexibility in the burning of low grades of fuel. For the forced draft supply there will be installed two Sirrocco blowers of 90,000 cu. ft. capacity per min., for each row of six boilers. These fans, which will be fitted with cases and driving engines by the B. F. Sturtevant Company, Boston, are to be located upon elevated platforms at the sides of the boiler room or in the basement, from which position the delivery will be through ducts leading down to cross flues beneath the ash pockets. Damper openings are to be provided at each opening, so that the blast may be regulated at will. Sufficient capacity is provided in each blower to operate the entire six boilers to their maximum if at any time this is found necessary.

FLUES AND STACKS

The products of combustion are discharged from the boiler furnaces through a large self-supporting steel stack, rising to a height of 250 ft. above the first floor level of the boiler room. This stack will be duplicated for each additional twenty-four boilers. Connection is made to each stack through an interesting design of flue and uptake, which rises in the space between the rear ends of the double row of boilers up into the base of the stack. This flue structure is built up of 3/8-in. plate and 2½ in. x 2½ in. x 5-16-in. angles, having openings 3 ft. 9 in. x 9 ft. in area, at the rear of each of the boilers. In the main uptake from the first to the second floors, which is 8½ ft. x 24 ft. in section, there is a baffle plate to prevent interference with the draft when one side is idle. At the second boiler floor level the flue opens out to an area of 11 ft. x 36 ft., changing section above that to a 23½-ft. diameter circular opening beneath the stack. The entire flue and uptake structure will be enclosed in a non-conducting covering to prevent radiation of heat into the boiler room.

The stack, which thus commences at the third story level, is 181½ ft. high, and has an inside opening varying from 21 ft. 8 in. at the base, to 21 ft. 2 in. at the top. It consists of thirty-three sections of thicknesses of plate, varying from ½-in. at the base down to ¼-in. at the top. It is lined with 4-in. hard common red brick, backed up to the shell with 1 in. of concrete. This lining will be supported by an angle frame work throughout the interior of the stack, with horizontal members at every third plate of the shell, which will thus permit any section to be renewed without disturbing any of the remainder.



COAL AND ASH HANDLING SYSTEM

While there is no intention of installing economizers at the present, by virtue of the arrangement of uptake and flue adopted, ample space is provided for economizers for use in connection with boilers toward the sides of the boiler room. Additional connections for such a purpose may easily be made from the boiler setting to the economizer, from which the outlet connection could be joined to the uptake with ease, although the middle boilers of each group are inaccessible for such a connection owing to the presence of the main uptake at their rears.

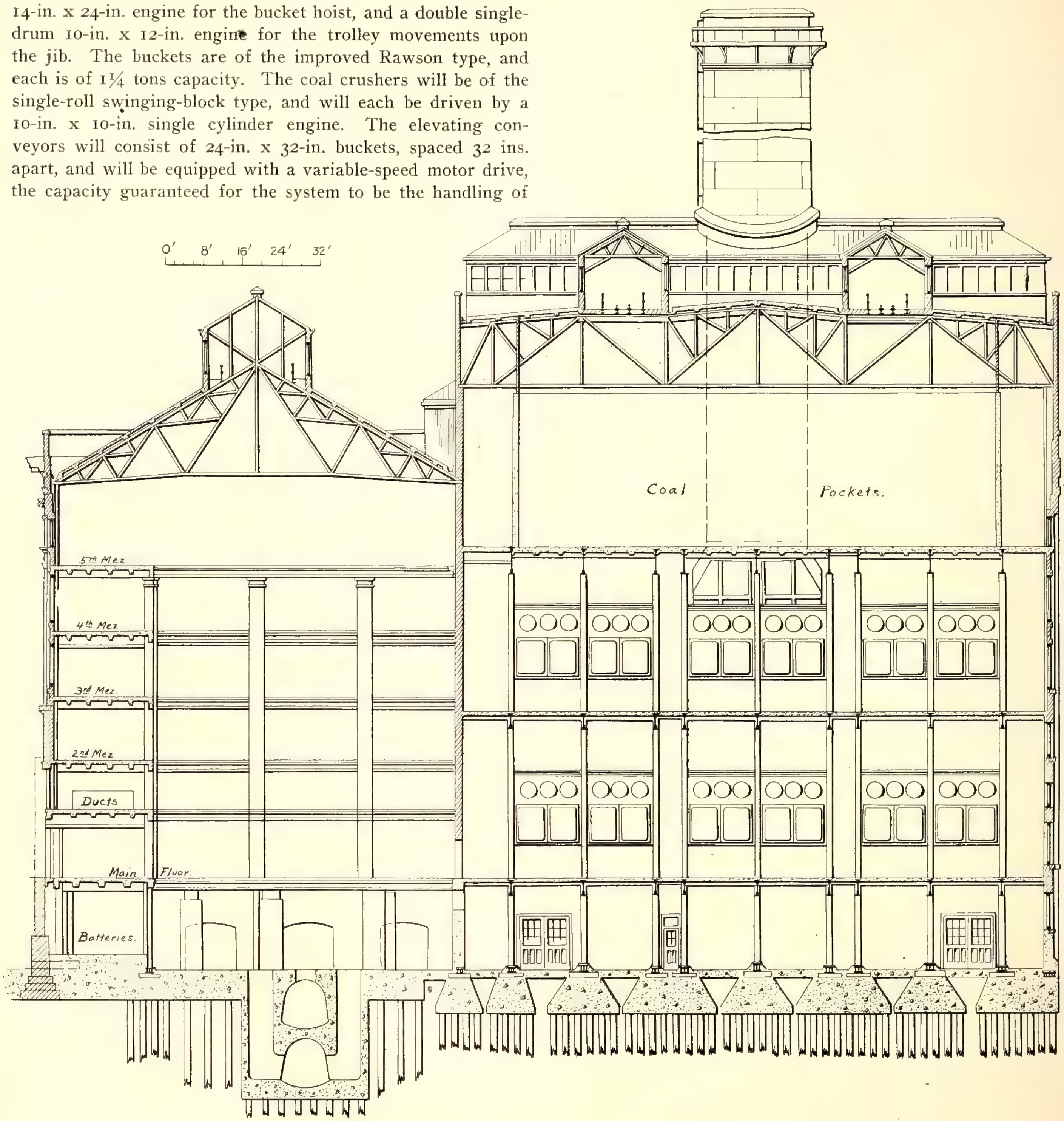
COAL AND ASH-HANDLING MACHINERY

Coal will be delivered to the new station by barges in the Wallabout Canal of the East River, which will be unloaded by a coal tower, and from the tower cars upon an elevated cable railway, which will distribute it in the pockets over the boiler room. The tower will consist of a steel structure 100 ft. long, 25 ft. wide and 133 ft. high, containing the barge unloading apparatus, coal-receiving bins, crushers, etc., together with an ash-handling and storage equipment. The coal unloader hoist jibs, of which there are two, one at either end of the tower, are to be located 73 ft. above the bulkhead level, from which the lift to the receiving bins will be 57 ft. The small receiving bins deliver to the coal crushers, whence the coal is elevated 115 ft. by two lines of bucket conveyors to the top of the structure for delivery to the automatic cable railway cars. Of the latter, there are to be five of 2½ tons capacity each, which

will be loaded at a rate of about two per minute, giving thus a total capacity of about 300 tons per hour. The cable railway crosses to the boiler house by a bridge, and makes a complete circuit of the coal pockets above the boilers.

The coal unloading tower equipments are of the two-man type, and each is operated by a combined hoisting and trolley engine set, consisting of a double direct-connected two-drum 14-in. x 24-in. engine for the bucket hoist, and a double single-drum 10-in. x 12-in. engine for the trolley movements upon the jib. The buckets are of the improved Rawson type, and each is of 1¼ tons capacity. The coal crushers will be of the single-roll swinging-block type, and will each be driven by a 10-in. x 10-in. single cylinder engine. The elevating conveyors will consist of 24-in. x 32-in. buckets, spaced 32 ins. apart, and will be equipped with a variable-speed motor drive, the capacity guaranteed for the system to be the handling of 300 tons to 350 tons per hour. The entire coal-handling equipment, together with the ash-handling apparatus, is being supplied by the Mead-Morrison Mfg. Co., of New York.

The ash-handling system will comprise a line of narrow-gage railway cars, passing underneath the ash-chutes in the boiler house basement, which will deliver the ashes to an elevating conveyor in the coal tower, raising them to a 1000-ton ash-storage pocket. Cast-iron chutes are carried from the furnace ash bins of the boilers upon both floors down to outlets over the track for dumping direct to the cars. The latter will be of the V-bottom dumping type, and will be hauled by a 6000-lb. electric locomotive, having a capacity of drawing a total load of 14,000 lbs. at a rate of about three miles per hour up a 5 per cent grade. The ash-elevating conveyor is of the bucket type, and is designed to deliver at a rate of from 50 tons to 60 tons per hour from the receiving bin to the storage pocket. The latter is provided with outlet spouts for delivery either to wagons or boats in the channel.



CROSS-SECTION OF STATION, SHOWING ARRANGEMENT OF GALLERIES AND FLOORS

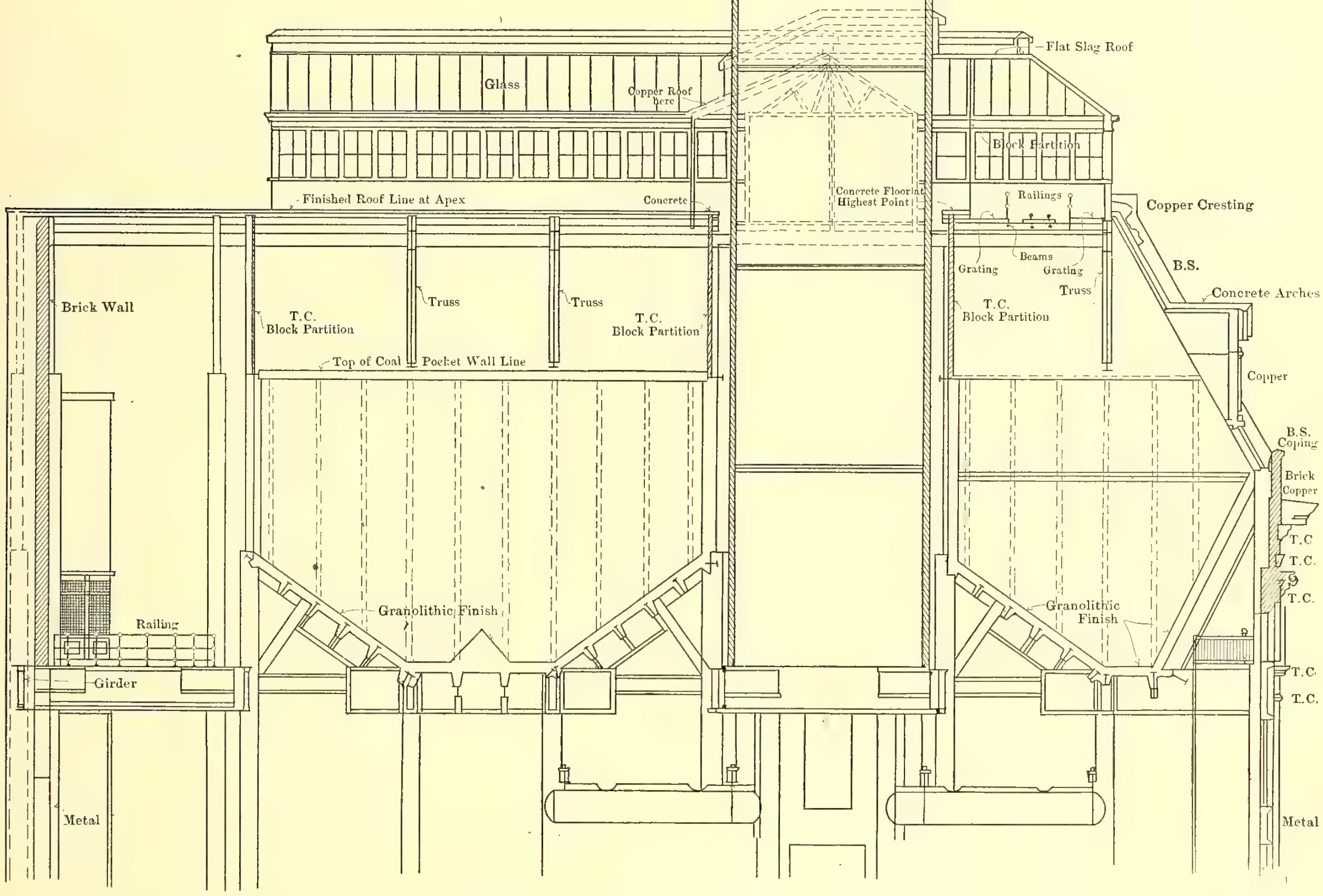
PIPING

Several of the accompanying diagrams illustrate the system of steam piping which will be used, and which is greatly simplified by reason of the use of turbines instead of reciprocating engines. Relatively small pipe sizes are to be employed, with correspondingly high velocities of steam flow, and the system of connections secured by this cross arrangement of boiler

room is simplified to the extreme. From the 14-in. main steam header next to the division wall a 14-in. branch steam pipe extends up and over the rears of each six boilers, reducing in size to 12-in. and 10-in. pipe toward the opposite side. There are intercepting gate valves between each battery for isolation in case of testing or repairs. The battery header or branch is located about 3 ft. above the boiler settings, and connections to it from the boilers are made by heavy return bends of 8-in. pipe of 5-ft. radii. Each bend has two valves, that next to the boiler a plain gate valve, and the other a non-return stop valve.

The main steam header will be of 14-in. pipe, and is to be located in the areaway alongside the division wall on the first floor, where the branch loop connections may easily be made to the boilers upon either floor. The branches to the turbines will be carried from the header through the basement, so that no piping will be visible in the turbine room, although the control of valves will be readily accessible at the machines. All of the high-pressure piping will be of wrought steel, with Van Stone joints, using sheet steel gaskets, while the bodies of all valves and all fittings will be of Baldt steel.

The feed-water piping system embodies an interesting arrangement of ring mains of 6-in. cast iron encircling each group of twelve boilers just below the floor level. These mains are connected to each boiler front by branches composed of a 5-in. branch between each battery, joined through a tee to 3-in. brass individual boiler connections. By virtue of this combination of a ring main, two independent feed connections thereto, and the sectionalizing valves, the system will be thoroughly reliable, as each boiler will have two independent sources of feed supply, and any section of the main is capable of removal from duty without affecting the remainder. The feed water supply will be taken normally from the condenser hot well, and the make-up water from the city mains. There will be three feed pumps and two closed-tube and one open feed-water heater utilizing the exhaust of auxiliary engines, pumps, etc., for the heating of the feed before entering the boilers. All connections from these to the two ring feed mains are carefully duplicated, so that there will be little chance of shut-down of the system.



LONGITUDINAL SECTION ABOVE BOILER ROOM, SHOWING ARRANGEMENT OF ROOF AND COAL BUNKERS

PUMPS AND HEATERS

For the initial installation there will be three boiler feed pumps, which will be vertical direct-acting cross-compound Blake simplex pumps of the center outside-packed-plunger pattern, supplied by Henry R. Worthington. These pumps are designed for delivering against a pressure of 240 lbs. when operating with 175 lbs. steam pressure and no suction lift, and have a capacity of delivering 500 gals. per min., with a piston speed of 75 ft. per min. Each has 19-in. and 32-in. steam and 11½-in. water cylinders, with an 18-in. stroke. The open feed-water heater will be the Cochrane horizontal cylindrical feed-water heater and purifier, built by the Harrison Safety Boiler Works, Philadelphia, Pa., and will have a capacity for heating 400,000 lbs. of water per hour from 100 degs. to 207 degs. Fahr. This heater is 15 ft. long and 8 ft. in diameter inside, and has a water carrying capacity of 376 cu. ft. It is fitted

with twenty 15-in. x 144-in. trays for the deposition of impurities, and has the usual coke bed filter for purification of the feed, while a Cochrane oil separator incorporated in the heater prevents contamination of the feed by lubricating oil from auxiliary engine cylinders. The closed heaters are both Wainwright heaters, each 48-in. inside diameter, with 800 1-in. corrugated copper tubes 76 ft. long, giving thus a heating surface of 1333 sq. ft. The tubes are divided into four groups, through which the water passes in succession and baffles are used to cause the exhaust steam to pass in counter-current to the feed water.

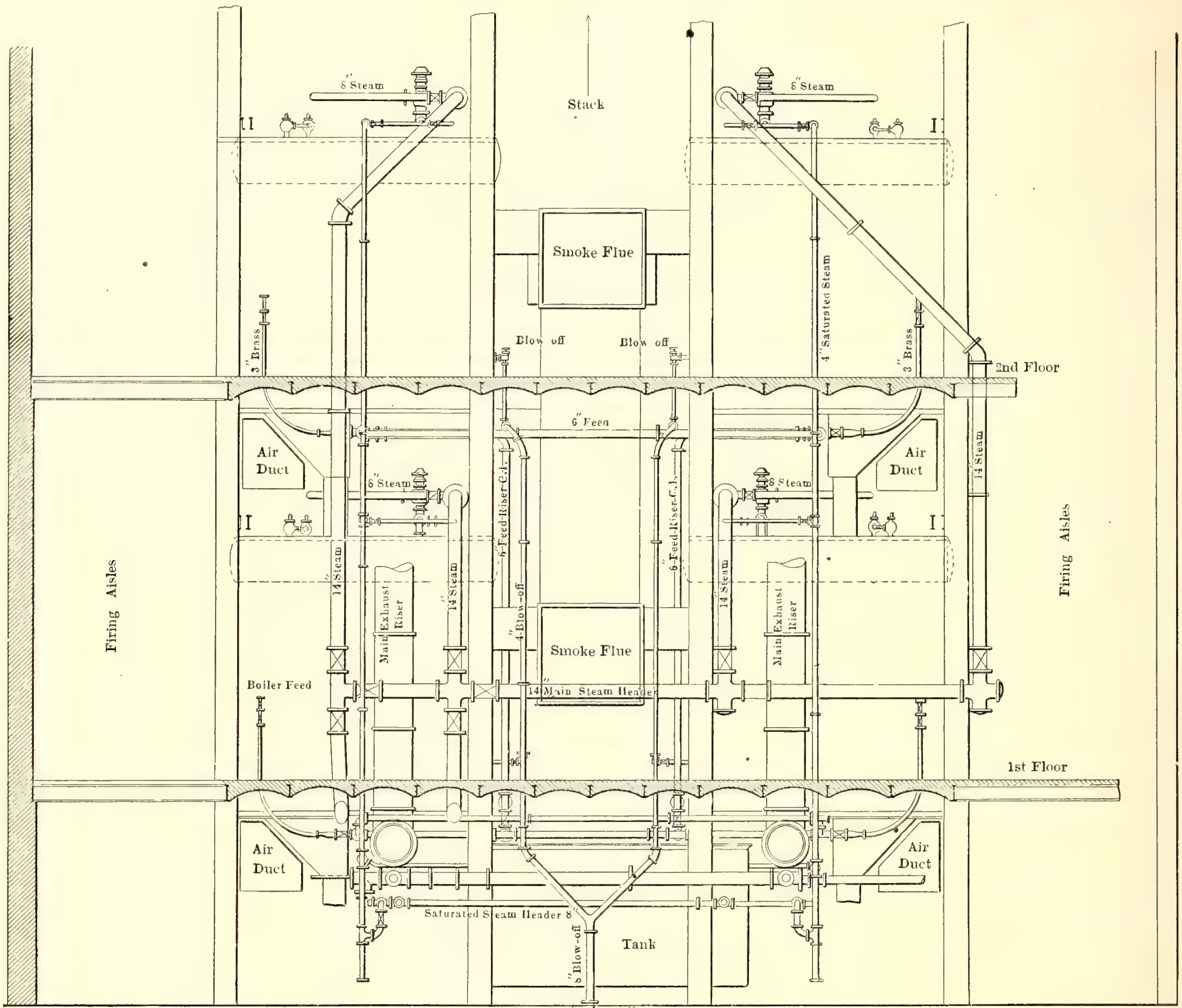
BLOW-OFF PIPING

The blow-off piping will consist of a single header of 4-in. pipe at the rear of each row of boilers, into which every boiler delivers through two 2½-in. brass blow-off connections. The two headers at the rear of boilers in every chimney flue space discharge downward through 6-in. connections to a tee leading to a common 8-in. discharge pipe to the condenser overflow tunnel beneath the turbine room, making thus short, simple and direct outlets for each group of boilers independently. The piping is all of wrought iron, with screw-flange joints, except the branches leading from the boiler mud-drums, which are of double extra-heavy wrought-iron pipe. Each blow-off connection will be provided with two valves for protection from leakage, one a Best angle and the other a Johnstone straightway blow-off valve.

TURBINES

The station has been laid out to accommodate ultimately nine steam turbine generating units, one of 5500-kw capacity and the other eight of 7500-kw capacity each, giving thus a total station capacity of 65,500 kw, or, with the 50 per cent overload rating, of about 100,000 kw. At first, however, only three turbines will be installed, two of these to be of the Westinghouse-Parsons type, and the other the new turbine of the Allis-Chalmers Company. The use of turbines of the 7500-kw ratings and the 50 per cent overload capacity mark an important departure, as each turbine at 50 per cent overload will be capable of delivering 15,000-hp, which is by far the greatest amount of power ever developed in a single prime-mover in stationary practice.

The new 7500-kw Westinghouse turbine units will differ in some details from the company's well-known 5000-kw capacity machines, the same general type and form of unit being preserved in the new design. It is understood that the blades are to be made longer, and that other modifications of a minor nature are to be incorporated, which materially affect the increase of capacity. As to the size of the new Westinghouse unit, it will be 50 ft. long, 17 ft. wide and 15 ft. high, occupying



Section A-B

Street Railway Journal

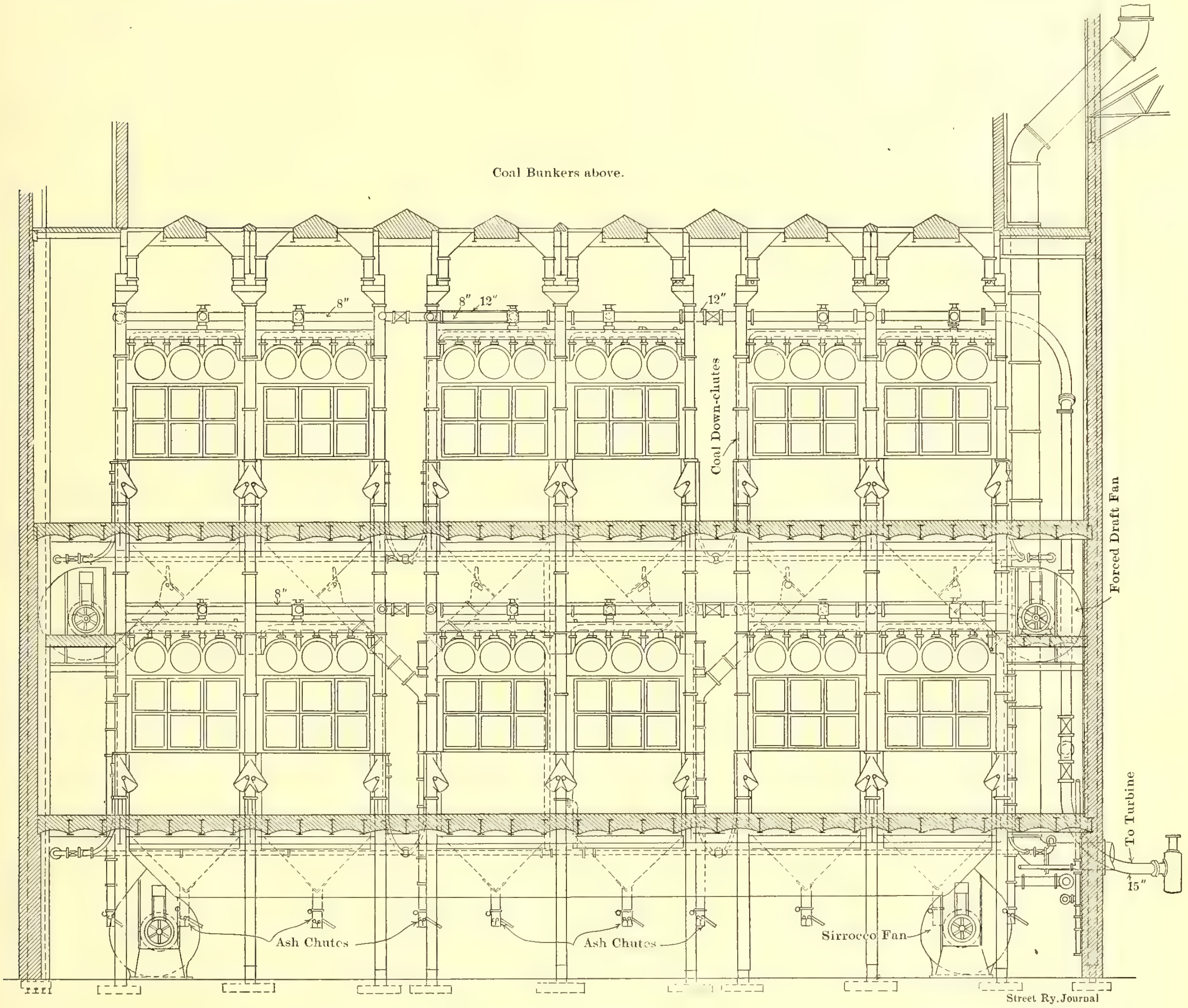
ELEVATION OF PIPING IN BOILER ROOM, SECTION A-B OF PLAN ON PAGE 434

thus a total floor space of 850 sq. ft., or 0.113 sq. ft. per kilowatt capacity. It will thus be only about 4 ft. longer than the 5000-kw turbine unit, while the width will remain practically the same. These turbines will operate at 175 lbs. pressure and 100 degs. of superheat, and the speed will be normally 750 r. p. m. Under the above conditions and a vacuum of 28 in., the steam consumption at full load will be approximately 16 lbs. per kw-hour. An important feature of the new design is that its best economy will be secured around full load, although heavy overloads may be carried at any and all times without material sacrifice of efficiency. The design also permits of the turbines developing its full-rated load non-condensing.

The alternators connected to the above units will be similar to the former standard Westinghouse designs for use with turbines, with the exception that they will embody a new enclosed construction which will be effective in entirely eliminating the hum peculiar to high-speed turbine generators. They are of the 4-pole type, and are wound so as to deliver either 6600 volts or 11,000 volts. As connected, they will deliver three-phase current at a voltage of 6600, and frequency of 25 cycles per second. The stationary armatures will consist of a cast-iron frame with laminated core, and coils set in practically closed slots; the field cores will be built up of steel castings, with slots closed by brass wedges. Their efficiency will approximate 97.5 per cent at full rated load, and they will be able to sustain 50 per cent overloads for three hours without dangerous rise of temperature of windings.

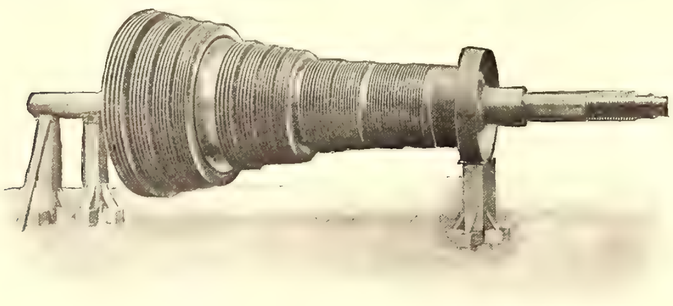
The turbine generating unit to be supplied by the Allis-Chalmers Company will be the first large unit installed by it for commercial operation. It is of the Parsons horizontal type, and will be of 5500-kw capacity, operating at 750 r. p. m., with a pressure of superheated steam of 175 lbs. The generator will be a four-pole revolving field Bullock machine, and will deliver three-phase alternating-current at a frequency of 25 cycles, and will be wound to deliver either 6600 volts or 11,000 volts. The rating of the unit provides for carrying 25 per cent overload continuously, and a 50 per cent overload for three hours with a temperature rise not exceeding 55 degs. C. The steam turbine is of the horizontal, parallel-flow, reaction type, being very similar in general construction and principle of operation to the well-known Parsons type.

One of the principal features of the Allis-Chalmers turbine is the blading. The blading is manufactured by special machine tools which have been constructed for this purpose. One of the widest departures from previous practice is in the method of securing the blades to the turbine spindle and cylinder. The blades are first inserted in a foundation ring, which is afterward secured in the turbine in such a manner as to withstand safely the high centrifugal force, instead of inserting the blades individually in the turbine. Another improvement is the ad-



LONGITUDINAL SECTION THROUGH ONE OF THE CROSS-FIRING AISLES, SHOWING COAL AND ASH CHUTES

dition of a channel-shaped shroud ring which is riveted to the ends of the blades, thereby stiffening them and preventing the effects of vibration in weakening the blades. The flanges of this channel strip are made very thin, so that if from any accidental cause the rotating and stationary part should come in



ALLIS-CHALMERS TURBINE SHAFT

contact, the flanges of the ring will not be injured. The use of this protecting shroud ring enables the Allis-Chalmers Company to build its turbines with a very low clearance between the rotating blades and the stationary cylinder. The speed of the turbine is regulated by a spring-loaded centrifugal governor acting through suitable mechanism on the steam inlet valve.

The turbine is lubricated by a thorough system of piping, whereby the oil is forced by a centrifugal pump, which is driven by the turbine, through the system of pipes to the bearings, thence through a large cooler, and used over and over again. There is a separate direct-acting steam pump in the oiling system for use in starting up the turbine, or to be used in case of emergency. The turbine and generator shafts are connected by an enclosed flexible coupling, and are carried in ball and socket bearings lined with a special hard babbit metal.

The generator is constructed with special reference to safety of operation at turbine speed and with thorough ventilation. Particular care has been taken in the method of supporting the ends of the coils of the revolving field and at the same time thoroughly ventilating it, this being one of the specialties of the Allis-Chalmers construction.

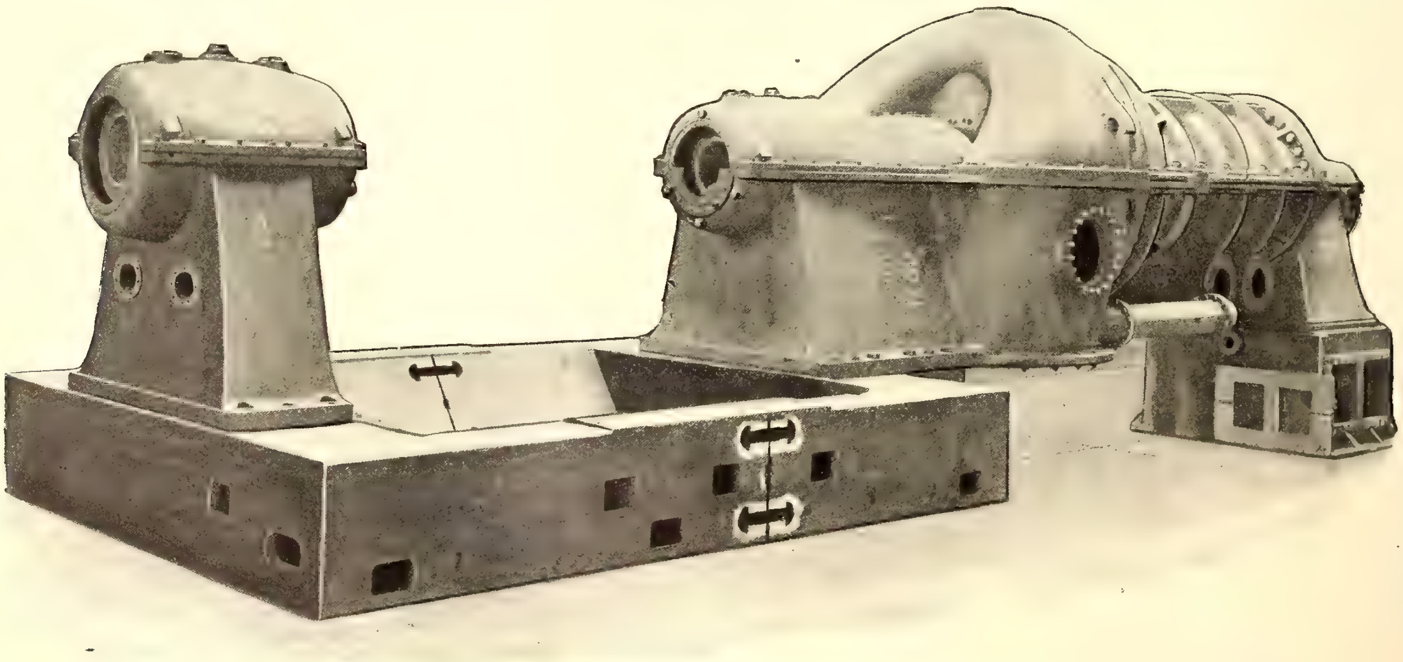
The whole unit of turbine and generator measures 47 ft. 1 in. in length over all. The outside diameter of the stationary armature of the generator is 13 ft. 4 ins. The greatest outside diameter of the turbine casing over the flanges at the low pressure end is 8 ft. 10 ins. The highest part of the unit, namely, the top of the generator, stands 11 ft. 6 ins. above the floor level.

In the basement, underneath each turbine, there is to be installed a Worthington surface condenser, with a two-stage turbine hot-well pump, motor-driven, and a horizontal rotative dry vacuum pump. The circulating water will be handled by volute circulating pumps, direct-driven by vertical compound engines, short direct connections being had to the inlet and overflow tunnels beneath the basement floor. The condensers are rectangular in section. That for the 5500-kw turbine will have 22,000 sq. ft. of surface, made up of 1-in. tubes, 17 ft. long between heads, over which the steam makes three passes. It has a capacity, when supplied with circulation water at 70 deg. Fahr., of maintaining 1 lb. absolute in the exhaust passages when condensing 150,000 lbs. of steam per hour. The tube heads are of Muntz metal, and the tubes are of No. 18 B. W. G. seamless drawn brass, secured in the heads with stuffing boxes of the navy standard pattern. The condensers for the 7500-kw units will be of the same general design as the smaller one, but with 25,000 sq. ft. of surface; they are of the same length and height, and sufficiently wider to accommodate the increased tube surface.

ELECTRICAL DISTRIBUTION

The electrical control equipment for the new plant will be similar to that in general use in three-phase generating stations of this type, although features of departure have been introduced in minor details where practice has indicated the possibility of improvement. The high-tension system, including oil switches, control and switching apparatus, will be operated like that in the Central Power Station, although, instead of being arranged at one end of the building, this equipment will be located in the mezzanine galleries, of which there are five extending along the entire north side of the turbine room.

The arrangement of the electrical galleries adopted, as shown in an accompanying section, is novel. The space under the gallery on the first floor level adjacent to the turbine room will contain the exciter and lighting units, and associated control apparatus, also the lighting and power switchboard panels. The balance of this space and the first mezzanine will be devoted to the cable ducts, while the second mezzanine gallery is to contain the high-tension feeder switches, by which the feeders are connected to the group buses. The third mezzanine gallery will carry the control boards and operating



VIEW OF STATIONARY PART OF ALLIS-CHALMERS TURBINE

stands, which will be located near the middle of the proposed building in the form of an open balcony overlooking the entire turbine section. The potential transformer equipment and the equipment of generator and feeder buses will occupy the rear of this gallery. The latter equipment will be encased in cells of brick wall and alberene partition construction, with wired-glass doors in front and rear, where the connecting cables are attached through disconnecting switches. The control boards are to be arranged in two rows of semi-circular shape, the generator panels in front and the feeder panels at the rear. In general, the equipment of the panels will be similar to those in the Central Station, which has been referred to in considerable detail in these columns. The individual generator and group feeder oil switches are to be located upon the fourth mezzanine gallery, from which leads are carried down through the series transformers to the feeder switches.

The system of connections for the switching system provides for two 1200 amp. non-automatic switches in series between each generator and the generator bus, while the feeders are supplied in groups of four by a 600-amp. main group-feeder oil switch. The buses are in all cases sectionalized, the generator buses having been planned so that but three or four generators will be assigned to each section. Tie switches are provided to connect the various sections together if desired. There is to be only one section of the generator bus installed at present, while there will be three of the feeder buses, each supplying four feeders. The feeder switches, located on the second mezzanine gallery, are equipped with relays for automatic tripping under overload.

AUXILIARY ELECTRICAL APPARATUS

While the electrical equipment is not as yet installed and cannot be definitely referred to, there are several interesting features to be noted. Among the latter may be mentioned the exciter and lighting system, which will consist of three 150-kw units, two motor-generator sets and the other a steam-engine-driven unit, delivering direct current at from 125 volts to 150 volts; this is to be supplemented by a storage battery which will float upon the system constantly, not so much in the sense of reserve capacity as in security from interruptions, which it is arranged to prevent absolutely. The battery, which will be installed on the fifth mezzanine gallery, is to be of 2000-amp. discharge capacity, and will be operated without end-coil switch regulation. A novel form of direct-current reverse relay, or circuit breaker, will be used in this connection on all the motor-generator leads to prevent a destructive return flow from the battery to a motor generator in case it becomes inoperative. This relay is designed to open the circuit on any reverse flow from the bus to the machine equal to or above one-half its full-load capacity, although it is entirely inactive when current is flowing properly from the machine to the bus, even at heavy overloads.

The type C oil switch of the Westinghouse Electric & Manufacturing Company will be used as standard throughout the new station, as well as in all new high-tension work. These will be automatically controlled by the GE diaphragm-type inverse-element overload relays, which are designed to break the circuit more quickly in proportion as the overload or short circuit is heavier or more severe. The entire switch and control board equipment is being supplied and installed by the Westinghouse Electric & Manufacturing Company.

ENGINEERS

This station is being built by the Transit Development Company, an equipment and operating company subordinate to the Brooklyn Rapid Transit system. In the details of design and construction, the latter company has been represented by Edwin W. Winter, president; C. E. Roehl, electrical engineer, and R. C. Taylor, mechanical engineer. Thomas E. Murray has acted as consulting engineer.

DEPRECIATION AND RESERVE FUNDS IN MILWAUKEE

It is well known that the Milwaukee Electric Railway & Light Company makes a practice of charging off a certain amount of its gross receipts for different reserve accounts, and that the president of the company, John I. Beggs, has always been an advocate of this policy. The actual amounts so charged off are not, however, so well known.

The company has been following this plan for the last nine years. At that time the company had a depreciation reserve account, to which was carried from the gross receipts $15,000 monthly, which at that time was nearly 15 per cent of the gross receipts of the company. This fixed amount was carried to the depreciation reserve account until the company's gross receipts had increased to such an amount that the $15,000 monthly, or $180,000 per annum, equalled 10 per cent of its gross receipts. Since then the company has carried monthly 10 per cent of its gross receipts to the depreciation reserve fund, this amount being in addition to the ordinary current repair and renewal accounts which are charged month by month. From this depreciation reserve fund all large amounts for replacement and reconstruction are taken, that is, any single piece of work exceeding $500, as, for instance, expensive pieces of special work, replacement or reconstruction of tracks and overhead and rebuilding or replacing cars.

The company has also established a "fire insurance reserve," to which is carried a given percentage of its gross receipts monthly, and from this fund all fire insurance premiums and fire losses are paid. The amount carried to this fund in the past has been considerably in excess of the annual requirements, so that at the present time the company has in its fire insurance reserve fund (invested) over $350,000.

Another fund established by the company is an "injuries and damages" reserve, to which is carried a given percentage of its gross receipts monthly, and from which fund is paid every expense incident to taking care of and paying for injuries and damages to persons and property. The amount charged off to this fund in the past has been sufficient to create a reserve fund which at the present time amounts to nearly $230,000, and which is likewise invested in interest-bearing securities.

The company has also established a "legal expense reserve," to which is charged off 1 per cent of the gross receipts monthly. From this fund the city pays all legal expenses outside of the legal expenses in connection with the injuries and damages department.

Still another reserve fund is called the "storage battery maintenance reserve." To this the company credits each month, and charges against operation of power plants, a certain percentage of the original cost of the battery, and out of this reserve fund pays all the expenses of maintaining and replacing the battery.

At present the company's depreciation and reserve funds of all kinds amount to nearly $1,700,000.

The postoffice department is calling for bids for the carrying of the mail between Doylestown, Pa., and Newton, fourteen miles, by wagon after Oct. 2, 1905. The mail has been carried on the Newtown Electric Street Railway for several years, and the company has run a mail car twice daily through to Bristol, twenty-seven miles. The mail clerk was on the car leaving Bristol at 6.10 a. m., 2.03 p. m., and leaving Doylestown at 8.37 a. m., 4.13 p. m., making the run each way in 2 hours 10 minutes, or 1 hour 5 minutes to Newtown. The wagon service will be double daily each way, between Doylestown and Newtown, covering the fifteen miles in three hours, leaving Doylestown at 10.30 a. m. and 4 p. m., and leaving Newtown at 7 a. m. and 4.30 p. m. The change will inconvenience a great many people, and the only excuse given by the postoffice authorities is that the electric railway wants too much money.

THE PHYSICAL ANALYSIS OF AN ELECTRIC RAILWAY PROPERTY

BY ALBERT B. HERRICK

The period is rapidly approaching in the electric railway industry when greater attention must be paid to minor economies in electric railway operation. Net income is often such a small percentage of gross receipts that it is only by paying great attention to every detail of operation that ultimate success often depends. Moreover, the greatest defense against both competition and legislation is effective and satisfactory transportation facilities. Competition will not be fostered by a satisfied public, nor will its representatives be encouraged in adverse legislation.

The manager of an electric railway property is confronted with a peculiar problem—similar to a factory with a fixed output. This output, in the railway, is so many trips per day, accomplished with a given number of equipments, while the revenue received varies with season, weather and the temper of the traveling public. The manager often realizes that the difference between receipts and expenses is too small, and that there are leaks which ought to be stopped, yet he cannot put his finger on them. Some of these wastes may be inherent to the system, others have grown up through unsymmetrical development along the line of improvement and maintenance of the property, and ought to be corrected.

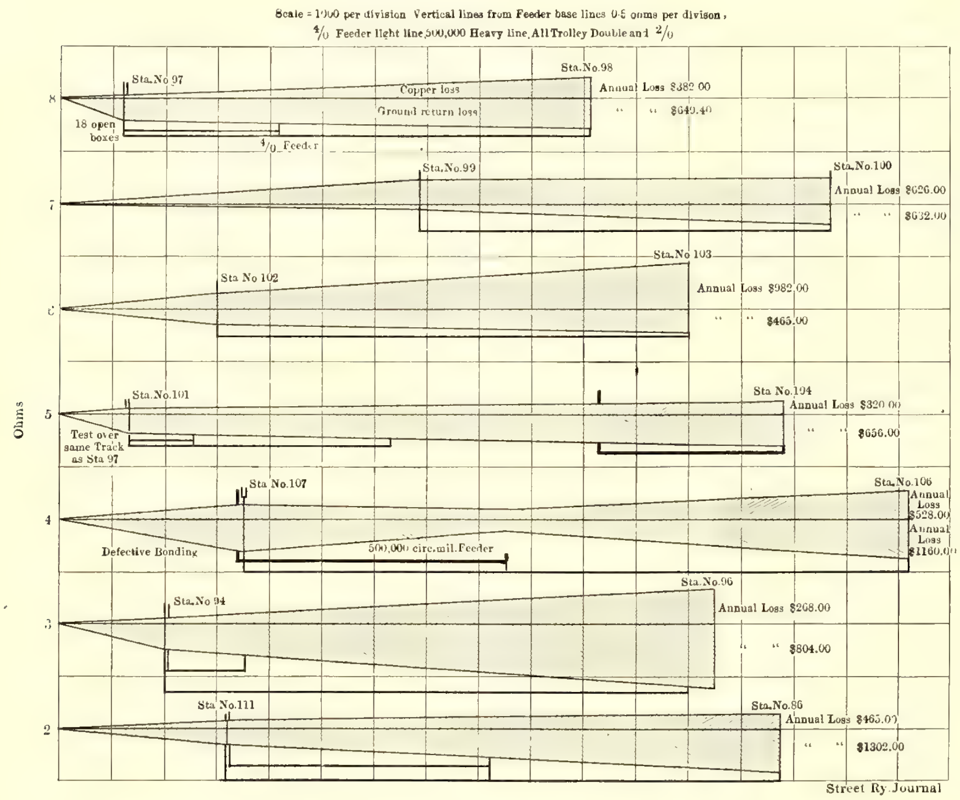


FIG. 1.—METHOD OF PLOTTING FEEDER LOSSES IN OUTGOING AND RETURN CIRCUIT

The maintenance in the different departments is so correlated that a defect in one will often react in the decreased efficiency of others, so that the true cause of the increased cost of maintenance is disguised. Good examples of this are the rapid depreciation of a good car body operated over a poor roadbed, the accelerated depreciation of motors when operated under low potentials, and the decreased efficiency of the power plant per car mile, due to defects in transmission.

It is rare to find, on an examination of an electric railway property, that the maintenance has been uniform throughout the system, for this would require that all technical personnel of the property should be equally efficient in their various lines. Very often the management will give special attention to development and maintenance along certain lines, while along other lines the efficiency will fall so that the aggregate is far from high. It is at this stage in the life of a railway property that a technical expert can become of value to a property. The expert should have had experience in the examination of other railroad systems, and be able to describe the condition in which he finds the property in a report which will contain an analysis of the improvements required for the betterment of the plant. The physical report cannot be prepared from a cursory examination, but only by a thorough and practical test while the system is operating under normal conditions. It should not deal with the problematic or academic side of the subject, but should be devoted to the concrete conditions existing in the particular plant under examination and their direct bearing on the operating costs. The function of such a report should be to explain how to increase the utility and economy of what now exists by expenditures within the allowable maintenance charges, and not the easy way of recommending reconstruction and the replacement of apparatus which is still useful with something new and of problematical economy, when the cost of the loss of the old apparatus would have to be added to the interest on the investment of the new.

A physical report should include within itself the direct deduction from the facts to the dollars. Where the dollars are to be expended either in operation or maintenance, graphic methods which appeal directly to the eye and do not require the analysis of a mass of figures, are found to convey the problem forcibly and make the deductions more evident. I have found it best in all cases of this kind to use graphic methods, and as each class of facts requires different treatment, some of the different methods used for graphically representing these conditions will be fully explained.

THE DISTRIBUTION SYSTEM

The physical report on the distribution system should include an analysis of the feeders, trolley and ground return, as well as of each feeder individually. The first thing that is to be determined is called the "economical factor" of each feeder; in other words, the cost of the losses in each feeder per annum under practical operating conditions. The load on an individual railway feeder is, of course, fluctuating constantly, but if an autographic recording amperemeter is inserted in the circuit of this feeder it will be found that there is a rhythmic fluctuation, the period of which depends on the schedule time required for an equipment to make a complete circuit of the trolley fed by this feeder. The average, maximum and times of maximum demands can be instantaneously recorded. The resistance of this feeder is then determined by measurement at the center of its load while the system is in operation. The problem then becomes simple if the cost of energy per unit as produced by the station is known. The autographic record can be readily planimetered to find the mean current, as the amperes are reproduced as a rectilinear function, with time as the horizontal component. The square of the mean average current when multiplied by the resistance of the feeder gives the units lost, and if this product is multiplied by the time this current flows in a year over this feeder we obtain the kilowatt-hours

lost per annum. This product multiplied by the production cost per kilowatt-hour, gives the cost of these losses. If this cost is too high there is a number of ways where this loss can be averaged throughout a system. Thus the length of the trolley wire fed by a particular feeder can be reduced, and if the feeder adjacent to it shows lower annual losses, it can be given more trolley to feed.

Undoubtedly, the most extravagant use of copper is caused by the employment of section insulators, by which each feeder is kept as an independent unit. This is usually done for safety in case of short circuits on the line. The same results can be obtained, however, by introducing an automatic circuit breaker between the end of one feeder and the feeder passing beyond, which practically jumps the section insulator. This automatic breaker can be set to open at any desired current value, which is generally 60 per cent of the maximum of the shorter feeder.

on the ground side of the system, extending toward the center of load of the system, is usually desirable. With a well welded joint, however, this density can be carried up to a mean average of 700 amps. per 60-lb. rail before the supplementary will be a profitable investment, provided the track joints are carefully maintained and cross bonding is used at frequent intervals. The above limit must be used as approximate only, as the resistance of rails varies over 30 per cent, according to the manufacturer and the time of rolling the rails.

The character of soil on which a city is built has a great influence on the percentage of current which the rails will carry back. That which does not return on the rails takes other paths, and again enters the rails or other ground connections near the power station. Cities near sea level, those built on earth carrying a substratum of moist earth, and those largely filled in with ashes and other refuse, show low resistance be-

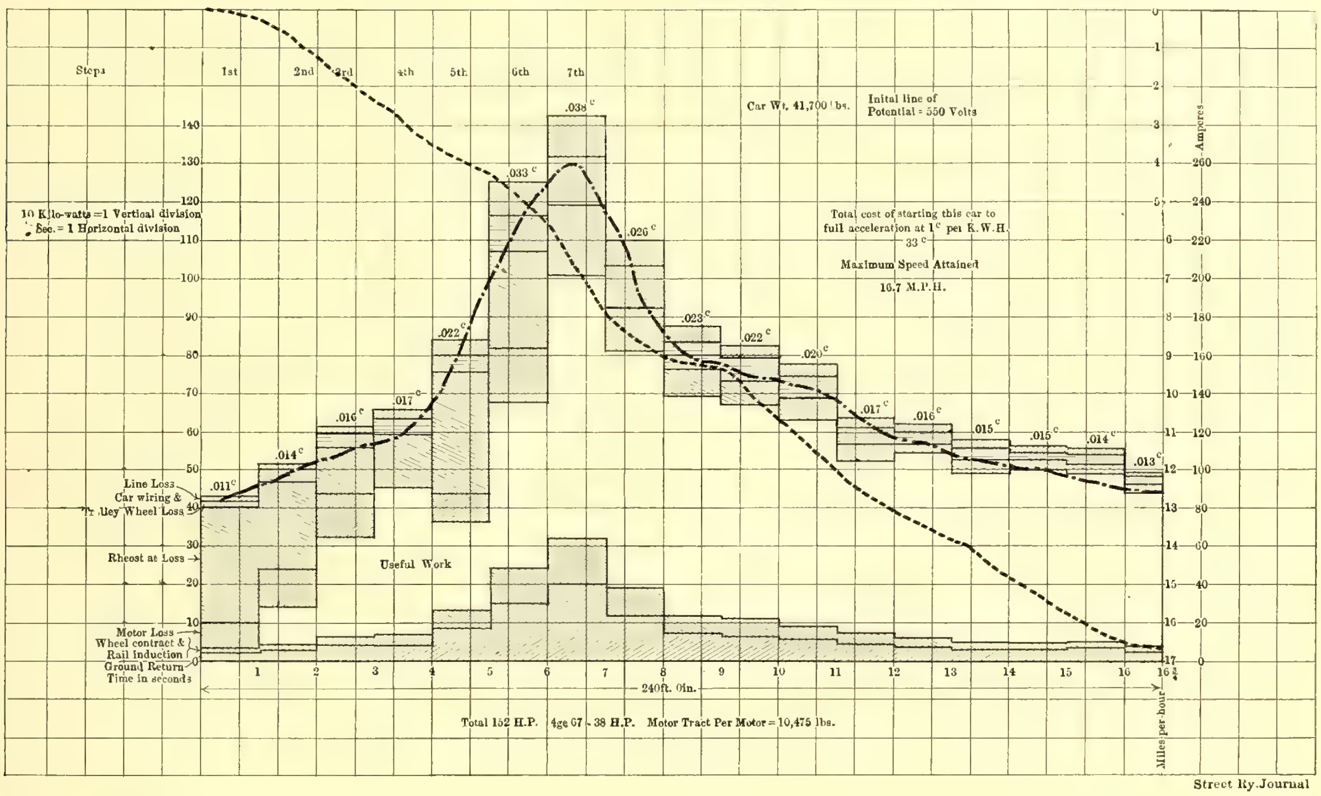


FIG. 2.—LOCATION OF LOSSES IN A FOUR-MOTOR GE 67 EQUIPMENT, WITH K_2 CONTROLLER AND CAR, WEIGHT 41,700 LBS.

If a short circuit now occurs the breaker between these feeders opens and leaves the different feeding sections independent of each other. This breaker can be provided with a semaphore so that it can be kept closed under normal working conditions, and as the maximum very rarely occurs on two adjacent feeders at the same time the economy of transmission is greatly increased. The expense is slight, as a breaker boxed with semaphore complete does not cost over $70.00. The returns on this class of investment, on the other hand, are very large. In a number of cases the cost of investment has been paid for monthly in energy saved, besides securing increased speed and lower heating limits on the equipment.

The methods of plotting these losses in the copper distribution is shown in Fig. 1, in which the annual cost of losses is given for both the overhead and return portion of the distribution system.

There are several physical conditions in the relation of the power plant to the railway system which largely affect the losses in the ground return circuit. Thus, if the station is located at the junction of several tracks the current density on each rail is less than in a station located on a single line. In either case, if the current density exceeds 600 amps. for a 60-lb. rail with two No. 0000 bonds, a supplementary feeder

tween rail and earth and a considerable diversion of current from the rail return circuit that has been provided. If a river with high banks passes through a city, a congestion of current will often be found on the banks of the river, accompanied by a return of the current to the rail in restricted areas. This physical condition has caused a great many of the cases where complaint has been made regarding underground piping systems. With well drained clay and sandy sub-soil, or in a city underlaid with a rock formation, the normal resistance of the earth paths is high. The physical report should show graphically the total loss existing on this return circuit. This can best be done when these losses are plotted out in the form of a diagram, as shown in Fig. 1, in which copper and ground return losses are separated. It is found that where two power stations feed over the same territory, but are placed in different points of the system, that the ground returns will swap current between each other. The ground resistance under this condition of distribution is much lower than with both systems operating independently.

When a car passes a given point there is a rise of potential on the rail, which may be caused by the induction of the rail, but when the car has passed, the potential again falls. The rise is proportional to both current discharged to the rail and the

speed of the equipment, and values varying from 2 volts to 21 volts have been found. This is a loss that is inherent with the operation of the equipment.

Insufficient cross bonding is another source of loss which is plainly indicated on autographic records of bonding where the current density is continuously recorded for both rails, as with the progress of the car the maximum current will follow one rail and then shuttle over to the other. It is often assumed that the car wheels and axles offer sufficient cross bonding between the rails as the cars roll along the track. This is not true, however, when they are discharging current into the rail and when they offer a high resistance, as they always do when the track is dirty. In roads where permanent cross bonding has been neglected except between the inside rails, the current density, while in operation, often averages 60 per cent greater on the inside rails than on the two outside rails, a feature which quently found. In this case the question often arises whether supplementary ground return feeders should be used or whether the rails which have neared the end of their life should be rebonded or welded. If the latter is proposed, care should be taken to learn whether the roadbed is of sufficient stability to hold the rail so as to insure reliability in the bonding or welding of the rail return circuit.

The current flow on the pipes can be shown on a pipe map by a broad color band paralleling the pipe, the width of the line being proportional to the mean current flow on the pipe. It makes considerable difference whether tests for current flow are made in summer or winter, as the current that leaves the rail is less when the ground is frozen, but the conductivity of the rails is better at low temperature, and any metallic connections between pipe systems and rail become accentuated, and are easily located by the direction of current flow on the rail.

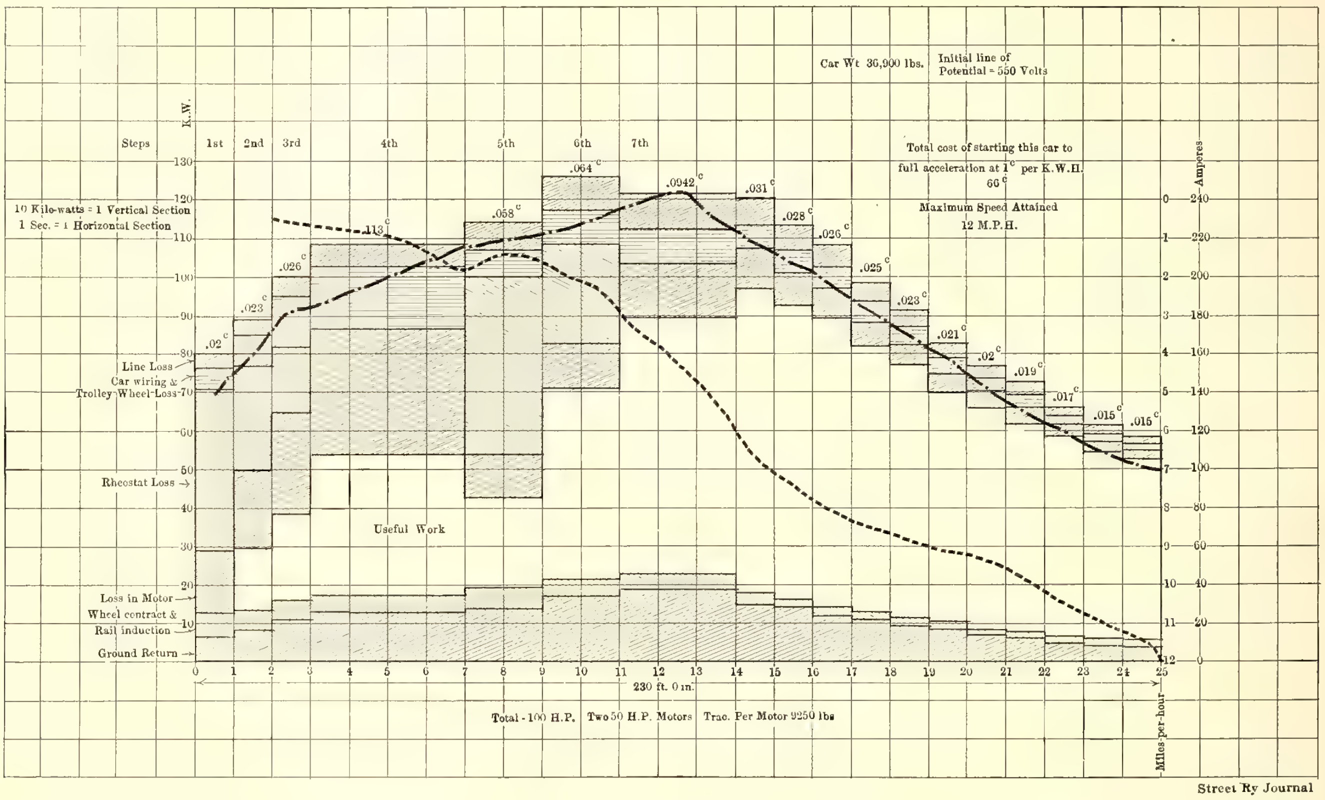


FIG. 3.—LOCATION OF LOSSES IN A TWO-MOTOR GE 57 EQUIPMENT, WITH K_2 CONTROLLER, 14 B3 TRUCK, CAR WEIGHT 36,000 LBS.

greatly increases the ground return losses and does not fully utilize the conductivity of the rail return. All these existing conditions have to be discovered, and their relative importance in the operating economy of the system determined in a complete physical report. By an autographic record the condition of each bond is recorded, the locations of those which are defective are marked, and the current density which should be carried by the rails, as determined by the feeder outputs supplying equipments operating on that line, is obtained. There occurs in every system critical points where the bonding plays a very important part, and the current may be diverted through roundabout paths with large losses in the return circuit. To designate these bonds and to state definitely where the return circuit is otherwise defective, form an essential portion of a physical report.

The amount of current carried by piping systems, whether through earth leak or inadvertent metalic connections, should be discovered, and whether there exists a hazard in the district where the tendency is for the current to leave the pipes for the rail; also what causes this diversion of current and what is the remedy. It is found that steam rail crossings, bridges and special work are the points where open joints are most fre-

In the case of some interurban roads entering a city, where the interurban power station is located some distance outside the city, the direction of the current on the rails will reverse before reaching the city trolley, and the interurban return current will use the city rail system as an earth plate to return to its power station. In certain cases of this kind the rails of one company have been badly pitted by the current from another company where the two lines joined.

THE EQUIPMENT

The economical operation of an equipment depends, more than upon any other factor, on its proper maintenance, the motorman and the proper schedule, the proper selection of the motors for the weight of car body, and the road characteristics. It is often found on a road operating different kinds of equipments that some are unduly forced by grades, weight of car body and schedules, while other equipments are operating under underload conditions, and have been assigned to routes for which they are not fitted to give the best service. In such a case it is necessary to so adjust equipments over a system as to bring them all to maximum duty, and not require a four-motor equipment to run on a two-motor schedule, where most

of the time it is operated in series instead of the multiple position of the controller. The economy of the two methods can be seen graphically from Figs. 2 and 3, which show the results at the end of one acceleration period in a distance of 240 ft. with car bodies of practically the same weight in each case. The two-motor equipments reached a speed of 12 m. p. h., and the four-motor equipment of 16.7 m. p. h., while the cost of the four-motor acceleration is half that of the two motors. In this case, with a 10-mile run and a 15-minute schedule, a four-motor equipment would show a marked saving over a two-motor equipment in both maintenance and power. In the graphic illustration the different losses in the equipment are shown where they occur, and are determined by autographic methods, which are instantaneous. These diagrams are the result of the averages of a number of different equipments of the same type, and the weight and acceleration values are taken along the same track with the same motorman.

The route constant is determined by operating over the route a number of times a calibrated equipment which follows a car in regular service so that the stops are the same, as are also the maximum speeds that are obtained and the maximum and mean current demand. This car is operated over all routes and a constant is determined for each. The relation of these constants gives the relative duty required of the equipments over the different routes, and from these data the equipments can be placed to perform their best duty. Schedule speeds can then be altered to bring the same average duty on the equipments and reduce to a minimum the equipment depreciation.

Car electrical maintenance is determined by an electrical inspection of the equipment. Measurements are taken with 500 volts, and the results are plotted as in Fig. 4, where the resistance of the rheostat, the motor fields and armature is given for each step on the controller. Each point that passes the standard is marked with a D, so that the equipment can readily be brought to a standard. A diagram of this kind reflects in an excellent way the care that the cars get in the car house and repair shop. There is no one thing that varies so greatly among electric railway companies as car maintenance.

In the repair shop the methods of making the repairs, handling material and motors, and the machinery and appliances used are subjects of consideration. In the majority of cases

EQUIPMENT 4-WEST. 68 MOTORS K6- CONTROLLER

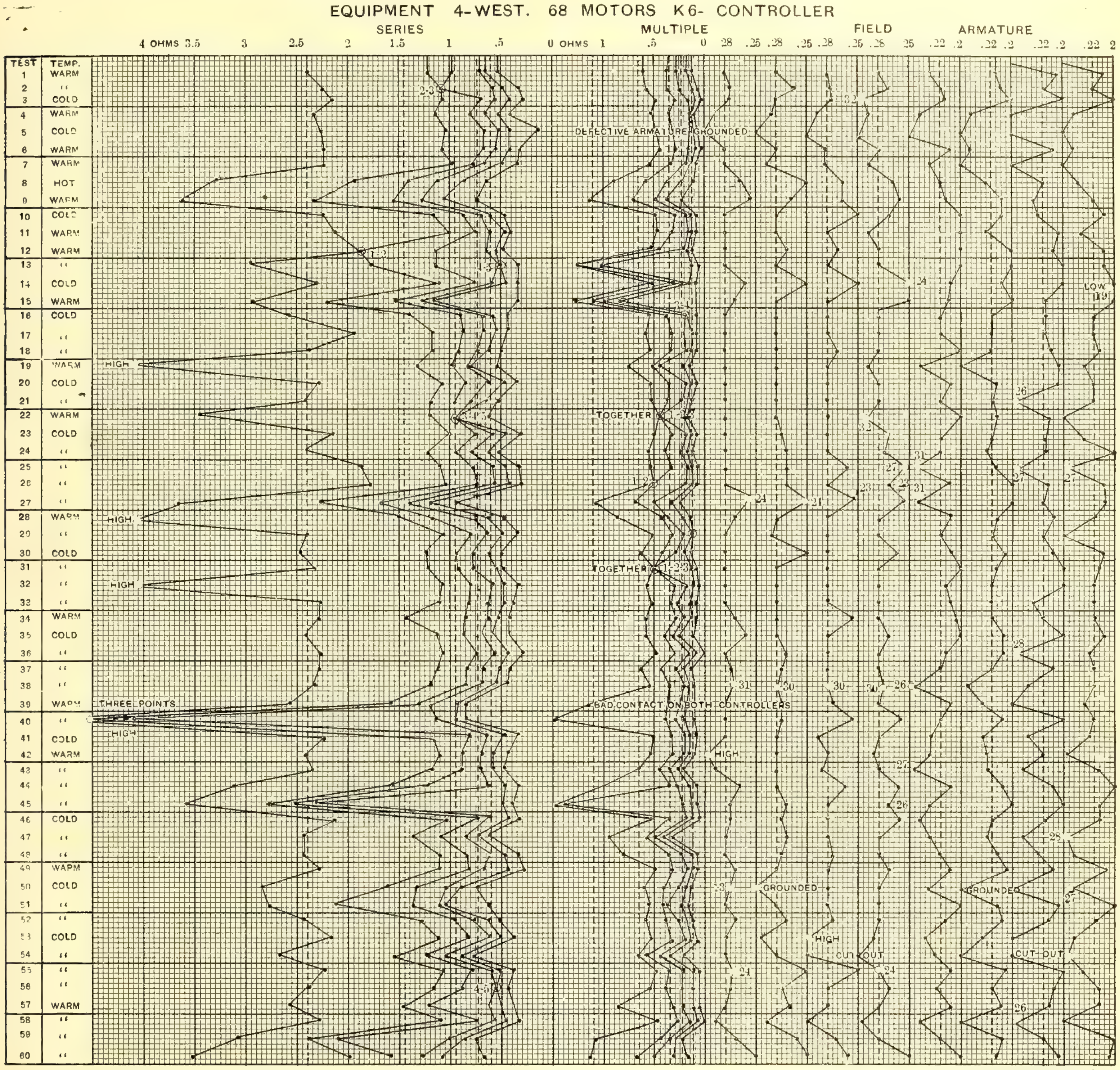


FIG. 4.—GRAPHIC ILLUSTRATION OF THE RESISTANCE ON DIFFERENT POINTS OF SIXTY EQUIPMENTS.—THE RESISTANCE POINTS SHOULD FALL ON THE DOTTED LINES FOR EACH STEP OF THE CONTROLLER

the simplest and most successful of the apparatus has often been devised by the employees themselves, as they are products of a special study of the class of breakdowns which is peculiar to the system under inspection. All of these points should be brought out in a physical report on the property.

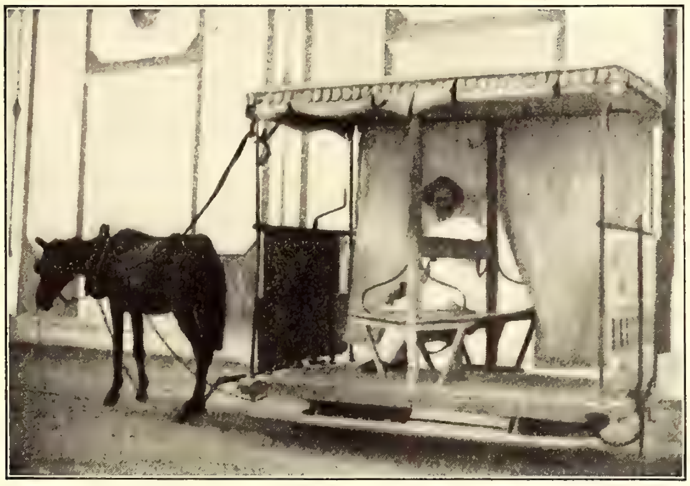
POWER STATION

The power station should be subjected to operating tests with calibrated instruments, to discover where the leaks are, as well as the character of supplies and help employed. The boiler room is generally the portion of the plant where the greatest losses occur. A complete graphic analysis of power station losses was given by the writer in the Street Railway Journal for Jan. 6, 1900. Especial attention should be given in the investigation to the method of firing the furnaces and to the quality of coal, because the higher steaming valves of more expensive coal will often show a net saving. Oil is another question to be considered, and, as a rule, economy in oil means extravagance.

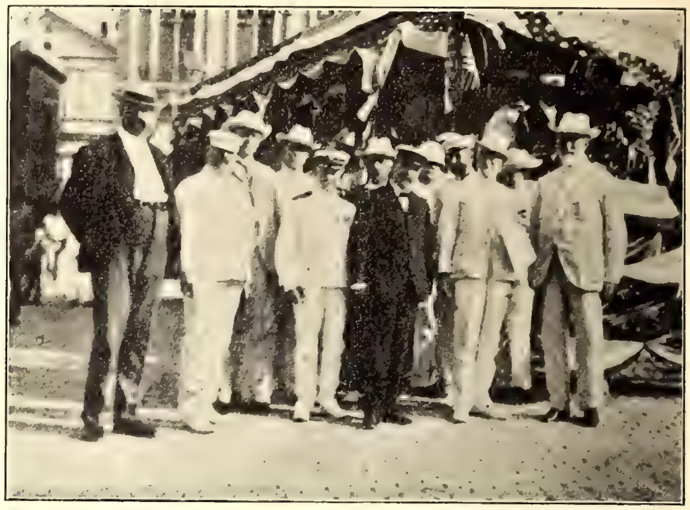
Broadly stated, no road is any better than the manager, and car maintenance is in no better shape than the repair shop. The cause of the troubles on any road can often be determined from the scrap heap.

THE ELECTRIC RAILWAY AT SAN JUAN, PORTO RICO

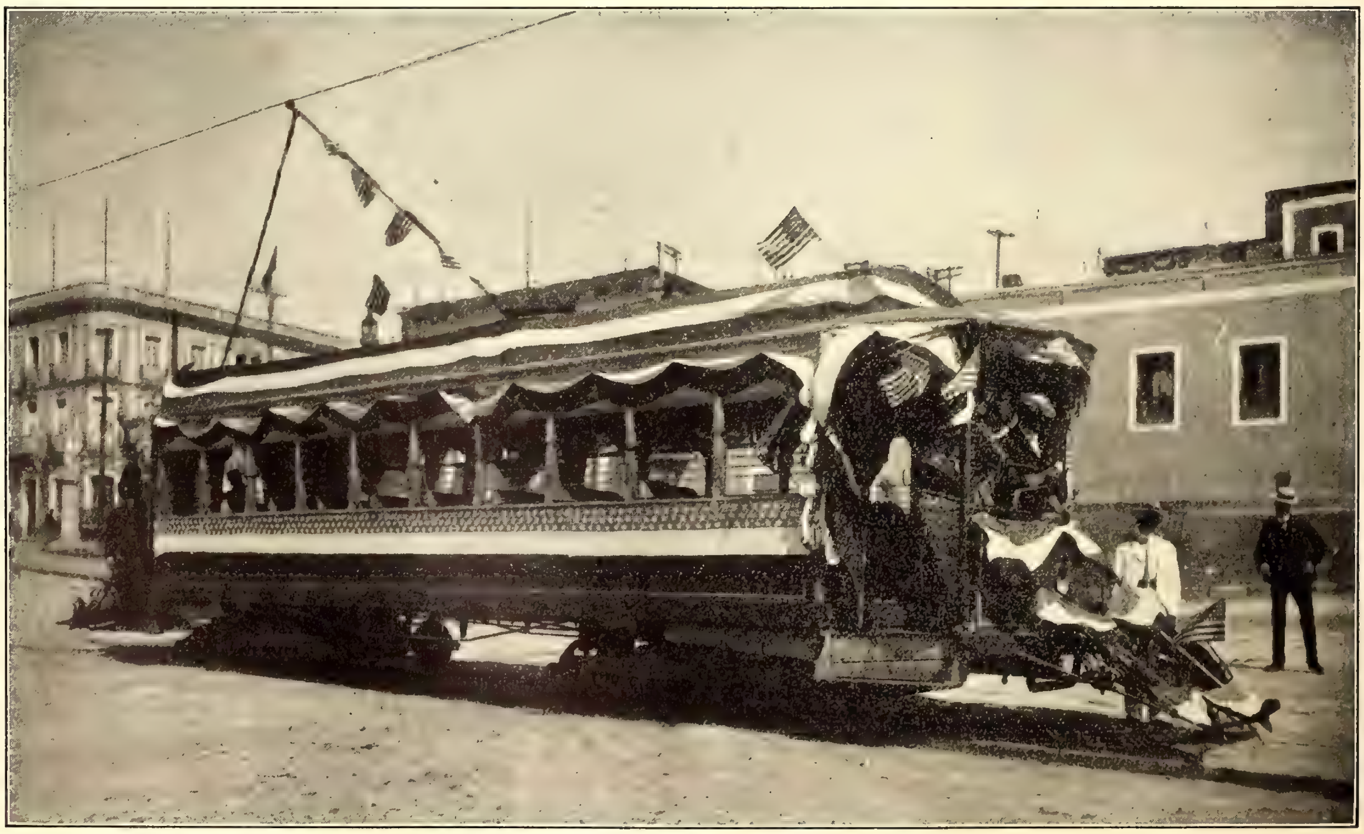
Among the important reconstruction work that has been carried out by J. G. White & Company, of New York, in the territory acquired by the United States from Spain, is the rebuilding and electrification of the mule and steam tramways of San Juan, Porto Rico. Several of the accompanying views show scenes on the opening day. In the group shown on this page, the gentlemen in the front row, counting from the left, are: (1) C. C. Benson, manager; (2) Secretary Moody; (3) Congressman Foss; (4) Commandant Dunlap, of the naval station at San Juan; (5) the late Postmaster-General Payne; (6) Joseph Cannon, of Chicago; (7) Senator Proctor.



A CAR IN SAN JUAN REPLACED BY THE ELECTRIC SYSTEM



THE LATE POSTMASTER-GENERAL PAYNE AND OTHER VISITORS AT OPENING OF SAN JUAN ELECTRIC RAILWAY



ONE OF THE NEW CARS ON OPENING DAY

San Juan, the metropolis and most beautiful city on the island, has a population of 40,000 inhabitants. The city proper is built on a peninsula of comparatively small area, and in the course of expansion of the resident districts, it became necessary to provide means of transportation to and from the outlying suburbs, particularly Santurce and Rio Piedras, two of the more important suburban towns on the island. Some years ago these communities were connected with San Juan by a narrow-gage steam railroad, whose rolling stock consisted of a dozen diminutive passenger cars and four small Baldwin locomotives. The track of this steam railroad was of .8 m gage, and in electrifying it the gage was changed to 4 ft. 8½ ins., American standard.

The San Juan Light & Transit Company, as the new organization is called, has at present 9 miles of road in operation, the main line extending from San Juan through Santurce, to the town of Rio Piedras, the terminus, a distance of 8 miles. There is also a branch leading to the beautiful Parque Borinquen, situated on the north beach of the island. The railway follows the Caratara, or Spanish miltary road, along which are many beautiful residences. At several points, private right of way is used. In San Juan, the railway enters the city near the sea level and gradually works its way through the narrow streets to the Plaza, or center square of the city, several hundred feet above the level of the sea. In leaving the city the road follows another route, and thus forms a loop. The suburban portion of the track is 70-lb. A. S. C. E.-rail laid on native wood, which resembles and has many of the properties of mahogany. Cinder is used as a ballast in many places, and has proved very successful. In San Juan, 90-lb girder rails were employed. The streets are paved with patent block. The overhead trolley is suspended from bracket construction, and is No. 00 in cross section. Four feeders of No. 0000 cable supply the system.

LAYING TRACKS IN SAN FRANCISCO STREET, A TYPICAL THOROUGHFARE IN SAN JUAN

The rolling stock consists of fifteen passenger cars and one express car. All are mounted on maximum-traction trucks of the St. Louis or Peckham make. The passenger car bodies are from 35 ft. to 39 ft. over all and 8 ft. wide, and are of the semi-convertible type. This style of car is well adapted to the climate of Porto Rico, as sudden and intense rainfall is common in certain seasons. The car bodies were supplied by the Stephenson and American Car companies.

LEAVING THE CITY FOR THE INTERURBAN SECTION

The majority of the cars are equipped with two GE 57 motors with K-8 and K-11 controllers. Two of the cars have GE 58 motors and K-10 controllers. All are fitted with hand brakes of the ratchet type.

The schedule in effect at present is as follows: Between 11 a. m. and 10 p. m. cars run between San Juan and Park Junction every 7½ minutes, and between San Juan and the Park every 15 minutes. Between 6 a. m. and 11 a. m. and between 10 p. m. and 12 p. m. the headway is twice as long. Cars run between San Juan and Rio Piedras every 30 minutes throughout the day.

This close schedule on a single track necessitates the utmost care to avert accidents. This is especially true in view of the fact that the motormen are all native Porto Ricans. In order to eliminate as far as possible all chances for collision, a novel block signaling system has been installed. This system was described in full by Charles G. Bennett in the STREET RAILWAY JOURNAL for July 15, 1905.

In addition to its railway, the San Juan Light & Transit Company owns and operates a lighting system, which furnishes the residence and business houses of San Juan and Santurce with 60-cycle 104-volt alternating current through transformers. The lighting current is distributed at 2200 volts.

TRACK CONSTRUCTION ON THE CARATARA, SAN JUAN

One of the most interesting features of the overhead construction at San Juan is the arrangement whereby all feeders and high-tension lines are carried on specially built trusses or cross-arms on the roofs of the houses. This condition was necessitated by the fact that the streets are too narrow to permit the erection of pole lines. The majority of the buildings in the city are of brick, with flat roofs. The exterior walls, however, extend several feet above the roof level. To these walls are fastened the braces or trusses, so that the wires are carried at a safe distance above the tops of the buildings. The secondary distribution is three-wire. Electricity is used by the natives for both light and power to a surprising extent, largely on account of the high cost of oil. A gas plant was installed by an English company, but was not a success, and the mains have been removed from the streets.

The power station is located on the Caratara, midway between San Juan and Santurce, and is of steel construction, with corrugated iron roof and sides. Steam is generated in four 500-hp Cahill boilers. Current for the railway system is supplied by two 250-kw General Electric 600-volt generators, driven by Fisher engines. The alternating current for lighting is supplied by two 60-cycle two-phase Westinghouse generators of 225-kw capacity each, driven by Ames engines.

It was necessary to provide a machine shop for the repairs of the cars and motors, and this shop was located at Rio Piedras. Here several lathes, a wheel press, forges, drill presses, etc., are installed. The tools are motor driven.

The road is managed under the supervision of the operating department of J. G. White & Company. C. F. Beames, the local manager, is in active charge.

HINTS ON SHOP MANAGEMENT

BY A REPAIR MAN

Notwithstanding the fact that the average workman about a street railway repair shop encounters more dirt and grime than do other mechanics, these shops are often lacking in proper wash basins where the workmen may wash themselves at the close of the day. Pure negligence is about the only reason that can be given for the absence of such facilities. The cost of setting up one or more wooden troughs a foot wide, a foot deep and 10 ft. or 20 ft. long, and connecting them with the water supply system, is too small to be considered when the convenience afforded to the men is considered. But there are other considerations which show that money so invested is a paying investment. In some shops where washbasins are not provided, many of the men have their own buckets, which they keep either in their locker or in some out-of-the-way corner. These are usually filled with water before the whistle blows, and the time to do so is the company's loss.

In many cases a marked decrease in the consumption of gasoline would also be coincident with the installation of wash troughs. A piece of waste saturated with gasoline removes grease better than anything to be found about a car shop. If an inspection of lockers were made, in many belonging to workmen who have no legitimate use for it except for cleaning, a half gallon or a gallon can of gasoline will often be found. But the decrease in the consumption of gasoline is not the only item to be considered. The fire risk would be lessened materially, for there is hardly anything so dangerous as bunches of cotton waste saturated with gasoline lying around wherever thrown by the workmen, as they hurriedly leave the shop.

There is even a stronger argument in favor of the installation of proper washing-up facilities. The more self respecting the workmen and the more cordial their relation with the management, the better will be the class of work turned out. It necessarily follows that a self-respecting man is more likely to be attracted to a shop where some provision is made for his leaving it in a presentable manner.

RELATIONS WITH SHOP EMPLOYEES

The attitude to be assumed by a master mechanic or superintendent towards the men under him is one of the most vexing problems that comes before the head of a shop for solution. The fellow feeling common to all of us prompts a close and in-

timate relation. But the fact that in every collection there are always some who are ready to impose on such a relation makes it necessary for the superintendent to hold himself somewhat in reserve. The amount of reserve to be exercised depends as much on the characteristics of the governing man as upon the natures of the workmen governed. Some men are fortunate in having a demeanor that permits them to be free and easy with their employees, yet one which in itself always commands respect. Others who are called upon to govern men must assume a haughty, over-bearing attitude before they are able to make themselves obeyed.

The presence of the few men in every shop who cannot stand decent treatment causes many master mechanics to become imbued with the idea that all the men under them must be treated as cattle and be literally driven in order to get work out of them.

This is probably a more serious mistake than the opposite extreme of becoming too intimate with the men. The workmen, feeling that they are treated as unintelligent beings, act accordingly, and are ever afterwards at variance with the management. The consciencious workman observing that he is classed with those whom he regards beneath him, leaves the shop at the first opportunity. The plant, as a whole, soon acquires a bad reputation, and self-respecting men shun it. The result is a gradual lowering of the character of the men employed until the shop is filled with men who require the treatment of cattle.

Rather than shape his demeanor to that demanded by the lower class of workmen, it would in most cases be better for the master mechanic to fit his attitude to that required by the better class of men and to get rid of those who do not appreciate decent treatment. This would have a tendency to raise still higher the character of the men employed in the shop. Good men make returns for good treatment. It appeals to the manhood in them, and they try to show their appreciation by doing better and more earnest work. New comers into the shop, soon catching the prevailing atmosphere of good will and cordial relations between employer and employees, exert themselves to their utmost to maintain it.

When once the confidence and respect of his men are obtained, half the difficulties of the master mechanic are removed. Instead of being compelled to do and to see everything for himself, each man under the superintendent is on the alert to help him. The whole shop works with the idea of accomplishing something rather than simply to put in time. Work is done better, more quickly and more satisfactorily in every particular.

After cordial relations are once established, the utmost care should be exercised in order to retain them. It should be remembered that men are human and may make errors. An error should call for a caution against repetition rather than for an outburst of anger and a flow of vulgarity. If cautions and hints do no good, then it is in all probability best to get rid of the man before he exerts a bad influence on his fellow workmen.

RUSHING SHOP WORKMEN

Some master mechanics and superintendents believe that the best returns from money spent in labor are obtained when foremen or overseers are continually at hand to drive and urge the workmen to exert themselves to their utmost. Such treatment of employees is no doubt a success when the work is of such a nature that negligence and carelessness causes no great inconvenience. But it is a question whether forcing and driving employees should be practiced in car repair shops. It is true that this treatment will give the shop a busy appearance, but the men may be doing the work in a haphazard, imperfect manner, such that its nature will become evident at some future date.

There is a right and a wrong way of doing everything about a repair shop. In making a splice, for example, the wire may be "skinned" or the insulation peeled off most quickly by "ringing" the wire, or on the other hand it may be removed without injuring the wire by taking more time. The joint may be soldered by simply coating the outside with solder, or the solder may be allowed to sweat thoroughly through the splice. The chances are great that when men are rushed continually they will make splices in the quickest manner possible. The fact that an imperfect splice is soon taped and hidden, so that it has the same appearance as one which is carefully made, increases the liability to careless splicing. At some later date, however, an unusually severe strain may come upon the defective splice. Then the ringing of the wire, or the imperfect soldering, becomes evident. The actual cost to the company of the single joint may run up into dollars, and the master mechanic who reckoned its expense from the time spent in making it is therefore laboring under a delusion.

We often hear a superintendent say that his men tear down and rewind a certain armature in ten hours. The winders in another shop may require fifteen hours for the same machine. It does not follow that the work of winding the machine in the latter shop costs the most money. Possibly only one-third the number of defective armatures per car per year are brought into the shop where more time is allowed for rewinding them. If the superintendent who rushes his work was to make a close inspection of his rewound armatures he might find the coils beaten and hammered in such a manner as to cause him to reflect seriously on the difference between apparent and real economy.

The examples cited, the making of a splice and the winding of an armature, are but two of the innumerable pieces of work about a repair shop where quality of work rather than quantity should be the aim. In open work, such as in some parts of carpentry and machine work where the nature of the workmanship is made evident by an inspection, it may be well to drive workmen, but certainly one should do so with caution where the work is hidden, or where defective work may cause as much inconvenience and loss as the electrical work about a car.

WASTES ABOUT THE REPAIR SHOP

Laboring under the belief that the time required to save the little articles of waste material about the shops is worth more than the material saved, quite a few master mechanics allow themselves and their men to acquire careless and negligent habits concerning waste material. These increase the expenses of shop maintenance far more than is realized at first thought. To be sure there is a point of "diminishing returns," as many of us were taught in political economy, beyond which it does not pay to go, but we believe that this point is never reached in very many shops. Each little loss is in itself so trivial that at first reflection it seems more economical to let it continue than to go to any trouble whatever to stop it. In the course of a year, however, the losses multiply until they assume important proportions.

An incident that occurred in a winding room might be cited. Because of an improperly constructed armature coil former about four inches of wire was cut off the end of each coil after being wound. This loss continued for possibly six months or a year before it was corrected. In each coil there was 9 ft. of wire, so that 4 ins. cut from a coil meant a loss of about 4 per cent. The coil former was afterwards corrected and only one-half an inch of wire was wasted. While this was better, still, with the exercise of a little ingenuity, a method could have been devised for eliminating the loss completely. In this same shop these ½ in. and 4 in. lengths of copper wire were often swept out the door, to be scattered about the yard. Here is another source of loss in many shops. Proper attention is not given to saving copper and brass scraps. A great deal of money is swept out of many winding-room doors. Similar losses often occur at the lathe where commutators and brass

bearings are turned. The brass and copper filings and turnings and scrap ends of copper wire should be regarded as so much money and proper care should be exercised with regard to saving them.

If the shop foreman permits the waste of even copper and brass filings, the men seemingly become possessed with the idea that the material costs nothing. Tape, solder, cotton waste and in fact all material will be used carelessly. The quantity of friction tape consumed in the average repair shop is far greater than necessity demands. This tape is a very handy article for a myriad of purposes, other than for insulating. It takes the place of string in tying bundles. It may be used to form a knot or projection on a piece of wood or metal. The fact that it is always present in the tool box, brings it into use oftener than its cost warrants. A smaller loss occurs in the use of soldering paste. Only a thin coating of paste is necessary on a surface to be soldered, yet many electricians, either through indifference or because they believe it necessary, persist in covering the joint with a layer of paste so thick that when heated it melts and runs to the floor in a stream.

The whole list of electrical material used in a repair shop might be gone through in a similar manner. It may be seen, therefore, that these trivial losses, in the aggregate, become important factors in influencing the shop maintenance expenses. To eliminate the majority of them it is necessary to be on the watch continually and to drive into each workman, by repeated cautions, the importance of exercising a little judgment in the use of materials. When once the atmosphere of economy and saving prevails through the shop, a very little attention at proper times will maintain it.

CHANGING THE GAGE OF THE CARS IN EAST ST. LOUIS

The method of changing the track gage on the lines of the East St. Louis & Suburban Railway Company was described in the Sept. 9 issue of this paper by W. A. Bennett, engineer of maintenance of way of the company. The problem of changing the gage of the cars was also a very serious one, and through the courtesy of Lee Massengale, master mechanic of the company, the following facts are available:

In all, 125 cars had to be changed from 4-ft. 10-in. gage to 4-ft. 8½-in. gage. In order to avoid delays in service, it was necessary to plan the work well beforehand and to do as much preliminary work on the cars as possible while they were in service prior to the commencement of gage changing.

While the cars were in service on the 4-ft. 10-in. gage, the extra cars were taken into the shops in turn and a large amount of work done upon the trucks without changing the gage of the wheels. On the cars having St. Louis 23-B trucks, equipped with four GE 57, two-turn, high-speed motors, ¾ in. was faced off from the hub of each wheel. It was necessary, of course, to take the wheels off the axles to do this work, after which they were put back on the 4-ft. 10-in. axles. In order to take care of the space from which this ¾ in. was taken, the company had a collar of cast iron made in halves, which was temporarily fastened on the axle to take care of the end thrust of the motors. On cars having Brill 27-G trucks and Peckham trucks, equipped with GE 67, GE 1000, GE 800 and Westinghouse 49 motors, it was unnecessary to face the hub of wheels, as these cars had the wheel fits on the axles turned back ¾ in. on each end. This work was done as opportunity presented itself, and the wheels were put back on the axles at 4-ft. 10-in. gage. On all the cars, excepting the St. Louis 23-B, the brake beams were drilled for the 4-ft. 8½-in. gage. This work was also done before the gage itself on the cars was changed.

The effect of this preliminary work on the cars was such that when the track changing commenced, the mechanical department, under Mr. Massengale's direction, was able to put cars through the shops very rapidly by putting on extra gangs of men, and was able to supply the needs of the transportation department with cars of 4-ft. 8½-in. gage. This work, of course, was facilitated by the manner in which the track changing was done—that is, one division at a time was changed, which gave the shop time to keep up on its work of changing the gage of the cars. As it was practically impossible to get the narrow gaged cars on changed divisions back to the sheds each night, they were left out on their divisions all night and men were sent from the shops to give them whatever attention they might need.

When the time came for changing the gage of the St. Louis 23-B trucks, the cars were jacked up, the wheels were taken out, the temporary cast-iron collar was knocked off, the wheels were pressed in ¾ in. and the brake hangers were replaced with complete new ones made especially for the purpose. This was found to be a cheaper method than to try to move the brake-hanger brackets ¾ in.

To facilitate the work, both before and after the actual changing of tracks, a large number of extra axles of the different sizes, and also extra wheels, were purchased. The actual time required to change the gage on the cars (the preliminary work mentioned having been done) was about four hours to a car on the suburban cars with a gang of four men, and about three hours on a city car. It was necessary to change twelve cars outside the shops, as in the operation of their ordinary service that number could not be brought into the shops for that purpose. This work was done on the street at the termini of divisions without much greater expense for time than on those changed in the shops, the preliminary work above mentioned having all been done in the shops.

Before the tracks were changed so that all cars could be got back to the sheds, there were as many as twelve cars which were kept out on the divisions all night. Some of these were out for as long a period as five weeks without being brought to the sheds. During this whole period the company did not lose or burn out a field or an armature or a controller, and regular service on all divisions was practically uninterrupted.

Before commencing the work an estimate of cost was made at $25 per car for an average all around, suburban and city cars. The actual cost as finally determined proved to be about $30 per car. This increase over the estimate was due to a large extent to loss of wheels which could not be pressed on again during the preliminary work.

OUTING OF BROOKLYN EXECUTIVES

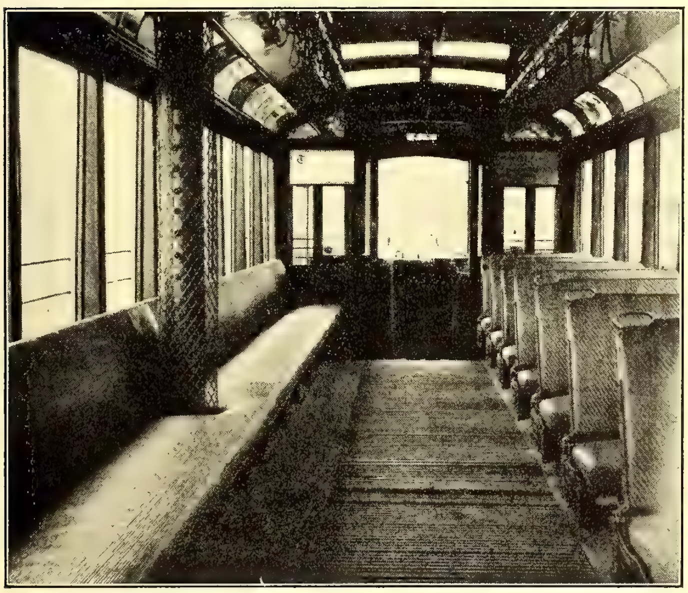
The annual outing of the executive force of the southern division of the Brooklyn Rapid Transit Company was held on Tuesday, Sept. 12. The party left the Fifty-Eighth Street depot at 9:30 a. m. in the parlor car "Montauk," and proceeded to Far Rockaway, Lond Island. On their arrival there they had luncheon at the Hotel Astoria. Athletic games and surf bathing were indulged in until 6 p. m., when the party left for Coney Island, where they spent an enjoyable evening as the guests of F. Henderson at his music hall. The following officials were in attendance: H. Bongard, assistant division superintendent; C. Hogberg and J. Cooney, depot masters; C. B. Hunter, stenographer; T. F. Young, timekeeper; W. J. Roome, W. P. Stott, P. H. Ryan, M. J. Loughlin, J. Forsythe, F. C. Duell, G. Schuck, W. J. Shaughnessey, C. Dreher, inspectors; E. B. Ricker, E. A. Keuney, J. Kelly, E. A. Cunningham, despatchers; E. A. Brown and J. Ham, shop foremen; G. Lockwood, L. Cunningham and F. McDermott, claim adjusters.

The Saginaw Traction Company, of Saginaw, Mich., has placed a 16-ft. gasoline launch in the water at Wenona Beach.

A NOVEL ARRANGEMENT OF CAR SEATS AT SCRANTON, PA.

In several recent articles a number of novel features introduced in street railway practice by the Scranton Railway Company, Scranton, Pa., have been described. Another interesting departure from accepted methods is to be found in the equipment of a number of new closed cars recently placed in service, and involves a combination of cross and side seating and the use of sashless windows. The interior of one of these new cars is illustrated herewith from which the seating arrangement may be observed.

Along one side is arranged a row of cross seats of the "walk-over" pattern, while upon the other is a longitudinal seat of the usual type, approximately 18 ins. wide and covered with rattan. The result of this arrangement has been that of securing an aisle of nearly the width and convenience of a car with the usual longitudinal arrangement of seating, but with the added conveniences and seating capacity on one side of the cross seats. This new arrangement has proven very satisfactory and popular to the patrons of the system and has rereceived much favorable comment. It is to be noted also that



INTERIOR OF SCRANTON CAR

the scheme works out well in connection with the use of the "under-floor" type of stove which is used by the company. This stove is located upon the longitudinal-seat side of the car so that the top stove lid opening at the floor level for attendance is convenient of access.

The "sashless" feature of this car is something of a novelty in car construction, but has been applied for the purpose of making the car of the semi-convertible type. The window glass is removed entirely for the summer months and is inserted permanently for the fall and winter. The glass is inserted entirely without sash, that is, the panes are merely held in place in the window posts, with rubber-lined battens or strips and are cushioned at the side and bottom edges with rubber liners. The battens are arranged for a considerable movement in screwing them fast to the window posts so that the rubber cushions are tightly compressed and the cars run with no rattling of windows whatever, and no breakage has been experienced arising from this particular type of construction.

The disadvantage of the sashless window lies, of course, in the impossibility of lowering the glass or otherwise opening the window, in warm spells of early spring or late fall, but this is found to be easily counteracted to the satisfaction of passengers by use of the deck ventilators and opening of end doors. The great advantage of the elimination of the sash is, however, the greater interior width of car made available by obviating the necessity of the window pockets back of the seats; the seats are here located close up against the window posts, with a gain of 6 ins. to 8 ins. of available interior width of car. The elimination of repairs to sash, window pockets, etc., and their annual cleaning and varnishing, are also important desiderata, while in removing windows for the summer, the necessity for numbering the sash for proper return in the fall is entirely avoided, as all glass is interchangeable.

In case of rain, protection is secured at each window by lowering the usual roller shade with which each window is equipped.

THE MONTREAL STREET RAILWAY MUTUAL BENEFIT ASSOCIATION

In 1903 the employees of the Montreal Street Railway Company, in conjunction with the management, took in hand the organization of the Montreal Street Railway Mutual Benefit Association, and in August of that year delegates appointed by the men met the officials of the company and perfected the organization of the association along the lines of a general plan which had already been suggested. Rules and regulations were drawn up, and these were submitted at a general meeting and approved. Before the latter part of August a temporary board of directors was elected. A secretary-treasurer and a medical officer were also elected.

Every possible means was taken to place the idea clearly before the employees, and within three months of the time that the association was formed there were 600 members on the roll, while now there are upward of 1700 members in good standing, or practically all the employees eligible for membership. Briefly stated, the benefits of the association are as follows:

In case of disablement after the first six days, 60 cents per day for ninety days, and 30 cents per day for the next ninety days.

Free medical attendance.

Free medicine.

Twenty per cent discount on all medicines, etc., required by members of the family.

A life insurance policy of $500 and $50 toward cost of funeral expenses.

A pension when superannuated and too old to work.

All this costs the members the sum of $1 to join and 50 cents per month.

Of course, with the small revenue derived from the separate members, it would be impossible for any mutual benefit association to survive. But here the Montreal Street Railway itself steps into the breach, and by large contributions enables the association not only to pay all its liabilities, but to lay by a substantial surplus for future requirements as well.

Some idea of the calls made upon the association can be gathered from the following short summary of the relief work done for the year ended April 30, 1905:

Number of members disabled through sickness or injury.	611
Number of prescriptions issued	2,864
Number of visits made by physicians to disabled members	692
Number of consultations given by physicians to disabled members	4,026
Amount paid for sickness and injury	$6,239.10
Amount paid for medicine	783.73
Amount paid for death and burial insurance	5,767.67

The objects, as already pointed out, are to afford relief to the employees of the company, but the association does more than this, for it brings the men together socially. During the year special entertainments are given to members and their families, and each August the annual picnic is held. Here there are games in which the men and their families participate, special

prizes being given. In fact, the officers of the association leave nothing undone which will further the fraternal feeling and make the men happy and contented.

Aside from the benefits of life insurance and free medical attendance, an old-age pension is provided, and this insures old employees a sufficient income to maintain them in their declining years.

Within the past twelve months the medical staff of the association has been increased materially, which at all times provides the men proper and prompt medical treatment. In addition to the three doctors employed at the different stations, there is a chief medical officer and examiner.

The committee of management of the association is composed of fifteen members, drawn from the various departments, so that each may be fairly represented.

THE CONVENTION PROGRAM

As already announced, the annual convention of the American Street Railway Association and affiliated associations is to be held in Philadelphia next week. The following programme has been adopted:

MONDAY, SEPT. 25

Registration will commence at convention hall at 8:45 a. m.

10 A. M.—Convention of the American Railway Mechanical and Electrical Association. Address of welcome, Hon. John Weaver, Mayor of Philadelphia. Address by Hon. W. Caryl Ely, president, American Street Railway Association. President's annual address. Report of the executive committee. Report of the secretary and treasurer.

1:30 P. M.—Paper, "Power Distribution," by C. H. Hile, superintendent of wires, Boston Elevated Railway Company, Boston, Mass. Paper, "The Power Station Load Factor as a Factor in the Cost of Operation," by L. P. Crecelius, chief electrician, the United Railways Company, St. Louis, Mo. Report of the committee on "Controlling Apparatus," chairman, J. S. Doyle, master mechanic, Interborough Rapid Transit Company, New York, N. Y.

TUESDAY, SEPT. 26

9 A. M.—Convention of the American Railway Mechanical and Electrical Association. Report of the committee on way matters, "Welding of Rail-Joints," chairman, F. G. Simmons, superintendent of construction and maintenance of way, the Milwaukee Electric Railway & Light Company, Milwaukee, Wis. Report of the committee on "Maintenance and Inspection of Electrical Equipment," chairman, William Pestell, New York, N. Y. Paper, "The Power House," by Fred N. Bushnell, chief engineer, the Rhode Island Company, Providence, R. I.

1:30 P. M.—Paper, "The Track Brake," by F. F. Bodler, master mechanic, the United Railroads of San Francisco, San Francisco, Cal. Discussion of the question box. Reports of special committees. Election of officers.

10 A. M.—Convention of the American Association of Street Railway Claim Agents. Meeting at Room 1048 Land Title & Trust Company Building, Broad and Chestnut Streets. Reading of minutes of last meeting. Report of membership. Report of treasurer. Discussions of accident claims and methods of fakirs. Election of officers.

9 to 12 P. M.—Reception given by local reception committee, James Rawle, chairman, in ball room, Bellevue-Stratford Hotel; dancing.

WEDNESDAY, SEPT. 27

10 A. M.—Convention of the American Street Railway Association. Address of welcome. Address of the president, W. Caryl Ely. Approval of minutes of last annual meeting. Report of the executive committee. Report of the secretary-treasurer. Report of standing committees. Report of the reorganization committee. Consideration of, and action on, new constitution and by-laws. Appointment of nominating committee. Paper on "Notes on the Design of Large Gas Engines with Special Reference to Railway Work," Arthur West, Westinghouse Electric & Manufacturing Company. Paper on "The Application of Gas Power to Electric Railway Work," J. R. Bibbins, Westinghouse Electric & Manufacturing Company. Paper on "Single-Phase Railway System," Charles F. Scott, Westinghouse Electric & Manufacturing Company.

8 P. M.—Theater party at New Lyric Theater, "Babes of the Wood."

THURSDAY, SEPT. 28

10 A. M.—Convention of the American Street Railway Association. Unfinished business. New business. Report of nominating committee. Election of officers for the ensuing year.

2 P. M.—Convention of the Street Railway Accountants' Association of America. Annual address of President W. G. Ross, Montreal, Can. Annual report of the executive committee. Annual report of the secretary-treasurer. Appointment of convention committee on nominations. Appointment of convention committee on resolutions. Report on proposed reorganization of the American Street Railway Association.

8 P. M.—Banquet at the Bellevue-Stratford Hotel.

FRIDAY, SEPT. 29

10 A. M.—Convention of the Street Railway Accountants' Association of America. Annual report of standing committee on standard classification of accounts; C. N. Duffy, secretary and auditor, Chicago City Railway Company, chairman. Report of committee on international form of report; C. N. Duffy, secretary and auditor, Chicago City Railway Company, chairman. Report of committee to attend convention of National Association of Railway Commissioners, held at Birmingham, Ala., Nov. 15, 16 and 17, 1904; C. N. Duffy, secretary and auditor, Chicago City Railway Company, chairman. Annual report of standing committee on standard form of report; W. F. Ham, comptroller, Washington Railway & Electric Company, chairman. Report of committee to attend convention of National Association of Railway Commissioners, held at Deadwood, S. D., Aug. 15, 16 and 17, 1905; W. F. Ham, comptroller, Washington Railway & Electric Company, chairman. Reading and discussion of questions and answers in the question box. This includes those published and any others that may be presented.

2 P. M.—Paper on "The Cost of Carrying a Passenger." C. L. S. Tingley, second vice-president, American Railways Company, Philadelphia, Pa. Paper on "Interurban Fare Collections." Irwin Fullerton, auditor, Detroit United Railway, Detroit, Mich. Paper on "Interurban Ticket Accounting." J. H. Pardee, general manager, Rochester & Eastern Rapid Railway, Canandaigua, N. Y. Paper on "Accounting with Four Departments." H. M. Beardsley, secretary and treasurer, Elmira Water, Light & Railway Company, Elmira, N. Y.

2:30 P. M.—Grand ladies' trolley party by courtesy of President J. H. Porter, Fairmount Park Transportation.

8:30 to 12 P. M.—Vaudeville entertainment by amateur talent in the ball room of the Bellevue-Stratford Hotel; dancing.

SATURDAY, SEPT. 30

10 A. M.—Convention of the Street Railway Accountants' Association of America. Unfinished business. Report of convention committee on resolutions. Report of convention committee on nominations. Election and installation of officers.

CONVENTION NOTES

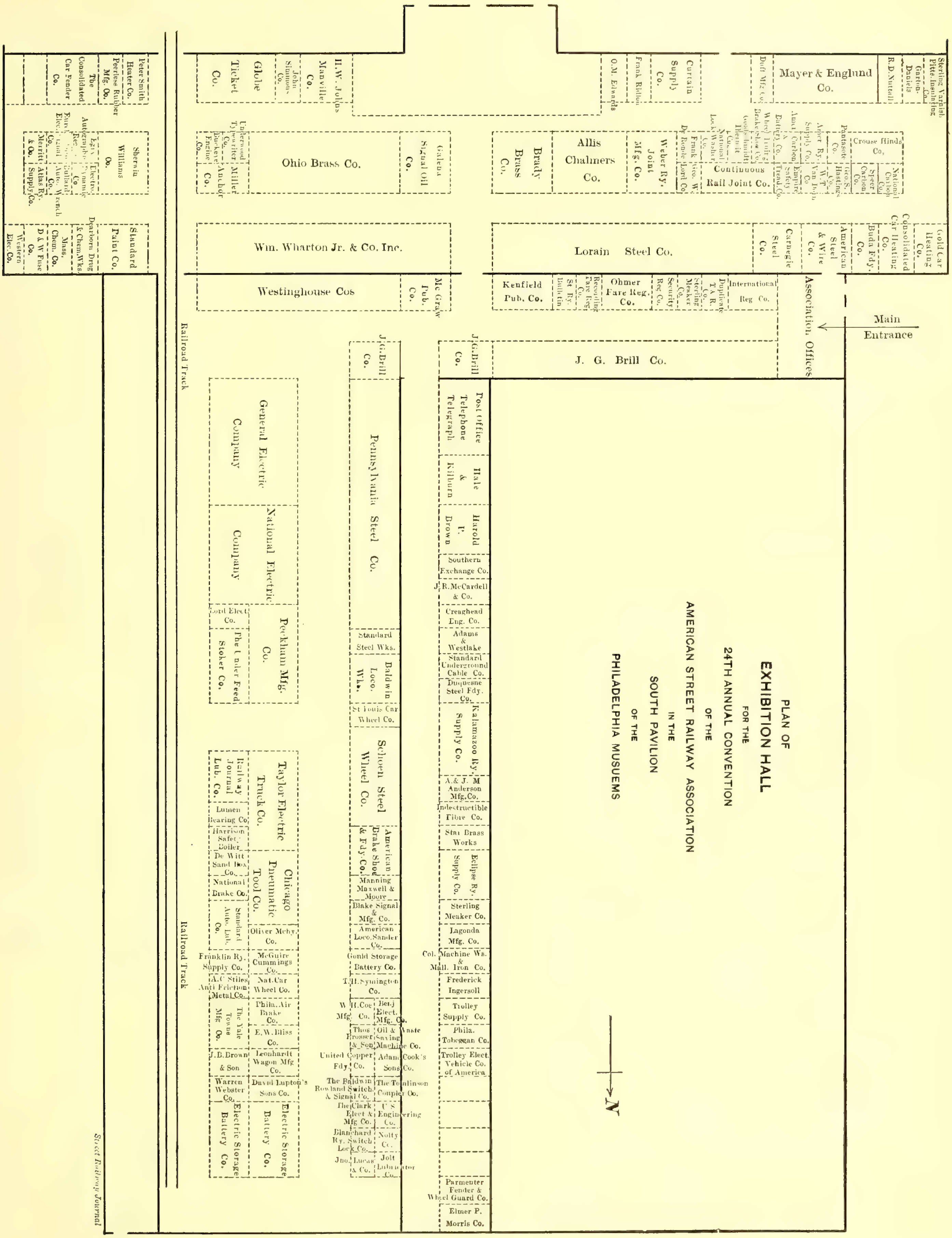
The patronesses of the reception Tuesday evening are to be:

Mrs. John B. Parsons, Mrs. James Rawle, Mrs. Geo. D. Widener, Mrs. G. Martin Brill, Mrs. A. Merritt Taylor, Mrs. Edward Brill, Mrs. Chas. O. Kruger, Mrs. Samuel M. Curwen, Mrs. David H. Watts, Jr., Mrs. Chas. A. Bragg, Mrs. Wm. M. Lycett, Mrs. Walter L. Eustis, Mrs. Henry L. Passavant, Mrs. Wm. H. Heulings, Jr., Mrs. H. S. Vane, Mrs. D. S. Coolidge.

Delegates to the American Street Railway Association and affiliated associations will obtain their badges and badges for ladies, also their banquet tickets, from Mr. Penington, who will be assisted by the secretaries of the different affiliated associations. Members of the Manufacturers' Association will obtain their badges and tickets from Mr. Baker, secretary of that association.

A diagram of the exhibit hall, showing the location of the different exhibits, as arranged at the time of going to press, is presented on the opposite page. These exhibits will be shown in the South Pavilion of the Philadelphia Museum, where all the meetings will be held, with the exception of that of the Association of Street Railway Claim Agents.

The Railway Commission of New York has granted the application of the New York Central Railroad to abandon the station at Crane's Village, 3 miles east of Amsterdam. Since the installation of electric railway service through the Mohawk Valley the station has not returned more than $4 a month.


PLAN OF
EXHIBITION HALL
FOR THE
24TH ANNUAL CONVENTION
OF THE
AMERICAN STREET RAILWAY ASSOCIATION
IN THE
SOUTH PAVILION
OF THE
PHILADELPHIA MUSEUMS
Main Entrance
Association Offices
Railroad Track
Railroad Track
N
Ohio Brass Co.
Wm. Wharton Jr. & Co. Inc.
Westinghouse Cos
Mc Graw Pub. Co.
Allis Chalmers Co.
Brady Brass Co.
Weber Ry. Joint Mfg. Co.
Continuous Rail Joint Co.
Crouse Hinds Co.
Lorain Steel Co.
Carnegie Steel Co.
American Steel & Wire Co.
Buda Fdy. Co.
Consolidated Car Heating Co.
Gold Car Heating Co.
Kenfield Pub. Co.
Ohmer Fare Reg. Co.
International Reg. Co.
Mayer & Englund Co.
R. D. Nuttall
Sterling Varnish
Curtain Supply Co.
Frank Ridlon
O. M. Edwards
H. W. Johns Manville Co.
John Simmons Co.
Globe Ticket Co.
Galena Signal Oil Co.
Standard Paint Co.
Sherwin Williams Co.
Peerless Rubber Mfg. Co.
Consolidated Car Fender Co.
Peter Smith Heater Co.
J. G. Brill Co.
J. G. Brill Co.
J. G. Brill Co.
General Electric Company
National Electric Company
Peckham Mfg. Co.
Taylor Electric Truck Co.
Chicago Pneumatic Tool Co.
Railway Journal
Lumen Bearing Co.
National Brake Co.
Oliver Mchy. Co.
Franklin Ry. Supply Co.
Nat. Car Wheel Co.
Phila. Air Brake Co.
E. W. Bliss Co.
The Yale Towne Mfg. Co.
J. B. Brown & Son
Leonhardt Wagon Mfg Co.
Warren Webster Co.
David Lupton's Sons Co.
Electric Storage Battery Co.
Electric Storage Battery Co.
Pennsylvania Steel Co.
Standard Steel Wks.
Baldwin Loco. Wks.
St Louis Car Wheel Co.
Schoen Steel Wheel Co.
American Brake Shoe & Fdy. Co.
Manning Maxwell & Moore
Blake Signal & Mfg. Co.
American Loco. Sander Co.
Gould Storage Battery Co.
T. H. Symington Co.
United Copper Fdy. Co.
Adams Cook's Sons Co.
Post Office Telephone Telegraph
Hale & Kilburn
Harold P. Brown
Southern Exchange Co.
J. R. McCardell & Co.
Creaghead Eng. Co.
Adams & Westlake
Standard Underground Cable Co.
Duquesne Steel Fdy. Co.
Kalamazoo Ry. Supply Co.
A. & J. M. Anderson Mfg. Co.
Indestructible Fibre Co.
Star Brass Works
Eclipse Ry. Supply Co.
Sterling Meaker Co.
Jagonda Mfg. Co.
Col. Machine Wks. & Mall. Iron Co.
Frederick Ingersoll
Trolley Supply Co.
Phila. Toboggan Co.
Trolley Elect. Vehicle Co. of America
Parmenter Fender & Wheel Guard Co.
Elmer P. Morris Co.
Street Railway Journal

IMPROVED SERVICE IN ARMATURE AND CAR-JOURNAL BEARINGS

BY H. P. WHITE

In the repair department of electric railways one of the largest items is the expense occasioned by maintaining the bearings. Superintendents and master mechanics having charge of this department are, as a rule, considered responsible for the comparative cost shown in the operation of different lines, and therefore are very much interested in any information which will tend to improve the service or in any manner reduce the running expense in that department.

One of the most common causes which lead to unnecessary expense in this department is the mistakes made by master mechanics in their choice of bearing or babbit metals for different special uses. Such mistakes are the outgrowth of natural trade conditions, for any manufacturer having a trade established on some particular product will not make any change in his business until the conditions of trade absolutely force him to do so. Such a change will affect every detail of his business. Supplies, labor, manufacturing equipment, advertising, the education of his selling force to meet the new conditions and many other business points would be involved, and such a step is never taken except as a last resort.

In no department of mechanics have there been greater improvements within the last few years than in the art of combining metallic alloys for use in bearings. The old process babbits were invented at a time when little or no attention was given to the proper proportions or chemical equivalents of the different elements involved, and, as a rule, they are mechanical mixtures of metallic elements and not chemical alloys. They are out of date, and their present position on the market is being maintained by that last insistent effort, which results from the natural trade conditions mentioned above. The plan of their construction makes it impossible for their cost to bear any relation to their real value as bearing metals. For example, take commercial copper genuine babbit, which is one of the most expensive of the old process babbits. The formula for this metal is: Tin, 88 lbs.; antimony, 8 lbs., and copper, 5 lbs. It is assumed that this product must have great value as a bearing metal, because it contains such a large per cent of tin, but there are no logical reasons which support such an assumption. It would be just as reasonable to expect silver or any other expensive element to add its relative value to the efficient service of a babbit, in the proportion in which it was used, as it would be to expect such a result from tin. The fact is that the commercial value of the elements in a babbit bears no relation to its real value as a bearing metal. An attempt to use any element in excess of the amount required to produce the desired molecular conditions of the alloy operates as a double loss, as it disturbs the molecular tension, thus injuring its quality, and adds unnecessary expense to the cost of production. The most desirable babbit is that which gives the most economical service, and as a rule such results are best secured by the use of special alloys which are designed to meet the conditions under which they are to be used.

The inventions and discoveries of recent years relating to metallurgical processes have made it possible for the expert metallurgist to design special alloys to meet the various requirements in every department of mechanical art with the same dependable accuracy that the expert mechanic designs special machinery. These modern new process babbit alloys are combined with due regard for both the physical and chemical properties of all the elements involved, and result in a chemical union which secures a close, fine, uniform grain and the highest possible molecular tension throughout the alloy. Mechanics will readily understand that babbits thus alloyed, from elements selected to meet the special conditions under which they will be required to work, will give more economical service than could possibly be secured from stock babbits selected without reference to their physical properties.

Some companies engaged in the manufacture of this class of bearing metals furnish a specification of the physical properties of each brand of their regular stock metals. Such specifications should at least list the following information regarding each brand or grade of babbit: (1) Melting point; (2) resistance to crushing strain per square inch; (3) elastic tension per square inch; (4) tensile strength per square inch; (5) elongation per lineal inch; (6) degree of anti-friction quality.

With this information before him, the master mechanic should be able to make an intelligent selection, and will often be able to find, among regular stock brands, metal well adapted to his service.

Every mechanic is not an expert metallurgist; therefore, the specifying of certain elements and their proportions to best meet the conditions of special service is out of their line. But they thoroughly understand every detail of the conditions connected with their service and the physical properties required in a metal to meet such conditions, and when they combine in their service their technical knowledge with that of an expert metallurgist they insure the most economical results than can be secured.

One of the companies interested in the manufacture of new process alloys is the New Era Manufacturing Company, of Kalamazoo, Mich. This company is not mentioned in an exclusive sense, as this field is not exclusive. Its business method, however, which includes, among other features, the furnishing of specifications of the physical properties of each of its regular stock brands of babbit and of special alloys, entitles it to consideration as one of the first to introduce this system, which is sure to lead to improved service and reduced cost in this department.

IMPROVEMENT IN HOT-WATER HEATERS

The Peter Smith Heater Company, of Detroit, has made a number of important changes in its system of hot-water heating for electric cars, so that a description of its present standard heater will be of interest. The heater is based upon the principle of rapid circulation, which, in the opinion of these manufacturers, is the secret of hot-water heating. To obtain this circulation, the company injects steam from the heater into the return end of the radiating pipe. This has a tendency to create a vacuum in the pipe and to assist the flow of water.

As will be remembered, the Smith heating system uses a coil heater fed with water from an expansion chamber, or reservoir of hot water, which is located above the heater. As the water passes from this expansion chamber into the heating coils in the heater, steam is generated very rapidly, because the pipes within the heater are of very small diameter, and also because the feed-water comes direct from the expansion chamber, where it is at the highest temperature of any part of the system, and so is much nearer the temperature of steam than if it first had to travel the entire length of the radiating pipes. After returning from the heater to the expansion chamber, the hot water circulates through the radiating pipes in the car.

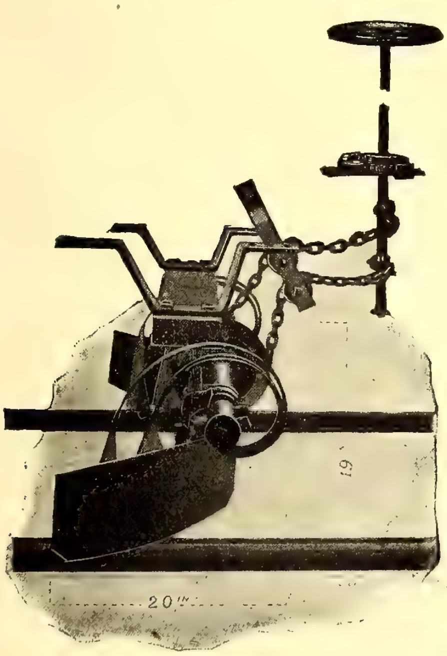
The return end of the radiating pipe does not terminate at the base of the expansion chamber, but is carried in it above the normal water level. The result is that every time steam is injected into the return end of this pipe it throws all the water above that point up into the expansion chamber and stimulates the circulation through the pipe. If the return end of the radiating pipe terminated at the bottom of the expansion chamber there would be a tendency for the water to run back down this pipe and retard the circulation. The rapid circulation is therefore due to gravity and not to a difference in temperature, as many suppose.

THE ROOT IMPROVED RAILWAY SPRING SCRAPERS

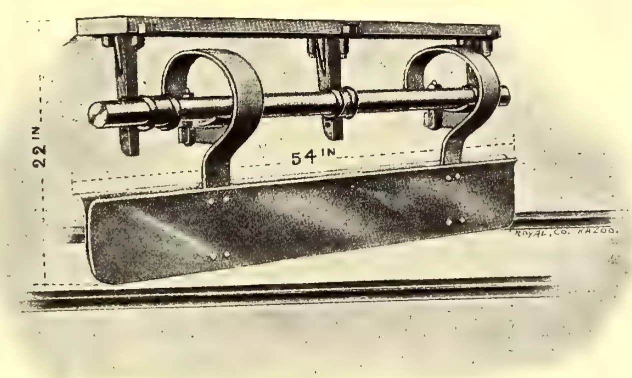
The track scraper is a valuable device at any time, but especially so during the winter season, when every effort must be put forth to keep the tracks free from snow, ice and mud. Learning from his extensive experience in this line, Fred N. Root, the inventor, has improved still further on his models of the widely-used Root scrapers, two types of which are presented in the accompanying illustrations. The Kalamazoo Railway Supply Company, of Kalamazoo, Mich., has recently arranged for the exclusive manufacture and sale of these scrapers, this arrangement being made after a very careful investigation as to their merits. These scrapers are giving good service at the present time on seventy-five or more different railway lines throughout the country.

The view of the No. 2 "special" scraper, designed for high-speed and heavy work, shows the maker's way of installing this scraper on high or short platform cars. On high cars, the hanger board is attached to brackets connecting with the platform or the sills of the car. By the use of a double pulley in connection with the guide chain and windlass rod, the scrapers can be installed and operated on any height of car. In this illustration, the hanger is shown fastened in the rear of the scraper shaft with the windlass rod in front, but both can be reversed if necessary.

The No. 3 fan scraper, shown in the second illustration, is designed for clearing snow from the middle of track, in connection with the company's regular track scraper. It is installed as a fixture and does not need to be operated. All parts are held rigid except the yielding springs, which will safely pass over any rigid object in the roadbed. The same results are obtained when the car is moving in either direction, always depositing the snow to the right, a valuable feature where there are double tracks.



NO. 2 SPECIAL SCRAPER



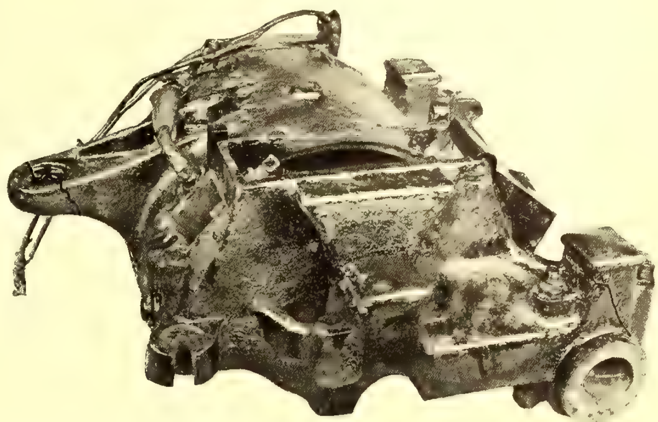
NO. 3 FAN SCRAPER

It can be installed in front of track scrapers on either end of a double-truck car, or on the rear end of a looped car. The shaft holding the springs is held rigid with keys, and can be set at any angle. The hanger board is installed about 22 in. above the rail, the shovels about 3 in. above the rail when the car is empty, or according to the track conditions.

Among the railway companies using these scrapers may be mentioned the Lansing & Suburban Traction Company; Michigan Traction Company; Grand Rapids, Holland & Lake Michigan Railway; Toledo, Fostoria & Findley Railway; Canton & Akron Railway Company; Rochester Railway Company; Binghamton Railway Company, Railways Company General; Chicago & Joliet Railway; Elgin, Aurora & Southern Railway; Scranton Railway Company; the Atlantic Shore Line Railway, etc.

IRON AND STEEL BRAZING PROCESS

A subject that is attracting great attention in the mechanical and engineering world is the brazing of cast, malleable and wrought iron and steel by the Ferrofix process under the Frederich Pich patents. Of course there are many skeptics who declare that cast iron has never been and cannot be brazed, but its usefulness, durability and practicability is being thoroughly demonstrated, and it promises to become a most potent factor in the reduction of operating and equipment expenses by the repairing of broken castings.



RAILWAY MOTOR REPAIRED BY THE FERROFIX PROCESS

The process of brazing cast iron is briefly as follows: Ferrofix, the brazing material in itself, consists of a powder together with a liquid which, when mixed, form a liquid paste which is applied to the fracture and subjected to a temperature of approximately 1600 degs. By the action of this heat on the Ferrofix, the pores of the iron are opened and receive the brass together with the flux, which latter is used to clean the surface of the fracture, as well as to assist the brass in flowing more readily. Invariably, the brass so used will penetrate far into the pores of the iron on both sides of the fracture and therefore should form a joint far stronger than the cast iron on either side of it. Many street railway companies have already taken advantage of this process to have broken motor frames, truck frames and gear cases repaired and restored, the advantages being the saving of the cost of new parts, the elimination of patch work in their plants, and the element of time saved.

The American Ferrofix Brazing Company, operating plants in Philadelphia, New York, Pittsburg and Scranton, is prepared to show wherein a street railway company will reduce very materially its operating expense in equipment, repair and purchasing departments by employing this method. Motor frames, depending upon the type, generally break through the bearings, or bearing and grease box combined. It is impossible at the present time to repair such breaks by other than

the Ferrofix process, successfully at least, as there is no room for patches to be employed. Gear cases have in the past been patched and riveted; the patches being of malleable iron will shortly work loose, the rivets wearing larger the holes where they are inserted. This means re-patching and the boring of more holes, which naturally weakens the entire casting.

By the method described, new patches are made and brazed solid over the fracture, and the part thereby gains additional strength in metal. The process not only applies to this particular line of street railway work, but to almost any and all classes of machinery used in every branch wherein cast iron parts are employed. The question of size of casting to be brazed is immaterial in the successful application of Ferrofix, providing the piece is so constructed that the heating will not distort.

A BOY-LESS BOWLING ALLEY

The Boy-Less Five-Pin Alley is a clever and most interesting game designed for use, particularly in connection with street railway parks. It is made in standard lengths of 40 ft., and in double sizes only, although single alleys can be furnished on special orders. It is made portable so that it can be moved from one place to another if necessary.

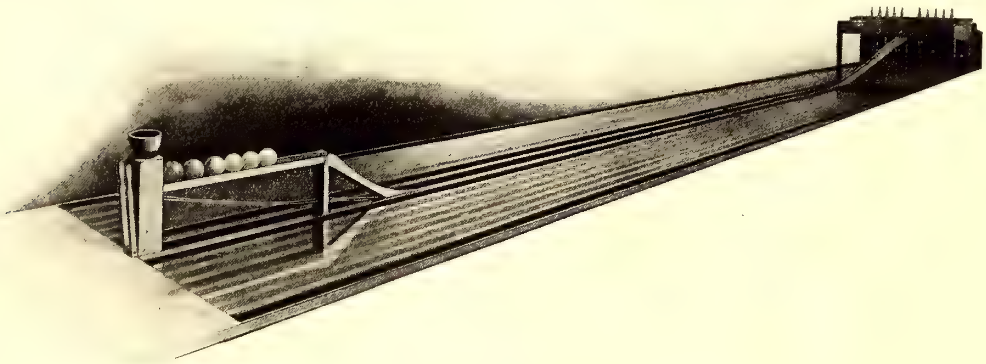


FIG. 1.—FULL-LENGTH VIEW OF DOUBLE BOY-LESS FIVE-PIN ALLEY

The feature that will appeal to the park manager particularly is the fact that no pin-boy is needed to set up the pins or return the balls. The balls are returned by gravity, and the pins reset by the simple pulling of a lever by the bowler. The earning capacity of the Boy-Less Five-Pin Alley is remarkable. At 10 cents a game one alley will earn $1.80 per hour. This will show a gross earning of $7.20 per hour for four alleys, which is the number one attendant can operate to the best advantage. Figuring on a basis of 30 hours' operation per week these alleys would earn a total gross income of $216.00 per week. This should prove very attractive to the up-to-date park manager.

Fig. 1 is a full-length view of the double alley, and Fig. 2 shows the pin platform sufficiently broken away to show the internal mechanism. In Fig. 1 is a platform upon which the bowler stands to deliver the ball onto the alley. Suspended above the alley at the opposite end is a curtain, having pointers arranged thereon to provide an objective point for the delivered ball. Passing under this curtain, the pointers serving as guides for the bowler; the ball, delivered with sufficient force, passes on to a curved runway, composed of a series of vertically disposed slats, spaced sufficiently far apart to receive the ball and guide it upwardly and forwardly.

Hinged bails (see B in Fig. 2), suspended from a rod and spaced apart by sleeve washers, have their lower cross pieces hanging across the path of the ball as it passes forwardly from the curved runway. These bails have upward extensions, designed to engage and knock down the hinged pins when a bail or bails is or are struck. A cushion receives the knocked-down pins. After striking one or more of these bails the ball is then received into an open-ended box, whose bottom is covered with sound-deadening material. The front wall of the box is provided with a cushion G1, and a cushion G2 is arranged along the upper rear edge of the box. The direction of rotation of the ball, in its travel along the alley and the curved guide ways, is such that when it strikes the cushion G1 the direction of rotation is counter to its momentum, and, unless the ball is delivered with considerable force, this counter rotation is sufficient to overcome the momentum, and consequently the ball will not strike the cushion G2, but will be arrested on cushion G1, and moved rearwardly down the incline provided by cushion G1, which terminates in a laterally inclined runway and delivers the ball on to an inclined runway. At the player's end of the alley this runway is provided with an unwardly inclined track, ending in a stall for the balls, placing them within convenient reach.

If a ball rolls off either side of the alley and is received in the curved guideways at the sides, a bail will be operated, but the side bails are not provided with upward extensions, and consequently a pin will not be knocked down. If a ball enters a curved guideway directly under the pointer 3, the bail struck will knock down either of the side pins directly above the pointer 3. If a ball enters either of the curved guideways between pointers 3 and 5, it will strike two bails and knock down two pins on either side. Should a ball enter directly under the pointer 5, the second pin on either side will be knocked down, and if it enters between pointers 5 and 7 the center and next adjacent pin on either side will be knocked down. If a ball enters the middle guideway directly under the wide pointer 7 it will strike an independently mounted bail and knock down all the pins standing. This makes a "strike" and a "spare" possible. The strike feature lends zest to the game, as it requires considerable skill for the bowler to deliver the ball accurately, so that it will reach the central curved guideway. It is designed so that the bowler shall bowl three balls. The game is counted the same as tenpins, except that the number of pins which the bails can knock down being five instead of ten, the value of a "strike" or "spare" is smaller by five pins. It is, therefore, possible, by observing the rules governing tenpins, to make 150 points.

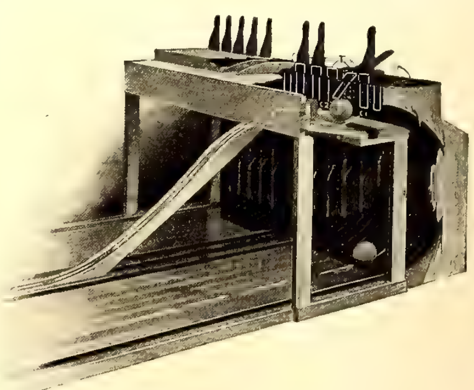
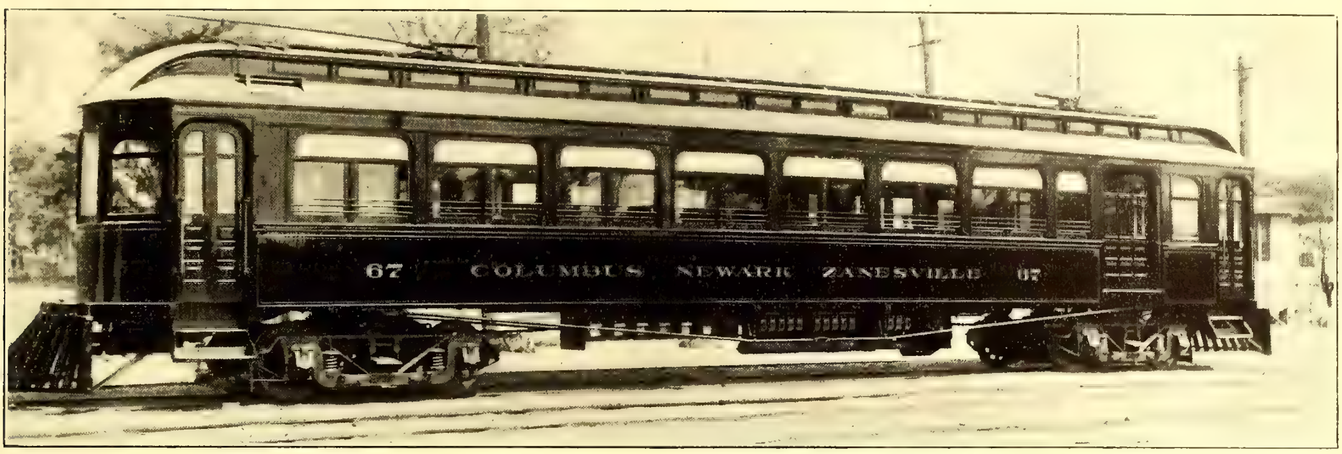


FIG. 2.—PIN PLATFORM AND OPERATING MECHANISM

The Matthews-Fahl Manufacturing Company, St. Louis, which owns the patents covering the boy-less five-pin alley, will have a double alley on exhibit at the convention.

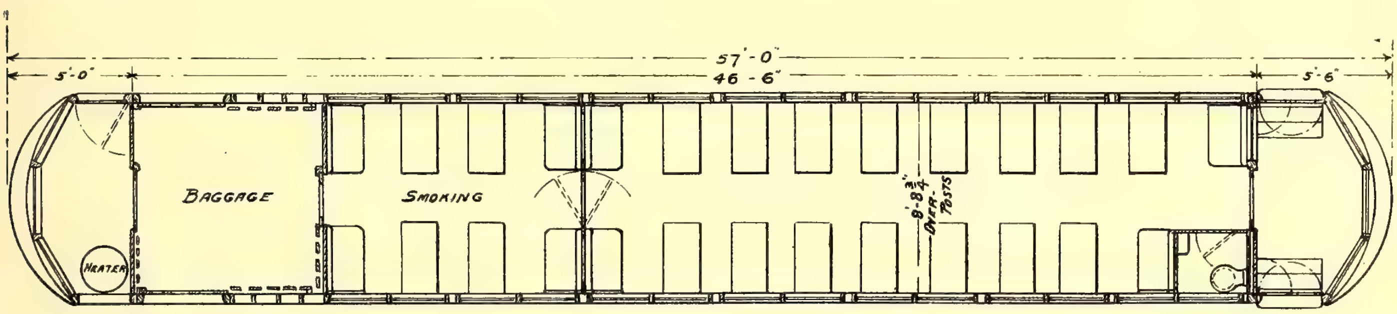
NEW CARS FOR THE COLUMBUS & CINCINNATI TRACTION COMPANY

The Columbus & Cincinnati Traction Company has just received four cars of an order of eight, built by the Jewett Car Company, of Newark, Ohio. These cars are of the latest



EXTERIOR OF COLUMBUS, NEWARK & ZANESVILLE CAR

type, and have all the new features of modern car construction, and are equipped with all modern conveniences. They are 57 ft. long, over buffers, and 46 ft. 6 in. over body; the width is 8 ft. 8¾ ins. over posts and 8 ft. 11¾ ins. over the widest



PLAN OF CAR, SHOWING ARRANGEMENT OF COMPARTMENTS

point. As will be seen from the accompanying plan, these cars are divided into three compartments, the main compartment seating thirty-eight people, the smoking compartment

INTERIOR OF CAR

seating sixteen people, and a baggage compartment. The baggage compartment has folding slat seats and will easily seat twelve people.

The finish throughout the car is of selected mahogany of a rich color, inlaid with marqueterie, which with the artistic design gives it a very handsome interior. The ceiling is of semi-Empire type. The seats are of the high back walkover type, manufactured by the Hale & Kilburn Company, and are upholstered in green plush in the main compartment, and rattan in the smoking compartment. The cars are equipped with toilet room at the rear end and are heated by the hot water system, the heater being placed on the front platform and out of the way of passengers.

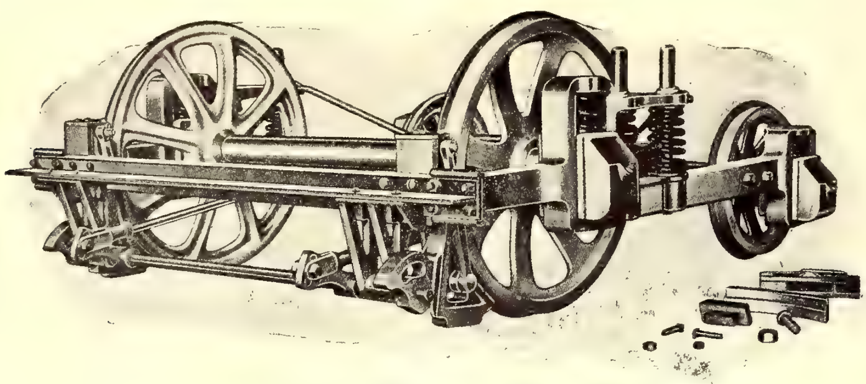
Parcel racks of a neat design are distributed all along the sides of the car and are made of solid bronze, same as the hardware. Curtains of Pantasote are provided at each window, manufactured by the Curtain Supply Company. The glass throughout the car is polished plate, except the gothics and deck glass, which are ornamented green glass. The outside finish is chrome green, which is used between the sash rest and on the letter board, and cream yellow, which is used between the letter board and the sash rest.

Each end of the car is equipped with M. C. B. couplers and the front end with locomotive type of pilot. The cars are further equipped with the De France air sanders, Westinghouse air brakes, Mosher arc headlights, signal lamps, cocoa matting in aisle, safety treads on steps, etc. They are mounted on Peckham M. C. B. No. 40-A double trucks with 6-ft. 10-in. wheel base, 34-in. diameter wheels and 5¼-in. axles. The electrical equipment consists of four G. E. No. 73 motors, operated by the Sprague-General Electric multiple-unit control system. The wires are run in waterproof conduits and all contactors are assembled in one fireproof box.

Competition of new and extended electric lines that parallel the Hocking Valley Railway is attributed as the cause for the decrease in the passenger earnings of that company. The passenger earnings for the year ended June 30, 1905, were $764,956.51, as against $831,627.84 for the previous year. The number of passengers carried during the year was 1,979,731, and the passenger earnings per mile, not including mail and express, was 97 cents.

COMBINED WHEEL AND TRACK BRAKE

A combined wheel and track brake has been in use for a number of years on the Montague Street cable cars of the Brooklyn Rapid Transit Company. This line extends from the City Hall in Brooklyn to the Wall Street Ferry, and the 9 per cent grade surmounted is so severe that a special type of

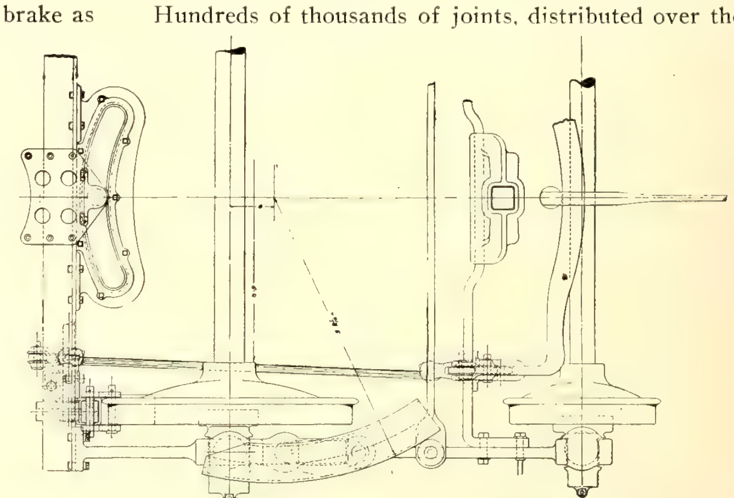


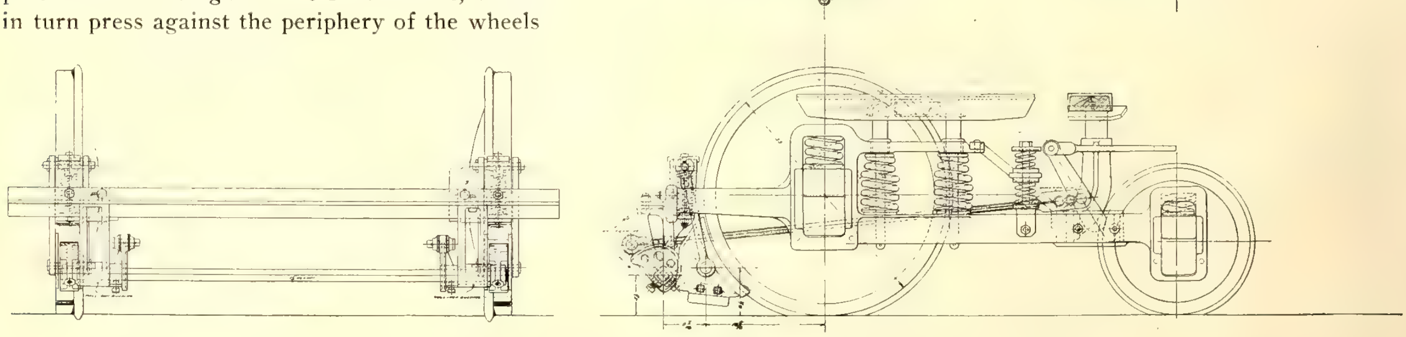
COMBINED WHEEL AND TRACK BRAKE

brake which would afford absolutely safety under all conditions was extremely necessary. The patents covering this brake have recently been secured by the United States Metal and Manufacturing Company of New York. The mechanism of the brake has been improved in certain directions suggested from its use in Brooklyn, and the brake has been adapted to electric cars and will soon be placed on the market by the company mentioned.

The accompanying illustrations show the improved brake as applied to a maximum-traction truck. As will be seen, the brake-shoe is regular shape, fitting the periphery of the wheel and flange, and being provided at its base with a track-shoe for engagement with the rails. The shoe can be of cast iron with chilled faces or any sort of detachable shoe can be employed with a malleable iron or other frame. The shoe is spring-supported from the outside cross-bar of the truck by hangers whose upper end has a vertical movement, and is pressed against the wheel by cams which are actuated by a rocker arm and which engage against the rear of the brake-shoe frames.

The shoes are applied by a movement of the hand lever, which revolves the rocker arm and presses the cams against the shoe frames, which in turn press against the periphery of the wheels by a rapidly increasing leverage on account of the shape of the cams. With an ordinary stop the shoes have a movement simply against the periphery of the wheel. If an emergency stop is required, the pressure on the brake lever is increased. This presses the shoes still tighter against the periphery of the wheels and carries the shoe down with the rotation of the wheel until the lower part of the shoe engages the rail. The brake then acts as a track brake, preventing the skidding of the wheels.





ELEVATIONS AND PLAN OF TRUCK WITH WHEEL AND TRACK BRAKE

CAST-WELDING IN BALTIMORE

On June 8 last, the United Railways & Electric Company, of Baltimore, entered into a contract with the Falk Company, of Milwaukee, to cast-weld 10,000 or more joints on its tracks in that city. The work is now well under way on Linden Avenue, where 2.5 miles of track will be made continuous by the Falk process. Certain parts of Charles Street and McCullough Street have already been finished. Other streets to be cast-welded are as follows: Edmondson Street, 8.8 miles; John Street, 4.9 miles; Carey Street, 2.8 miles; Preston Street, 5.1 miles; Fremont Street, 3.7 miles; Orlean Street, 7.5 miles, etc.

Some time ago several Eastern street railway men visited a number of the largest cities in this country where cast-welding had been adopted, with a view to recommending similar work in their own town. In riding over old track which had been cast-welded by the Falk process for some time, and where the rail had formerly been pretty well worn and the ends gouged out, they found that the ends had been brought up to proper alignment and that it was impossible to feel a joint when riding over the track. In fact, a tape line was required to locate the joints. Electrically, it has been demonstrated that the conductivity of the rail is about 20 per cent greater throughout the joint than in the rail itself, and that the rail ends, when once cast-welded and finished, need no further attendance. The life of the rail end is made equal to that of the rail itself.

Hundreds of thousands of joints, distributed over the entire world, have been welded by this company. A few of the large cities in which work has been done by this company include the following: New York, Brooklyn, Boston, Baltimore, Newark, Jersey City, Providence, Cleveland, Cincinnati, St. Louis, Chicago, Milwaukee, Minneapolis, St. Paul, Los Angeles, San Francisco, Paris, Marseilles, Havre, Nancy, Bordeaux, Lyons, Nice, Berlin, Cologne and London.

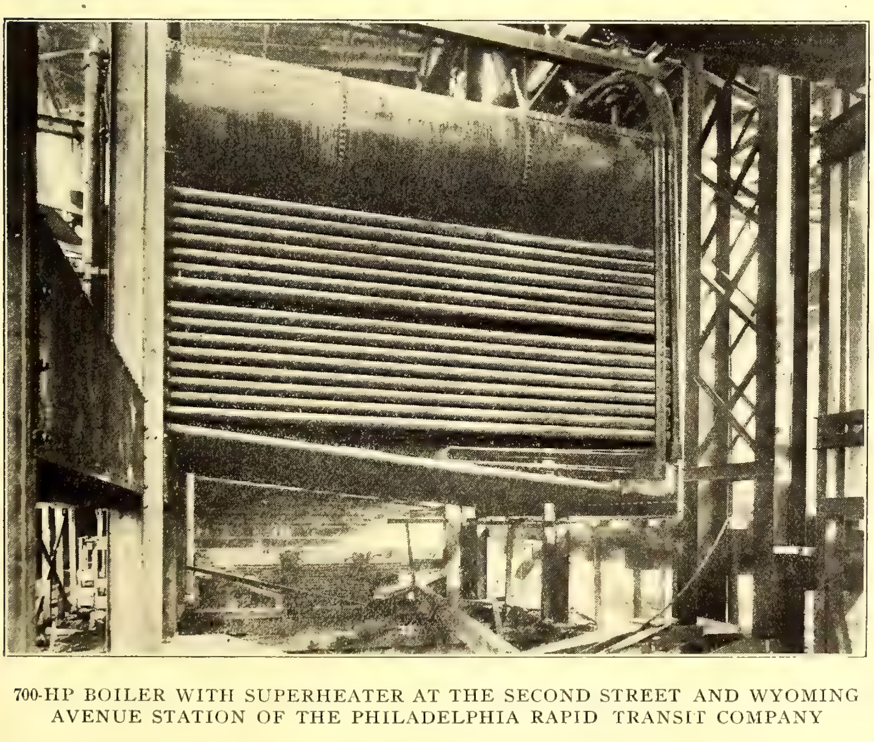
Outside the welding business, the Falk Company manufactures street railway special work, motor gears, pinions, etc.

THE PARKER DOUBLE-ENDED HORIZONTAL TUBE-BOILER

That important improvements are possible even in the well-worked field of boiler design seems to be demonstrated by the double-ended horizontal tube steam boiler invented by John C. Parker several years ago, and now manufactured by the Parker Boiler Company, of Philadelphia. The latter has installed several boilers of this type in power houses of the Philadelphia Rapid Transit Company, namely, the Thirteenth and Mt. Vernon Streets station and the Second Street and Wyoming Avenue station (10,000 hp). The Rapid Transit Company has also specified this boiler for its new Delaware Avenue station. The great advantage of this boiler is the material economy in the boiler room space, for, as the tubes are horizontal, grates can be set at both ends, and double the heating surface is secured on the same floor space.

Any number of boilers can be set in battery, as no access to the side walls is required. The horizontal tubes lend compactness, and in converting other types of boilers to this system it has been found possible to get 50 per cent more heating surface in the same space occupied by inclined tubes. One of the standard designs is made up of two drums of liberal size, a feed element next beneath them, and evaporating elements below the feed element.

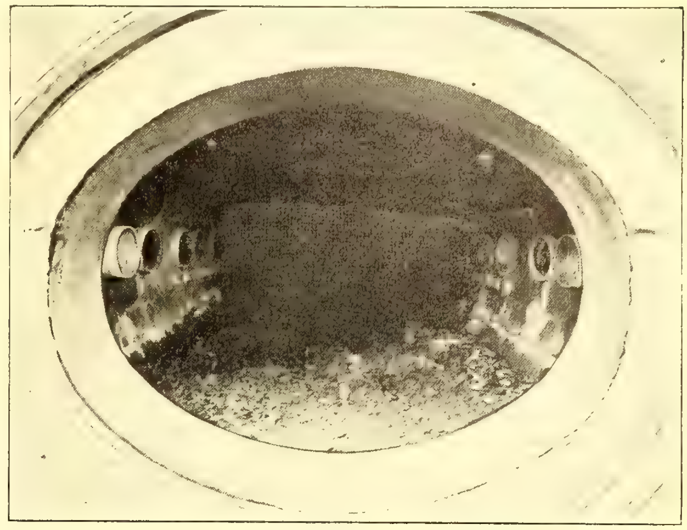
The drums are constructed in accordance with the very latest practice, using the best material and riveting of the highest efficiency. The diaphragm of ¼-in. steel plate is riveted to the shell and arranged to form a pocket at the front to collect the scale discharged from the tubes. The anti-priming valve is hinged to the diaphragm head and serves as a manhole for the lower chamber. The bottom of the drum below the level of the nipples leading to the elements forms the sediment pan or mud drum. An inverted angle with closed ends is placed along the bottom of the drum and over the blow-off opening, making the blow-off effective for its full length.



700-HP BOILER WITH SUPERHEATER AT THE SECOND STREET AND WYOMING AVENUE STATION OF THE PHILADELPHIA RAPID TRANSIT COMPANY

The tubes are expanded into the junction boxes, which are like return bends, holding two tubes. This arrangement permits the free and independent expansion of every tube without strain on any joint. The flexibility of the construction is such that the boxes can be separated several inches at any point for admittance to the baffles or for renewing a tube, giving sufficient opening to permit the removal of 18-ft. tubes in a 10-ft. fire room. Each tube is accessible for removal without disturbing the others. In high boilers, the lower row of tubes is usually inclined, giving access to the baffles and lower tubes without lifting the boxes.

The tubes above the top baffle form the feed element. The inlet end is connected to the drum with an expanded nipple, and the feed connection is made to the top rear junction box beyond the non-return valve. The flow in the element is forward and back alternately through each tube in the top row, then down to the next row, and so on, finally discharging through a vertical upcast into the rear drumhead above the diaphragm. A blow-off connection is made at the bottom end of the feed element, and solid water can be forced through the entire element under full boiler pressure.



VIEW THROUGH MANHOLE OF STEAM DRUM OF CONVERTED BOILER, SEPT. 17, 1904, SHOWING SCALE DISCHARGED FROM TUBE

The lower or evaporating elements are two tubes wide, passing the water twice across the furnace at each level. The connection to the drum at the upper or induction end is made by an expanded tube entering an "inlet" box which supplies two elements, each having a brass non-return valve in the top junction box, and the lower end of each element is connected to the steam chamber by an independent upcast. The baffles to direct the course of the gases are made up of small fire tiles resting on the tubes.

One of the illustrations shows a 700-hp boiler fired at both ends with inclined stokers and equipped with a superheater. The working pressure is 200 lbs. The lower tubes are inclined to give space for the superheater, and as much heat can be passed direct to the superheater as desired. The heating surface is as follows: Economizer surface, 3000 sq. ft.; evaporating surface, 4000 sq. ft.; superheating surface, 375 sq. ft. The grate surface is 140 sq. ft. The boiler proper, without the economizer and with a single grate, is rated at 400 hp, but by doubling the grate surface it has been run up to 940 hp. The addition of the economizer keeps the flue gases down to about 400 degs., and makes the economy very high for that rate of working.

Aside from economy in space, other advantages are:

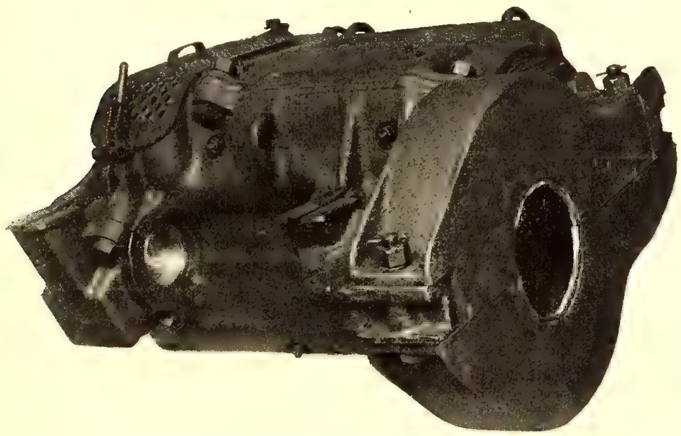
The scale can be removed from the tubes automatically while the boiler is in operation; the flexible construction permits the independent expansion of every tube; the combination of boiler and economizer in one setting, with the downward course of

the water and steam in the tubes, increases the efficiency of the heating surface by bringing the coolest water next to the coolest gases; the strong non-reversible flow makes burnt tubes impossible; the inside circular hand-hole covers, held to their seats by the pressure, with conical ground joints, require no cleaning nor packing, and do not become leaky; and the separate chambers for steam and for water, with anti-priming valve between, make wet steam impossible.

A NEW LINE OF RAILWAY MOTORS

Heavier rolling stock and faster schedules in electric traction have from time to time necessitated the production of larger motors for elevated, subway, interurban and suburban service. Each increase in size has been marked by mechanical changes, but at no time possibly have such wide departures been made in railway motor construction as the Westinghouse Electric & Manufacturing Company has embodied in a new line which is fully described in this article. The smallest motor of the new design has a capacity of 75 hp, and the largest 200 hp, with a number of sizes between the two.

Among the many excellent features which characterize these motors may be mentioned the diagonally divided field frame, which makes every part accessible; the gear case supported entirely at the ends, so as to avoid the side strains which have been the source of so much trouble; housings for armature bearings clamped between the two halves of the frame; generously proportioned bearings, with the most effective system of lubrication yet devised; armature and commutator assembled upon a single spider; bar-wound armature with split coils; commutators with many bars; low-current density in the brushes; bolted-in laminated poles; sealed field coils wound with strap; excellent commutation, high efficiency, low operating temperature and great mechanical strength.



75-HP MOTOR

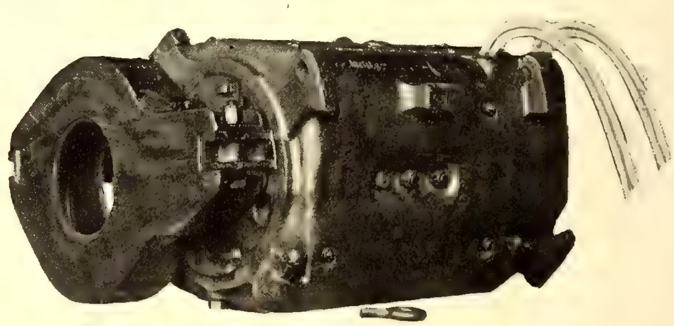
Limitations are naturally placed on the size and construction of a motor by the amount of available space on the truck of the car; therefore the frame of square cross section has been adopted as utilizing this space most advantageously. All motors in this line have cast-steel frames split at an angle of 45 degs. with the horizontal. The axle bearings are carried by the lower half of the field frame and are divided at an angle of 35 degs. with the perpendicular, so that the weight of the motor is supported almost entirely by the part of the frame extending over the axle, rather than by the axle cap bolts. By lifting off the upper half of the field casting, the armature may be removed from the frame without taking the motor from the truck, or the motor may be removed from the truck by simply taking off the gear case and axle caps. Three bales conveniently located make handling of the motor easy. Bolts with nuts and lock washers hold the two halves of the frame together and the axle caps in proper position.

The housings for the armature bearings are circular in form and are turned slightly larger in diameter than their seats in the frames, so that when clamped in place all the advantages of a press fit are obtained. Finished shoulders on the housings prevent any lateral movement, and also take the entire end thrust of the armature instead of imposing this severe strain on the clamping bolts. Two bolts through the frame at each end prevent the housing from turning.

The armature bearings are made of solid phosphor-bronze bushings finished all over, with a 3-32-in. lining of babbit metal. If from neglect the bearings should become so hot as to melt the babbit, the armature would be supported on the brass shell and would not strike the poles. Both oil and waste lubrication are provided. The waste comes in contact with the bearings on the low-pressure side and is supplied with oil from separate pockets from below; in this way it is filtered before reaching the bearing. The amount of oil in the reservoirs may be gaged so that it may be kept at the proper level for economical service. With intelligent care these bearings will run 100,000 miles to 150,000 miles.

ARMATURE

The axle bearings are similar in construction to those of the commutator, except that split bushings are used. Here also lubrication is by means of oil and waste, the oil being supplied from below. This is the same method which has given such universal satisfaction in steam railway service. All bearings have generous dimensions, and the large surfaces readily dissipate the frictional heat and insure cool running.

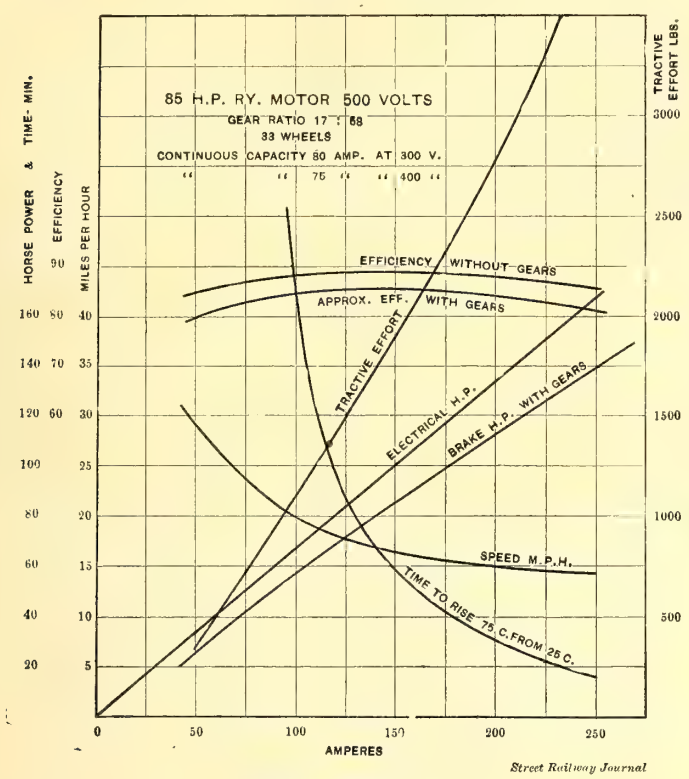


200-HP MOTOR

Pole pieces, built up of punchings of soft steel, are bolted to the top, bottom and sides of the motor frame, which, being almost square in cross section, permits the use of flat field coils. These coils are wound of copper strap, insulated between turns with treated asbestos ribbon, and then carefully taped and given repeated dippings in specially prepared insulating compounds and varnishes, which make them moisture repelling and able to stand internal heat. Brass hangers hold the coils in place independently of the poles.

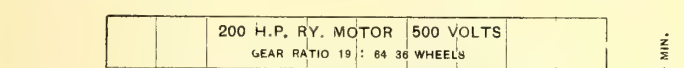
The armature core is built up of steel punchings keyed on a cast-steel spider, which also carries the commutator. The shaft is forced into the finished armature and keyed thereto, and may be removed, should necessity arise, without disturbing the windings or commutator. The armature coils are strap wound and made in two parts. As the top coils are more liable

to injury, this design makes it possible to remove the damaged part without disturbing any other part of the winding. The coils are liberally insulated with mica and sealed, and further insulated by dipping in varnishes which are oilproof and mois-



CURVES OF 85-HP MOTOR

ture repelling. On each end the armature slots are made deeper and wider, thereby providing space for mica cells, which greatly reinforce the insulation at these points. As a further

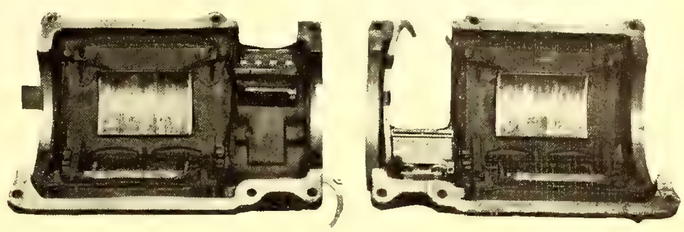


CURVES OF 200-HP MOTOR

protection, fibre strips are taped to the upper sides of the top coils. A bell-shaped flange at the pinion end and a cylindrical flange on the commutator end form rigid supports for the windings. Countersunk bands of steel wire on the core and wide bands outside the core hold the coils firmly and securely. Openings through the spider and core allow a free passage of air, which is thrown forcibly against the field coils, thus maintaining a low temperature throughout the motor.

The commutators are made from a great number of hard-drawn copper bars with short necks, carefully insulated from each other and held securely between insulated V-rings. A liberal wearing depth insures long life. The excellent design of the motor windings, the great number of bars in the commutators and the even wearing qualities of the insulation produce commutating characteristics of the highest merit.

The brush holders are of the sliding type, with springs of phosphor bronze held in a harness, which definitely fixes the radius of action of the spring tip, and is so constructed as practically to eliminate friction between turns, making it possible to provide a large number of turns, which gives a very uniform


INTERIOR CONSTRUCTION OF 200-HP MOTOR

pressure upon the brush over a considerable range without requiring adjustment. The tension of the spring may be adjusted without removing the holder from the motor. The brush holder proper is bolted to an insulated guide, and may be removed without disturbing the insulation or connections. Leads of flameproof flexible rubber-covered cable are brought out at the front of the motor over the commutator through insulating bushings. Access to the brushes and brush holders is provided through a large opening in the frame over the commutator which extends well down the side, making inspection easy from the pit. A hole in the rear end bell and an opening under the commutator provide means for inspecting the clearance between the armature and field poles.

Pinions used on these motors are machined from solid steel forgings and held on to tapered seats by keys, nuts and lock washers. Gear cases are made of malleable iron and divided along the center line of armature and axle. They are supported only at the ends, which does away with all side strains, which are responsible for so many broken gear cases. Nose suspension with safety lugs is ued for all motors of this design.

RECENT ORDERS FOR THERMIT JOINTS

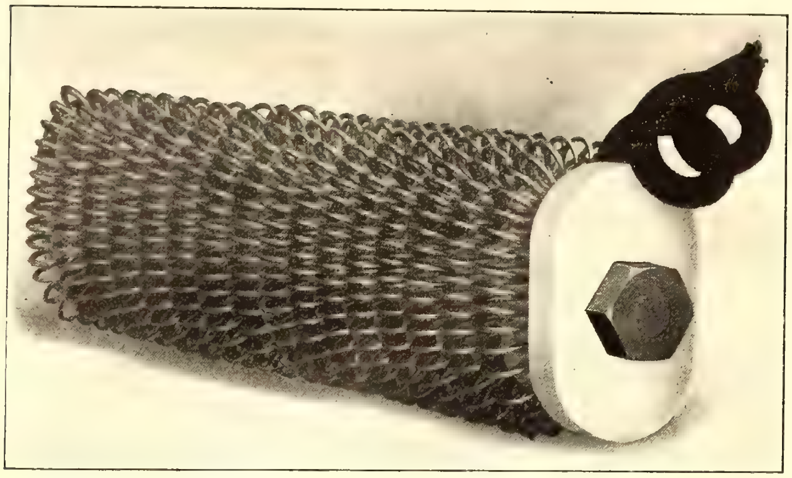
The Goldschmidt Thermit Company, of New York, reports that last year, the first year in which the Thermit joint was put upon the market in this country, it sold about 3000 joints. The record this year is over 10,000 up to date. Some of the larger orders this year are as follows: Altoona, Pa., 125; Birmingham, Ala., 25; Butte, Mont., 150; Joliet, Ill., 185; Cincinnati, Ohio, 100; Cleveland, Ohio, 2984; New Haven, Conn., 503; Fitchburg, Mass., 50; Holyoke, Mass., 1015; Buffalo, N. Y., 50; Los Angeles, Cal., 100; New York City, 650; Bayonne, N. J., 200; Camden, N. J., 100; Rochester, N. Y., 200; Springfield, Mass., 580; Utica, N. Y., 610; San Francisco, Cal., 1000; Salt Lake City, Utah, 600; Sao Paulo, Brazil, 250; Manila, P. I., 500; Worcester, Mass., 25.

WESTINGHOUSE AUTOMATIC BRAKE FOR SURFACE CARS

It is understood that the Westinghouse Traction Brake Company will exhibit at the Philadelphia convention an automatic air brake suitable for electric cars. An extended description of this brake will appear in an early issue of this paper.

HEATER COIL FOR NEW TRUSS-PLANK HEATER

The accompanying cut illustrates a heater coil wound on an elliptical spindle for the Consolidated Car Heating Company's new truss-plank heater. The cut is two-third actual size, and



TRUSS PLANK HEATER

shows how it is possible to use 1 mile of wire on the coils of twelve of these heaters. On account of this large radiating surface, the wire is only heated to a moderate degree. From the cut it will be seen that the coils are perfectly insulated and supported continuously, which absolutely prevents vibration.

DUPLEX DOUBLE-DOOR FIXTURE

This fixture is intended for simultaneously operating two doors, and more particularly for use on street cars that are equipped with twin doors, although it may be used in connection with elevator gates or for other purposes where it is desirable to have two doors operate reciprocally. The accompanying illustration gives a fair idea of the principal features of the mechanism and method of operation.

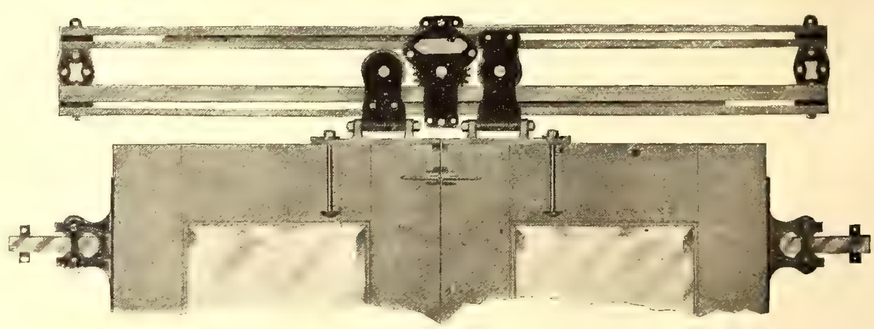
Channels are ingeniously arranged in such a manner as to form guideways for cold-rolled machine-cut racks. One of these racks is attached to the left-hand hanger at the bottom and the other to the right-hand hanger at the top. A gear wheel is interposed at the center of the mechanism between the two channel-iron guideways, and operates through a slot that is cut in the bottoms of the channel irons for a short distance, thus permitting the gear wheel to engage the racks, both top and bottom. Any force applied to either door is communicated to the opposite door by means of the interposed gear wheel, which operates both racks simultaneously and reciprocally.

While the accompanying illustration does not show this very clearly, attention is called to the fact that the hangers consist each of two plates, which straddle the channel irons, and between these two plates the rollers are journaled, the rollers operating in a supplementary channel, which is placed with the legs of channel upward, thus forming a sort of grooved trackway for the rollers. The racks are secured to the hangers by means of steel pins, and the holes for engaging these pins to the hangers are oblong in shape, thus preventing the possibility of any weight coming on the racks by reason of rollers wearing down or by reason of any inequality in the castings or in the manner of assembling them.

The supporting brackets, which are to be attached to the door, are hinged on to the hanger plates by means of a bolt. Thus the doors can be easily loosened and taken away without necessitating the removal of the fixture. Furthermore, this method of attaching relieves the fixture from any strain that may be brought against it in case the doors are forced out of line slightly by the weight of a person being thrown against them, or otherwise. This hinged feature also prevents any binding strains from warping of the wood or other suspending the doors does away with the unsightly causes. Aside from these advantages, the method of plates usually employed, as the bracket for suspending the doors is entirely out of view. A $\frac{1}{4}$-in. hole is bored through the rail of the door, into which a bolt is inserted before the glass is put into the door. The suspending bracket, which is made of malleable iron, is countersunk into the door stile, as shown in the illustration, and is firmly secured at that point by a long wood screw. The opposite end of the suspending bracket is slotted to receive the threaded end of the bolt, over which a key plate is placed, and the nut then turned down tightly. The key plate has its bearing against a slight projection or lug on the end of the bracket. This method not only securely carries the door and does away with the plates, but also reinforces the corner of the door, where it is most required. There is no chance for the door tilting. For example, if the front edge of the door is raised, the roller of the hanger by which it is suspended will travel on the under side of the channel immediately above it. If the back edge of the door is raised it will bring the lower roller of the double-back sheaves into contact with the under side of the track extension.

The width from the top of the door to the top of the fixture is only 7 ins., and even this can be reduced where conditions make it necessary to do so. The clearance required between bulkheads is only $1\frac{5}{8}$ ins., and this also can be reduced slightly if necessary. The total length over all of a fixture having a travel for each door of $16\frac{1}{2}$ ins., or a total opening of 33 ins., would be only 45 ins.

Double sliding doors have many advantages over the single type of door, one of which is the increased space available for a large door opening. By the use of an operating mechanism, the weight of one door is counterbalanced by the other, and



DOUBLE-DOOR FIXTURE

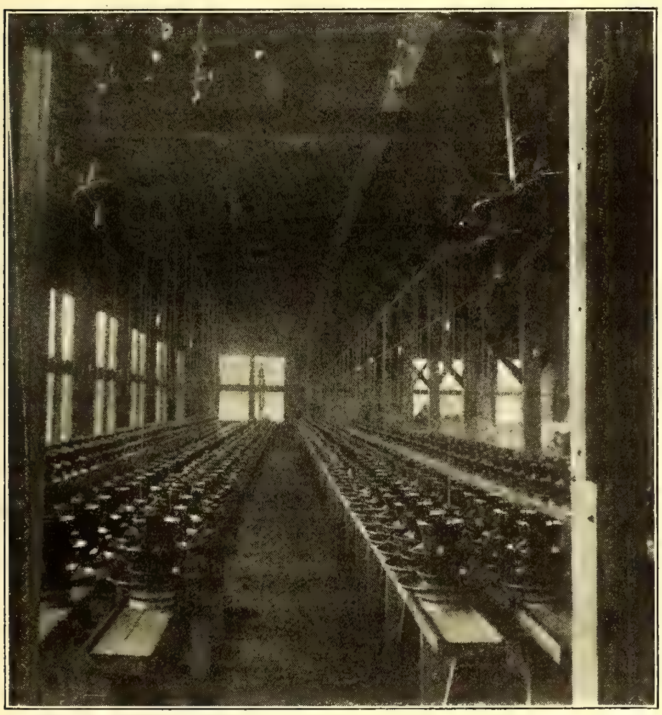
there is no danger of the doors shifting back and forth from the oscillation of the car or when rounding curves. Many accidents have occurred on cars equipped with doors of the single type by passengers having their hands crushed when doors would slide shut unexpectedly. One large road has had no less than thirty-eight accidents of this kind in one year.

The Duplex double-door fixture is the invention of Carl Metterhausen, who was for quite a number of years connected with the Pullman Company when it was still engaged in the street car building business, and later with the Jackson & Sharp Company, of Wilmington, Del. Mr. Metterhausen is at the present time secretary and treasurer of the Wallace Supply Company, of Chicago and New York City, which is marketing the Duplex double-door fixture just described, and other railway materials.

COMMERCIAL TESTING OF HIGH-VOLTAGE INSULATORS

Less than a year ago the testing of insulators—even the output of a large factory—was a very inconsiderable item, requiring but two or three men and a suitable testing equipment. So long as the insulators were small and easily handled, there was no occasion to improve the testing facilities. But with the advent of large pieces of ware for multi-part insulators, new conditions have arisen and have practically compelled the utilization of some more economical method of handling and testing.

The method in common use among insulator manufacturers two years ago called for a 25-kw or 30-kw testing transformer and a simple pin rack capable of accommodating about thirty insulators. After the insulators had been placed on pins or upside down in cups fitted on pins, a chain from an overhead high-tension wire was dropped into the pin hole or wrapped around the insulator head. Voltage was then applied for some stipulated length of time, after which the insulators were removed and others substituted. During this time the testing transformers were allowed to stand idle. With the change in organization of the Locke Insulator Manufacturing Company and its accompanying increase in business, it was found such primitive methods were entirely inadequate. To relieve somewhat the situation, a second exactly similar rack was put up parallel to the original one, so that by the use of large air-brake switches one rack could be tested while the other was being loaded or unloaded, practically doubling the capacity of the test without increasing labor costs. For a few months this method cared for the whole output, but the sudden increase for the past few months has at this time made some other provision imperative. First, all the parts of the multi-part insulators must be tested, then cemented together, and again tested, calling for much handling, with its consequent loss. With an eye to the elimination of much of the handling, the scheme now in use in Victor, N. Y., was developed, whereby 550 insulators may be tested, cemented and retested with minimum handling. To accomplish this, four double racks, each about 90 ft. in length, have been constructed and fitted with galvanized sheet-iron cups in which to set the insulator to be tested. The shells are then assembled with cement, and by means of a movable high-tension wire supported by large strain insulators and equipped with chains properly spaced, the test voltage is applied. Large air-brake switches are provided, that one or all racks may be disconnected or connected at will. The test having been completed, the high-tension wire and its chains are drawn up out of the way to facilitate loading and unloading of the rack, though unloading does not occur until the cement has become sufficiently hard to permit handling. On very large insulators the saving of time is very great; in fact, the time required to handle the 550 insulators on to the racks is entirely saved, since it is necessary under any condition to set up and assemble for the cementing. The saving of the inspector's time is also of importance, for he has but to witness the assembled test for fifteen or twenty minutes and the 550 insulators are ready for shipment.



TESTING RACK FOR INSULATORS

The testing equipment in use at Victor is of 200-kw capacity, in place of the commonly accepted 25-kw or 30-kw of two years ago. The whole reason for this may be summed up in one word, "regulation," and a short study of testing transformers brings forcibly to mind the fact that a testing transformer of small kilowatt output is little better than an inductive coil, draft of any considerable current in the secondary of which may reduce the voltage to a very low value. High secondary impedence would, of course, be disastrous to a good insulator testing transformer, for one of its prime requisites is that it shall be capable of delivering sufficient current to a soft or partially punctured insulator to insure its being detected before leaving the factory. Not only must the transformer be capable of delivering considerable current, but the arrangement of primary and secondary winding must be such as to insure that the generator supplying power shall work well up on its curve of magnetization, else any sudden draft of secondary current will at once reduce the generator voltage to a low value. The difference in the results obtained when using 200 kw and when using 50 kw are truly astonishing, more especially when the insulators are somewhat wet. If the regulation of the transformer be not good, final breaking down or flashing over of the insulator is usually preceded by a brilliant static display, while in the case of the large and powerful transformer employed at Victor the first display of static is accompanied by a powerful arc, which upsets everything and necessitates shut-down.

In connection with the test of large insulators in numbers of 100 or more, it is interesting to note the effect of the large capacity current upon the spark gap, which discharges with the force and vehemence of a small cannon. When such discharge occurs, all neighboring circuits, electric light, telephone, etc., take up their portion and discharge to the nearest available point. Only the most careful guarding will prevent the destruction of lamps, even in distant parts of the factory. Under normal conditions about ¾ amp. is required as charging current when a full rack of 14-in. insulators is being tested at 120,000 volts.

SECRETARY TAFT'S PARTY IN BERKELEY, CAL.

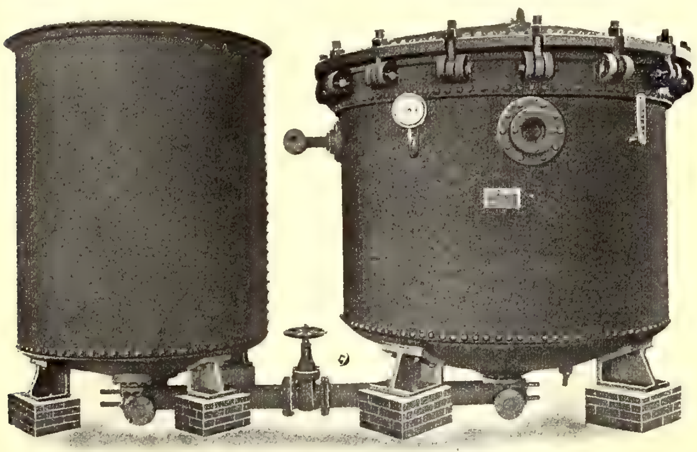
An interesting incident during the visit of Secretary Taft and his party to San Francisco last July was a trip across the bay to Berkeley, where they were entertained at the University of California, a special mass meeting of students being held to hear Mr. Taft speak. The party was taken from San Francisco to the Key Route Pier on the Oakland side of the bay, and as they landed, the Key Route messenger boy, on behalf of his employers, handed Miss Roosevelt a beautiful boquet of orchids. A special train was boarded and the trip over the 3-mile trestle and 3-mile land track to Berkeley station was made in 12 minutes and 36 seconds. Considering that the schedule time for this trip is over 18 minutes, and that after leaving the pier the road is all upgrade, with several curves, this record was a good one. The train consisted of three regular Key Route cars, two motor cars and one trailer, thus giving the train a total power of 1000 hp. Eight and nine-car trains are regularly operated over the Berkeley line of the Key Route.

THE PASSBURG SYSTEM OF DRYING ARMATURES

The Passburg system of drying and impregnating field and armature coils in vacuum has been giving such good results on a number of roads that some particulars on this subject may prove of interest.

The apparatus consists of a vacuum chamber and impregnating liquor tank, a combined condenser and receiver and a dry vacuum pump, with the necessary auxiliaries. The chamber is constructed to maintain an extremely high vacuum and an air pressure of at least 60 lbs. to the square inch. The coils to be treated are first placed in the vacuum chamber, a high vacuum is then obtained and the moisture is abstracted rapidly at the lowest possible temperature. The vacuum chamber and condenser are provided with observation glasses and by-pass valves, which permit an ocular demonstration of the moisture leaving the coils being dried. When the moisture ceases, the coils are absolutely dry and ready for impregnating.

The impregnating compound is heated, and if a solid compound is melted in the impregnating liquor tank, which is connected with the vacuum chamber. The latter is so arranged that



VACUUM DRYER FOR FIELD AND ARMATURE COILS

the compound is allowed to enter the vacuum chamber without breaking the vacuum. This eliminates any possibility of the dried coils absorbing moisture, as is the case in the old-fashioned method of drying and impregnating in bake ovens and dip tanks. Arrangements are also provided for overcoming the freezing or solidifying of the compound in the connecting pipes between the vacuum chamber and the impregnating liquor tank. The vacuum chamber is provided with facilities for accurately determining the temperature of the materials being dried, as well as of the insulating compounds. The apparatus is so constructed that any insulating compound can be used. When solid compounds, with a high melting point, are used, special arrangements are made to obtain the highest possible temperature and to prevent the material from coking or caking, which has heretofore been one of the greatest difficulties with solid compounds.

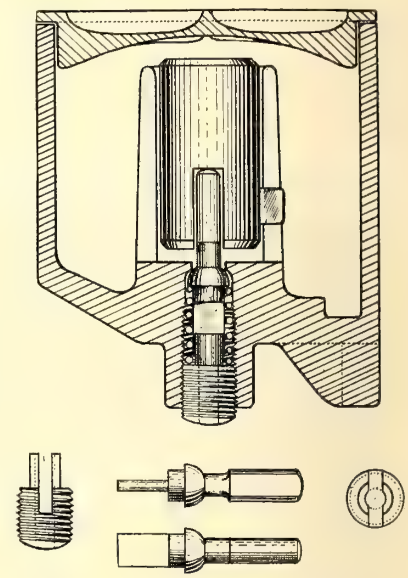
After the insulating compound has entered the vacuum chamber, the vacuum is broken and an air pressure of at least 60 lbs. is applied, which forces the compound through the entire coil, as all air and moisture have been removed. The impregnation is therefore absolutely perfect. The drying takes place at the lowest possible temperature and in a fraction of the time heretofore required, and is entirely independent of climatic conditions. Moreover, there is no waste of compound. Fire hazards are also done away with, as the apparatus, when working, becomes an hermetically sealed plant and all vapors or obnoxious odors pass off through the condenser into the sewer. If a solvent is used for cutting the compound it can be reclaimed in the receiver of the condenser.

The apparatus is in use in all of the principal electrical and cable manufactories in this country and in Europe, and is being placed on the market in this country by Joseph P. Devine, of Buffalo.

NEW LUBRICATING DEVICE

The Jolt Lubricator Company, of Providence, R. I., offers a novel design of oil cup for lubricating motor bearings and axles of street railway cars. The device has been put to prolonged practical tests, and is believed will meet every requirement, the mechanical construction embodying the essential elements of positiveness and simplicity.

The jolting of the car operates the feed mechanism, oil being supplied only while the car is in motion. The feed valve is controlled by a spiral spring, a weight resting on the valve stem in such a manner that it strikes a hammer-like blow at each jolt of the car, opening the valve and allowing a small quantity of oil to escape, the valve being promptly returned to its seat by the spring. The amount of oil fed can be closely regulated with the aid of the spring, the tension of which can be increased or lessened by a regulating screw with the aid of a simple wrench supplied for the purpose. The feed is positive, and adapted to the requirements of the bearing, either thick or thin oil being fed, at any season, with equal precision. No wick, felt or packing is used, and there is no possibility of clogging.



JOLT LUBRICATOR

The Jolt lubricator is made to be placed inside the regular grease cups of either armature bearings or axle bearings of any street railway motor, and any car can be completely equipped with the device in a few minutes.

Properly adjusted, the lubricator carries sufficient oil for one week's supply, without risk of waste or slopping over, or the possibility of leaking through the valve, and without requiring attention.

Thorough test, by a number of railroad companies, has proved the efficiency and dependability of the Jolt lubricator, and it is accepted, by those who have given it careful trial, as a solution of the troublesome problem of oil lubrication for street car motor and axle bearings.

MOTOR 'BUSES FOR NEW YORK

The Fifth Avenue Coach Company, of New York, is placing on trial for Fifth Avenue service a gasoline-electric motor omnibus, which will begin running on regular schedule between Washington Square and Eighty-Eighth Street within the next few days, a fare of 10 cents being charged. It is now being run for experimental purposes during the evenings. In designing this 'bus, the object sought has been to produce a vehicle that could be profitably operated with safety and despatch through the heavy traffic of the avenue. The omnibus is the design of the General Electric Company, and consists of a 40-hp four-cylinder engine, direct connected to a 6-kw generator transmitting current to two motors.

KOERTING & HORNSBY AKROYD INTERNAL-COMBUSTION ENGINES

The prominent place that the gas engine is taking in the production of power, both on a large and small scale, is well shown in the following illustrations and brief descriptions of some of the internal-combustion engines built by the De La Vergne Machine Company, of New York:

Fig. 1 illustrates a 1000-hp single-cylinder Koerting 2-cycle double-acting direct-connected unit. This engine is said to be the only large size two-cylinder double-acting gas engine built. A number of this size is used in the main power plant of the Lackawanna Steel Company at Buffalo, N. Y. They are direct connected to 500-kw 250-volt direct-current Sprague-Lundell generators and 440-volt 25-cycle three-phase alternating-current General Electric generators. The machines operate in parallel at 100 r. p. m.

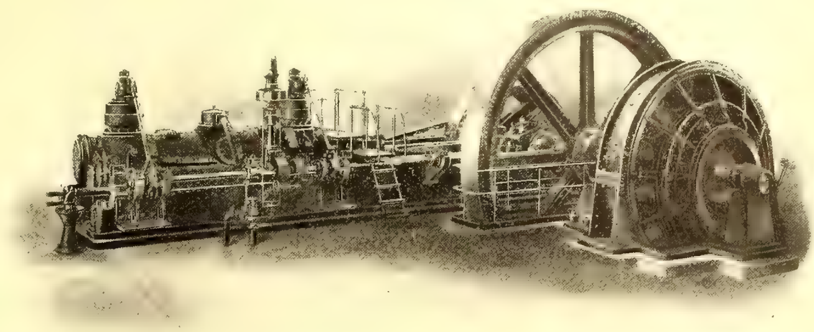


FIG. 1.—1000-HP KOERTING TWO-CYCLE DOUBLE-ACTING GAS ENGINE

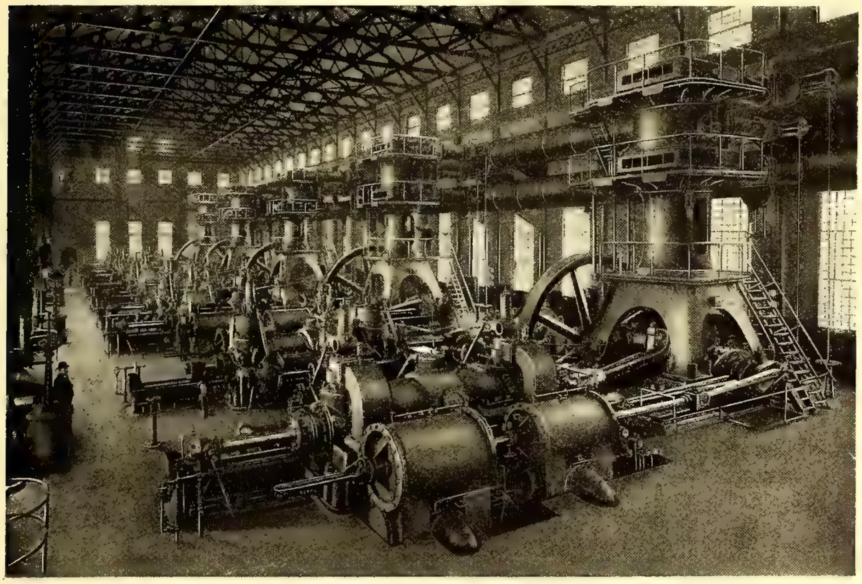


FIG. 2.—2000-HP KOERTING GAS ENGINES DRIVING BLAST FURNACE BLOWING CYLINDERS

Fig. 2 is an interior view, showing five of the sixteen twin-cylinder 2000-hp Koerting units, operating in the two main blowing engine rooms of the Lackawanna Steel Company's Buffalo plant. These engines run at from 70 r. p. m. to 80 r. p. m. on blast furnace gas of from 80 B. T. U. to 100 B. T. U. calorific value per cubic foot. The total horse-power of the Koerting gas engines of this installation, some of which have been in constant operation for over three years, will be, when the plant is completed, 40,000 hp.

According to the size and requirements of the power plant, the producer may be of the suction or pressure type. For plants of small and medium capacity, the suction producer is employed on account of its greater simplicity. In this type of producer, air and steam, both under atmospheric pressure, are drawn through the bed of coal in the generator by the action of a small engine, hot gases leaving the generator effecting the evaporation of the required steam. The partially cooled gases are then cleansed of the major part of their impurities by passing them through layers of coke, over which water is showered in a vessel called a scrubber. Entrained moisture and final traces of other impurities are removed in a sawdust purifier, after which the gas passes to the engine.

The pressure producer shown in Fig. 3 is similar in general construction to the suction producer, with the exception of the addition of a gasometer from which the gas is supplied to the engine. A slight pressure is maintained in the gasometer and other parts of the apparatus by the action of a Koerting blower operated with steam at about 100 lbs. pressure, which forces the air and steam through the gasometer. The action of the blower is automatically controlled by the amount of gas in the gasometer.

The company also makes single and twin-cylinder Hornsby Akroyd oil engines in various sizes. These engines are used largely for operating generators and compressors in connection with electrical and pneumatic tools. The cost of crude oil for operating these engines is about 0.3 cent per B.HP.-hour, or about $9 per hp-year of 300 ten-hour days.

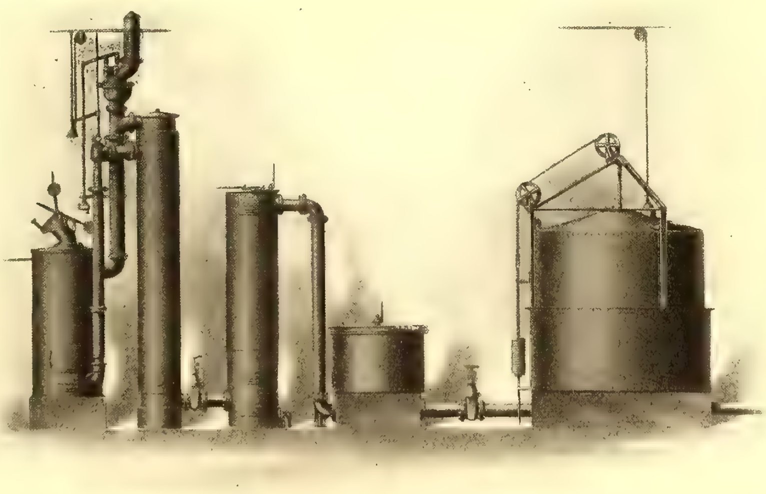


FIG. 3.—KOERTING PRESSURE PRODUCER PLANT

The Springfield, Troy & Piqua Traction Company has put on a limited car leaving Springfield at 5 a. m. and connecting with the Lima Limited on the Dayton & Troy, which reaches Lima at 7:57, or 2 hours and 57 minutes for 85 miles. It has also instituted a through freight service from Springfield to Dayton in connection with the Dayton & Troy.

FINANCIAL INTELLIGENCE

WALL STREET, Sept. 20, 1905.

The Money Market

There has been no appreciable change in the money market this week. The demand for funds, and especially for time accommodations, has fallen off considerably, but at the same time the local institutions have not offered with any degree of freedom, even at the current asking quotations, and there is nothing in the situation at the present time to warrant the belief of an easier market in the near future. Money continues to be sent in large amounts to the West and South for crop-moving purposes. Interior rates of exchange on New York have displayed an easier tendency, which would indicate a less urgent demand for funds at those points, but it is expected that the outflow of funds will continue in fairly large volume for several weeks longer. About the middle of October the final instalment on subscriptions to the Japanese loan becomes due, amounting to about $39,000,000, but it is understood that part of this payment has been anticipated. Since Sept. 15, the local banks have gained about $500,000 from the Sub-Treasury, which compares with a loss of $3,511,000 in the same time a week ago. Gold amounting to $2,750,000 has been engaged in the London market for shipment to New York, which, together with the $1,250,000 announced last week, brings the total amount to date up to $4,000,000. Of this amount about $600,000 has been received and the balance is expected to arrive within the next ten days. Future engagements of the yellow metal in the London market depend largely upon the action of the directors of the Bank of England this week. Private discount rates have displayed a hardening tendency, and it is expected that the bank rate will be advanced to 3½ or 4 per cent in order to check the withdrawals of gold, not only for New York, but for Argentina and the Continent as well. The sterling exchange market has ruled firmer at about 4.8530 for prime demand bills. The bank statement published on last Saturday showed a further loss in cash of $7,463,400, which was somewhat smaller than indicated by the preliminary figures. Otherwise the statement was considered favorable. Loans showed a further shrinkage of $20,861,600, owing to the employment of foreign money in the local market. Deposits were smaller by $29,069,400. The required reserve was $7,267,350 less than in the previous week, resulting in a small decrease in the surplus of only $196,050. The surplus now is $4,635,300, as against $29,353,150 in the corresponding period a year ago, $13,173,625 in 1903, a deficit of $1,642,050 in 1902, a surplus of $13,654,225 in 1901 and $20,836,175 in 1900.

Money on call ranged from 2½ to 4 per cent, with most of the new business transacted at 3 per cent. Sixty-day money was quoted at 4 per cent, ninety days' at 4¼ per cent, and four to six months at 4¼ per cent, with business reported at those rates. Commercial paper was in good supply at 4¼ and 4½ per cent for the best names.

The Stock Market

Monetary conditions continued to dominate the stock market and prices moved rather irregularly during the week, and, at times, were reactionary on the probability of higher rates for money here and the uncertainty of any heavy gold import movement during the ensuing week. Thus far the imports amount to only a little more than $4,000,000, but in addition to this the banks have gained moderately from the Sub-Treasury, and the currency movement to the interior has not been so heavy as in the previous week. The tendency of prices was downward until the close, when a sharp upward movement followed aggressive buying of Northern Pacific, Great Northern preferred and Northern securities, the moving influence having been rather positive reports that the Great Northern management is about to make an extra distribution to its stockholders out of the profits of the Northern Securities adjustment. The sharp advance in these stocks stimulated buying of the other active issues, which was also encouraged by unconfirmed rumors of further gold engagements of some importance. This left the market at the end of the week decidedly strong. While there is every reason to look for a heavy movement of gold in this direction, it is likely that the supply will come from Paris and Berlin rather than from London. Discounts in the English market have hardened in anticipation of an advance in the minimum rate of the Bank of England, and this institution is placing every obstacle in the way of gold engagements for America. The increasing exports of breadstuffs and cotton and the large volume of exchange resulting therefrom will enable us to draw rather liberally upon foreign supplies of the metal, but at the moment sterling exchange rates are above the point at which gold can be imported at a profit, although a decline in sterling appears inevitable. Until we have assurance of assistance to the money market, speculative opinion is likely to continue rather mixed, but fundamental conditions are so thoroughly sound that activity in and higher prices for stocks are rather positively indicated to follow the beginning of the return movement of money from the interior. There is some talk of an early dividend on Steel common, which would appear to be justified by the strong position of the industry and the enormous business and large earnings of the corporation.

The local traction stocks showed considerable weakness at times, the selling having been on the report that the local Democratic platform will contain a plank in favor of municipal ownership of public utilities.

Philadelphia

Increased strength characterized the dealings in the local traction issues this week, but apart from Philadelphia common very little activity developed. Trading in this stock was upon an extremely large scale; upwards of 18,000 shares changed hands. Early in the week the buying was said to be for Pittsburg account, and toward the close the advance was accompanied by rumors of a deal, but no news relating to the affairs of the company was forthcoming. From 46½ at the opening the price ran off to 46⅛, but subsequently it advanced to 47⅝ and closed within ⅛ of the highest. The preferred stock was quiet and practically unchanged as to price, about 150 shares changing hands at from 48 to 48½. Scranton Railway was openly dealt in for the first time in weeks, and was strong, 50 shares selling at 27, an advance of 2 points. Philadelphia Traction moved up ½ to 99½ on the purchase of upwards of 300 shares. Rochester Railway sold at 93 for 100 shares, and 500 shares United Railroads of San Francisco preferred sold at from 88½ to 90¼. Philadelphia Traction ruled quiet, about 500 shares changing hands at from 28½ to 28⅞. Union Traction sold at 61⅞ and 62 for about 250 shares, and 500 shares American Railways brought 52½ and 53.

Baltimore

Extreme dullness prevailed in the Baltimore market this week. Trading included a fairly large number of issues, but the individual totals were considerably below those recently recorded. About the only issue to show activity was United Railways pooled stock, of which about 4000 shares were dealt in at prices ranging from 17 to 16¾. The free stock sold to the extent of about 400 shares at from 17 to 16⅝. The 4 per cent bonds were very quiet, about $20,000 changing hands at 92¾ and 93. The incomes brought prices ranging from 67 to 66¼ for about $35,000, while the certificates representing income bonds deposited sold at 66¼ and 66 for about $10,000. Other transactions included Norfolk Railway & Light 5s at 94, Augusta Railway & Light 5s at 105½, Central Railway 5s at 117¾, Charleston Consolidated Electric 5s at 95¼, and Washington City & Suburban 5s at 105½.

Other Traction Securities

There was no improvement in the Chicago market. Trading continued upon an extremely small scale, and, with the exception of Metropolitan Elevated preferred, the price movements were insignificant. Metropolitan preferred, after declining from 69 to 67⅞ advanced to 70 on the exchange of about 300 shares. The common sold at 23½ for a small lot. Other sales were: 7 shares of North Chicago Street Railway at 65, 25 shares of Chicago Union Traction preferred at 62½, 13 shares of West Chicago at 49 and 70 shares of Northwestern Elevated at 22½. The feature of the Boston market has been the pronounced strength displayed by West End common, which rose from 99 to 102 and closed at the highest on the purchase of about 800 shares. The preferred remained unchanged, odd lots bringing 113½. Boston & Worcester was active and strong also, upwards of 1000 shares changing hands at from 29 to 30, while the preferred sold at 74 to 75½ for upwards of 400 shares. Boston Elevated was traded in to the extent of several hundred shares at 154½ to

153½. Massachusetts Electric sold at 16¼ and 17, and the preferred at 60 and 59½. Boston & Suburban brought 67 for small lots. In the New York Curb market Interborough Rapid Transit has been fairly active and strong. Early in the week transactions were made at from 216½ to 215½, but later on the stock advanced sharply to 219⅞ and closed at 216 ex the dividend of 2 per cent. Upwards of 3000 shares were dealt in. New Orleans Railway common has ruled quiet but firm, 300 shares selling at 37¼ and 37, while 650 shares of the preferred sold at prices ranging from 80¼ to 79¾. The 4½ per cent bonds sold at 90⅝ and 90¼ for $50,000. Washington Railway common brought 43 and 42½ for 400 shares, and 100 preferred sold at 93. Of the 4 per cent bonds, $8,000 brought 91. Other sales were: $10,000 Jersey City, Hoboken & Paterson 4s at 76⅝ and interest, and $20,000 Public Service Corporation 5 per cent notes at 97⅛ and interest.

Cincinnati Street Railway advanced to 148 at Cincinnati. Cincinnati, Newport & Covington continues active around 38⅛. Cincinnati, Dayton & Toledo stock sold at 24, a slight advance. The bonds sold for 97¾ for $65,000 worth. Detroit United sold at 93, a slight decline.

Tractions continued active at Cleveland. Aurora, Elgin & Chicago is still the active feature, about 1900 shares of common selling with an advance from 27½ to 29¼ and still going up. The preferred sold at 85½ and the bonds at 95¾. There was a strong movement in Cleveland & Southwestern which looks like an effort of insiders to support the stock against the slump which it suffered on the report that the preferred dividend was to be passed. The common opened the week at 10¾, and on Tuesday of this week it had advanced to 14½; sales, about 2000 shares. The preferred was boosted from 53¼ to 62 early this week; there is talk of a pool at 70 on this stock. Talk of a pool on Cleveland Electric Railway advanced this stock from 79¼ to 83 on Tuesday; this in the face of the almost certain re-election of Mayor Tom L. Johnson, with prospects of continued adverse legislation. Lake Shore Electric common made a gain from 12½ to 13⅞. Northern Ohio Traction made a slight advance from 23 to 24. Western Ohio receipts are stronger at 15⅛ and in good demand. The bonds of this company have been active and advanced to 83½. Northern Texas sold up from 72 to 75 on news of the consummation of the sale of the property to Stone & Webster, this being the price paid for the controlling interest.

Security Quotations

The following table shows the present bid quotations for the leading traction stocks, and the active bonds, as compared with last week:

	Sept. 13	Sept. 20
American Railways	52½	52
Boston Elevated	153½	153
Brooklyn Rapid Transit	67½	68⅝
Chicago City	a195	190
Chicago Union Traction (common)	8	8½
Chicago Union Traction (preferred)	—	
Cleveland Electric	79	79
Consolidated Traction of New Jersey	82	82
Consolidated Traction of New Jersey 5s	109	109
Detroit United	93¼	93¼
Interborough Rapid Transit	215¾	*215
International Traction (common)	32½	34
International Traction (preferred) 4s	73	73
Manhattan Railway	165	165⅛
Massachusetts Electric Cos. (common)	15½	15½
Massachusetts Electric Cos. (preferred)	59½	58½
Metropolitan Elevated, Chicago (common)	22⅝	25
Metropolitan Elevated, Chicago (preferred)	68	70
Metropolitan Street	127	126⅞
Metropolitan Securities	81	80⅛
New Orleans Railways (common), W. I.	37	36¾
New Orleans Railways (preferred), W. I.	80	79
New Orleans Railways, 4½s	90½	90¼
North American	98¼	98
North Jersey Street Railway	28	28
Philadelphia Company (common)	46¼	47⅜
Philadelphia Rapid Transit	28	28
Philadelphia Traction	—	99
Public Service Corporation 5 per cent notes	96½	96½
Public Service Corporation certificates	69¼	69¼
South Side Elevated (Chicago)	a99	97
Third Avenue	127½	126½
Twin City, Minneapolis (common)	117½	117
Union Traction (Philadelphia)	61¾	61¾
West End (common)	99	100
West End (preferred)	113	113

a Asked. W. I., when issued. * Ex-dividend.

Iron and Steel

The "Iron Age" says one of the characteristic buying rushes seems to be on in the pig iron market, reports from all the leading distributing centers showing a heavy movement. In Pittsburg the purchase on the part of the Steel Corporation of a lot of 10,000 tons of Bessemer pig for prompt delivery, has been followed by some large sales, aggregating 65,000 to 75,000 tons of Bessemer and basic pig, the bulk being taken by a large western Pennsylvania steel plant. Chicago reports large transactions in foundry iron, aggregating 25,000 tons, which included one lot of 10,000 tons of charcoal iron to large car wheel makers. Cincinnati notes some round sales. It is understood that the Steel Corporation will need 40,000 tons of outside iron for October. While the largest orders for steel rails which were in the market last week, including the 160,000-ton order for the New York Central, have not been placed, some goodly contracts have been booked by the mills. They total up to over 100,000 tons. Railroad buying is greatly in evidence, too, in bridge material. The scarcity of steel is becoming more pronounced.

CHICAGO COMPANY TO REPLY TO QUESTIONS PROPOUNDED BY THE CITY COUNCIL

The meeting of the committee on local transportation of the Chicago City Council on Friday, Sept. 15, ended in the traction companies agreeing to answer on Sept. 26 several questions submitted by aldermen. The tangible results of the meeting were two offers, made by the Chicago City Company, as a part of what it would agree to do in order to secure an extension of franchise. While the Union Traction representatives did not concur in these offers, they sat silent when the one involving them was made. They are understood to be bound by it. The two offers are:

"An exchange of transfers between the two companies outside of a fixed zone and a through routing of cars inside of that zone, so as to make a case of 'one city, one fare.'

"An immediate rehabilitation of the service of the company on the lines of the recommendations in the Arnold report."

The important questions which the company has agreed to answer at the next meeting of the committee are:

"In any settlement agreement which may be made will it be provided that at a determined period, or periods, during the life of the agreement the city may take over your lines and the price and method of fixing the same be therein set forth?

"Will you agree to the city taking over the lines at any time during the life of the franchise, if one is granted?"

The other questions are all based on the report of the committee on Dec. 11, 1901, when it outlined the terms of what it then considered a proper franchise ordinance. This report deals with requirements calling for good service on the part of the companies, and then provides for universal transfers; that the city can take over the properties at any time after the first ten years; that all grants terminate at the same time; that the underground trolley be used in the territory bounded by Ashland and North Avenues and Twenty-Second Street, and that the companies operate in subways if the city ever builds them.

CHANGES IN THE CAR WHEEL BUSINESS

One of the largest transactions in the iron world of the present year was consummated during the past week, when the control and management of the National Car Wheel Company passed into the hands of James D. Rhodes, of Pittsburg, Pa., and William F. Bonnell, of Cleveland.

This company owns and operates four plants, one at Pittsburg, one at Cleveland, one at Sayre, Pa., and one at Rochester, N. Y. Its product is cast-iron chilled car wheels, steel-tired wheels, grey iron castings, aluminum and brass castings. The works have an annual capacity of 300,000 wheels. The officers are as follows: James D. Rhodes, president; C. A. Otis, Jr., and William F. Bonnell, vice-presidents; George P. Rhodes, treasurer, and C. A. Maher, secretary.

The directors number nine, and are as follows: James D. Rhodes, of Pittsburg; George P. Rhodes, of Pittsburg; C. V. Slocum, of Pittsburg; J. C. Holt, of Grand Rapids, Mich.; C. A. Otis, Jr., of Cleveland; C. A. Maher, of Cleveland; William F. Bonnell, of Cleveland; W. T. Goodnow, of Sayre, Pa., and C. T. Chapin, of Rochester, N. Y. C. T. Chapin, former president of the National Car Wheel Company, remains with the company in a special capacity, with headquarters at Rochester, N. Y.

NEW YORK SUBWAY CONTRACTS

Contracts for the next rapid transit subways in New York may be let soon after Jan. 1, 1906, if the hopes of the Rapid Transit Commission as expressed at last week's meeting are realized. Albert B. Boardman, counsel to the commission, reported that he was ready to go to the Appellate Division of the Supreme Court to have consents to routes approved, and for permission to act in cases where consents had not been obtained, and said he would make the application as soon as the courts open in October. The routes which will come before the courts include the Lexington, Third, Seventh and Eighth Avenue lines in Manhattan with their Bronx connections and also include the Brooklyn route which will effect connections between the bridges.

Mr. Boardman said that his canvassers had been all along the routes of the proposed subways obtaining consents of property owners, but that it would be necessary to get the authority of the Appellate Division because not enough property owners had signed the consents.

By resolution the board extended to Sept. 11, 1906, the time for the construction of the Brooklyn addition to the subway. This action was taken at the instance of the Rapid Transit Subway Construction Company, which said it was unable to complete the entire work within the three-year limit.

The commissioners said that the extension of the proposed Jerome Avenue subway line as far north as 233d Street would be granted at the proper time.

ANNUAL REPORT OF THE PHILADELPHIA RAPID TRANSIT COMPANY

The annual meeting of the Philadelphia Rapid Transit Company was held Wednesday, Sept. 20. At that time was presented the annual report of the company for the year ended June 30, 1905, giving in detail the earnings of the company, and showing its status in the general balance sheet. That the report should have been presented at this time is especially gratifying, in view of the meeting in Philadelphia next week of the American Street Railway Association and affiliated bodies. Below follows the statement of earnings, as shown in the official report:

OPERATIONS FOR THE YEAR ENDED JUNE 30, 1905

	1905	1904
Number of passengers carried	402,893,245	390,532,689
Receipts from passengers	$16,188,645	$15,923,518
Operating expenses	8,183,437	8,093,315
	$8,005,208	$7,930,193
Miscellaneous receipts, interest, etc.	185,979	172,855
	$8,191,188	$8,103,048
Licenses and taxes, paid and accrued	966,535	1,060,896
	$7,224,652	$7,042,151
Fixed charges, paid and accrued	7,116,442	6,821,301
	$108,209	220,848

Operating expenses, including licenses and taxes, 56 52-100 per cent.

The increase shown in fixed charges is due to the advance in rental on Union Traction stock commencing July 1, 1904, as per lease, less sundry adjustments in certain fixed charge items.

The general balance sheet as of June 30, 1905, shows:

ASSETS

Cash	$1,976,230	
Cash in agents' hands	9,500	
Fire insurance fund	850,000	
Advanced to leased lines	502,208	
Supplies	456,577	
Construction and equipment	12,867,219	
Real estate	776,495	
Accounts receivable	25,312	
Sundry stocks	1,635,559	
Franchise account	115,325	
		$19,214,428

LIABILITIES

Capital stock	$11,972,320	
Accounts audited but not due	285,003	
Fixed charges and taxes accrued	2,113,748	
Open accounts	112,471	
Proceeds sale of bonds underlying companies	4,000,000	
Profit and loss	730,884	
		$19,214,428

REPORT OF THE TREASURER OF THE COMPANY FOR THE YEAR ENDED JUNE 30, 1905

RECEIPTS

Balance as per report, June 30, 1904		$589,650
Passenger receipts	$16,178,502	
Chartered cars	10,112	
Advertising	89,583	
United States mail	42,059	
Rents, real estate	26,648	
Interest	11,850	
Miscellaneous	143,644	
Capital, instalment on stock	2,987,640	
Market Street Elevated Passenger Railway Company bonds	3,000,000	
Philadelphia & Willow Grove Street Railway Company bonds	1,000,000	23,490,041
		$24,079,692

DISBURSEMENTS

Pay rolls	$6,161,456	
Operation, construction and equipment accounts	7,572,900	
Stocks underlying companies	47,000	
Advance to agents	1,000	
Advances to leased lines	73,594	
Sundry advances	3,450	
Taxes and licenses	1,014,604	
Fixed charges	6,945,287	
Real estate purchased	284,167	$22,103,462
Balance		$1,976,230

In presenting the report to the stockholders President Parsons said:

The gross receipts have not greatly increased during the year owing to the stagnation in business in the first five months and the severe weather of the past winter.

There was built during the year 28.72 miles of new road, which is now in operation; with the exception of 17 miles of this, which is the new line to Willow Grove Park, the balance is extensions of existing lines.

During the year 42.98 miles of track were laid with the new standard girder rail (137 lbs. to the yard), 18.55 miles of this were new lines and the balance were renewals through territory where the traffic is very heavy.

The total trackage of your system is 554 miles.

The construction of the subway on Market Street is progressing favorably, and at the present time the tunnel is practically completed to Sixteenth Street. The bridge over the Schuylkill River is completed with the exception of the tracks, and the foundations for the columns which will carry the elevated structure from the west bank of the Schuylkill River to Delaware County, at Sixty-Third and Market Streets, are almost all completed. The work on the terminal and elevated structure in Delaware County is being pushed as rapidly as possible.

The new line to Willow Grove was put in operation May 15, 1905, and has proved to be a decided success.

There was laid during the year approximately ten (10) miles of new conduits. The power-generating machinery has been increased by 6000 kw during the year, all of which has been installed at Second Street and Wyoming Avenue power house.

There have been added during the year seventy-two double-truck cars, with the necessary electrical equipment for same, making a total of 3554 cars of all kinds used in the operation of your property.

The following amount of paving has been maintained by the company during the year:

	Sq. Yards.
Belgian block	4,316,180
Asphalt	1,500,359
Macadam	499,072
Brick	341,701
Cobble	27,699

This paving has been maintained in addition to the payments of $966,535.28, being licenses and taxes paid and accrued to the city and State.

On Dec. 1, 1904, there fell due $67,500 of 5 per cent bonds of the Fairmount Park & Delaware River Passenger Railway Company (merged into Germantown Passenger Railway Company); these bonds were paid off and canceled.

There fell due Jan. 15, 1905, $219,000 of People's Passenger Railway first mortgage 7 per cent bonds; these bonds have been extended for thirty years at 4 per cent.

As per authority given at the special meeting of the stockholders

of this company, held April 25, 1905, this company has become guarantors for an issue of $10,000,000 of the Market Street Elevated Passenger Railway Company's bonds, bearing 4 per cent interest and running for fifty years from May 1, 1905; all of this issue of bonds has been disposed of.

Your company also became guarantors for an issue of $1,000,000 of 4½ per cent bonds of the Philadelphia & Willow Grove Street Railway Company, due thirty years from July 1, 1904, also guarantors for an issue of $200,000 of 4½ per cent bonds of the Darby & Yeadon Street Railway Company, due thirty years from Dec. 1, 1904; all of the capital stock of the above-named companies being owned by your company. The Darby & Yeadon line is now in course of construction.

The fire insurance fund consists of the following: Three thousand six hundred and fifty shares Philadelphia Traction Company stock, 5300 shares Union Traction Company stock, $100,000 Electric & People's 4 per cent stock trust certificates, $12,000 Union Traction Company 4 per cent collateral trust mortgage gold bonds, $100,000 Philadelphia & Willow Grove Railway Company 4½ per cent bonds, $58,000 Market Street Elevated Passenger Railway Company 4 per cent bonds, $455,000 in first mortgages on real estate, $1,437.60 in ground rents, $9,731.71 in cash.

ANNUAL REPORT OF THE NORTHWESTERN ELEVATED RAILROAD COMPANY

The Northwestern Elevated Railway, of Chicago, reports earnings as follows for the year ending June 30, 1905:

INCOME ACCOUNT OF THE YEAR ENDING JUNE 30, 1905

Passenger earnings		$1,340,446
Other earnings (including loop net earnings)		445,968
Total earnings		$1,786,414
OPERATING EXPENSES		
Maintenance of way and structure*	$63,720	
Maintenance of equipment	85,851	
Conducting transportation	400,537	
General expenses	66,518	616,628
Net earnings		$1,169,786
CHARGES		
Taxes†	$163,520	
Bond interest	779,379	
Other interest	9,727	952,627
Surplus for year		$217,159

* Includes $39,500, which has been set aside in monthly instalments, for betterments and maintenance of structure.

† Includes compensation to city on account of loop.

*GENERAL BALANCE SHEET—JUNE 30, 1905

ASSETS		
Cost of road and equipment	$29,411,098	
Land and buildings	450,908	
Stocks and bonds owned	32,265	
Cash and bills receivable	719,705	
Accounts receivable	108,134	
Materials and supplies on hand	21,578	
Unadjusted accounts	272,357	
		$31,016,045
LIABILITIES		
Capital Stock—		
Preferred	$5,000,000	
Common	5,000,000	
		$10,000,000
Bonds	$19,500,000	
Less bonds in treasury	1,076,000	
		18,424,000
Mortgages		151,973
Reserved for taxes		98,252
Reserved for interest		241,804
Reserved for maintenance		188,294
Other reserves		2,122
Accounts and notes payable		873,901
Unadjusted accounts		14,763
Profit and loss		1,020,937
		$31,016,045

* Includes Loop Division.

COMPARATIVE STATEMENT OF DAILY AVERAGE PASSENGER TRAFFIC PER MONTH DURING THE YEARS ENDING JUNE 30, 1901, 1902, 1903, 1904 AND 1905

Month	1901	1902	1903	1904	1905
July	40,816	48,559	56,110	59,393	60,816
August	43,961	49,770	57,911	60,093	62,453
September	47,092	54,065	63,950	68,107	66,407
October	50,808	59,044	69,562	71,617	73,385
November	53,345	59,857	67,236	71,422	74,307
December	53,798	63,375	71,607	76,259	78,263
January	52,022	62,010	68,266	70,204	73,728
February	55,256	64,760	69,885	73,193	78,773
March	57,193	65,362	70,070	74,344	80,500
April	58,623	65,430	71,340	74,217	79,779
May	56,999	63,199	66,990	69,232	77,863
June	53,586	60,813	66,571	68,222	75,837
Daily average	51,918	59,641	66,591	69,664	73,460

Passengers carried year ended June 30, 1901	18,950,167
Passengers carried year ended June 30, 1902	21,769,079
Passengers carried year ended June 30, 1903	24,305,704
Passengers carried year ended June 30, 1904	25,497,079
Passengers carried year ended June 30, 1905	26,812,825
Daily average passengers carried year ended June 30, 1905.	73,460
Daily average passengers carried year ended June 30, 1904.	69,664
Average daily increase	3,796
Equal to 5.45.	
	Per Cent
Ratio of operating expenses, including maintenance reserve to earnings	44.55
Ratio of operating expenses, maintenance reserve, loop account and taxes to earnings	62.04

ANNUAL REPORT OF RAILWAYS COMPANY GENERAL

At the annual meeting of the stockholders of the Railways Company General, in Jersey City, P. C. Rhoades was elected a director to succeed J. O. Hoffman. At a subsequent meeting it was voted to reduce the capital stock from $1,200,000 to $900,000. The report of the company for the year ended June 30 is as follows:

	1905	1904
Income for year	$38,215	$45,901
Expenses, rentals, taxes, etc.	14,473	7,482
Net profits	$23,742	$38,419
Previous surplus	124,377	85,957
Total surplus	$148,119	$124,376

The general balance sheet as of June 30, 1905, compares as follows:

Assets—	1905	1904
Cash	$17,006	$84,639
Cash from sub. companies	64,187	60,990
Bonds sub. companies	830,500	787,300
Capital stock sub. companies	264,695	242,723
Other securities owned	66,470	284,459
Sundry underwritings	......	24,500
Furniture, fixtures, etc.	3,443	1,910
Capital stock in hands of trustee	34,000	34,000
Unpaid stock sub.	26,000	28,000
Loans on collateral	39,816	......
Total	$1,346,119	$1,548,522
Liabilities—		
Capital stock	$1,198,000	$1,200,000
Notes due	......	224,145
Surplus	148,119	124,377
Total	$1,346,119	$1,548,522

President E. R. Dick says in his report:

"A feature of the past year has been the decided improvement in the net earnings of the Michigan Traction Company, the result of the large expenditures for equipment and improvements which have been made upon that company in the last two years. After the payment of interest, taxes and sinking fund, that company has shown a surplus equal to almost 6 per cent upon its capital stock of $500,000. The development of suburban trolley lines in the section of the State traversed by the Michigan Traction Company is giving that property a greater strategic value each year in addition to its earning powers. The other subsidiary companies, with the exception of the Elmira & Seneca Lake Railway, have been able to pay their expenses and contribute small amounts towards the pay-

ment of back interest, but as outlined in a previous report, the operation of these small isolated trolley properties is, as a usual thing, unsatisfactory. The Elmira & Seneca Lake Railway, which has been showing a decided improvement, met with a serious setback. A flood washed away a number of miles of track, destroying bridges, culverts, etc. This has caused the operation of the line as a whole to be abandoned for the present; and the management is now considering what shall be done in regard to putting the property in working condition. In the meanwhile, to preserve this company's interest in the property, Mr. D. A. Hegarty, general manager of the Railways Company General, has been appointed receiver.

"During the past year, in conformity with the laws of New Jersey, the management has taken advantage of the low price of Railways Company General stock to purchase same for the purpose of cancellation. It is expected this will be ratified at the forthcoming meeting of stockholders, at which time the capital stock will be reduced to $900,000. This will enable the management to mark down the book value of assets and in addition thereto the surplus fund of $148,117 will be applied, reducing the book value of assets to a fair market value, or in other words, the assets taken at a valuation would equal par for the company's stock."

THE CAMBRIDGE RAPID TRANSIT QUESTION

The Cambridge rapid transit question came up again last Wednesday at the meeting of the Cambridge City Council, when Mayor Daly sent in a letter containing reference to the correspondence that has passed between him and the officials of the Boston Elevated Railway Company since the latter refused to accept the act of the last Legislature providing for a four-track subway and his recommendations in the matter. The Mayor recommends that Howard A. Carson, the rapid transit commission's engineer, be employed to give an estimate of the cost of a four-track subway, and that the question of what the citizens want be submitted to the voters at the December city election.

Mayor Daily, in his letter, says:

The bill was presented to the Legislature in the name of the city under an order of the City Council, after consultations with the executive committee of the board of directors of the Boston Elevated Railway Company and its attorney, the Hon. Albert E. Pillsbury.

The bill was drawn and its provisions agreed to by the executive committee of the board of directors of the company and its attorney and the city, represented by the city solicitor and Mayor Daly. Mr. Pillsbury appeared before the committee of the Legislature in behalf of the passage of the bill.

The clause in the act allowing the company two months in which to accept it was inserted on the advice of Mr. Pillsbury. It was not stated that it was for the purpose of considering the cost, and the city's representatives were not informed during the negotiations that if the cost was more than $5,000,000 that the act would not be accepted.

The company says that it would have accepted the act if it provided for the building of a two-track subway.

Two points have been settled: First—The company recognizes that the city wishes a subway instead of an elevated railway. Second—It is willing to build a two-track subway under the same terms and conditions as are provided under the act of 1905 for a four-track which it has rejected.

The engineer of the company estimates the cost of a four-track subway will be $7,900,000. The city engineer estimates it $6,333,800—a difference of $1,566,200.

The Mayor recommends that the question of whether there should be built a four or two-track subway, and whether it should be built by the city under the Boston plan and leased to the company, be submitted to the voters at the next city election. Before the city election there can be placed before the public the report of Mr. Carson's estimates of cost, and the whole question can be discussed and determined so far as the voters of the city can determine it, in view of the franchise held by the company for an elevated railway. By this means public opinion will be manifested, and the next city government will know what it is upon this subject. There will be ample time for this procedure, because nothing can be done toward construction until the Legislature of 1906 passes a bill authorizing it.

NEW YORK & PORT CHESTER RAILROAD COMPANY GETS NEW YORK CITY FRANCHISE

At a meeting of the Board of Estimate and Apportionment of the City of New York, held last week, the application of the New York & Port Chester Railroad Company for a franchise to construct that portion of its line within the limits of the city of New York, about 10 miles, which is necessary for the completion of its system, was unanimously granted, and the Controller was directed to prepare the ordinance as required by law. This action of the Board of Estimate and Apportionment completes the last legal step of the Port Chester Railroad, and gives it a complete set of franchises and charters through all the towns and cities lying between the Harlem River and the Connecticut State line. The Port Chester Railroad Company had already taken the following steps:

Secured the certificate of public convenience and necessity, commonly known as the charter, from the Railroad Commission as required by law.

Had that certificate twice unanimously sustained by the New York Court of Appeals.

Secured from the Common Council of Mount Vernon a franchise, in perpetuity, and without any conditions whatever, to pass over all the streets of the city of Mount Vernon.

Secured from the Common Council of New Rochelle a franchise, in perpetuity, and without any conditions whatever, to pass through all the streets of New Rochelle.

Secured the right, in perpetuity, to pass through the towns of Pelham, Larchmont, Harrison, Rye and Port Chester.

Secured an order, in perpetuity, from the Supreme Court of White Plains to cross all of the other public highways and streets in Westchester County.

Purchased the real estate for the joint terminal station between the Interborough Rapid Transit Company and the Port Chester Railroad Company under the traffic alliance contract between those companies.

Purchased about 75 per cent of its Bronx right-of-way real estate and stations property; also purchased large tracts of real estate for right of way and stations in the city of New Rochelle and other parts of Westchester County.

The Port Chester Railroad will be constructed by the New York Railroad & Development Company, which is now letting the sub-contracts for that purpose. Among the underwriters of that company are Edwin Gould, William C. Sheldon & Company, Harvey Fisk & Sons, the Trust Company of America, Charles D. Barney & Company, C. D. Simpson, of the Chicago subways, O. C. Barber, president of the Diamond Match Company.

The individual members of the syndicate now own in the borough of the Bronx alone approximately 600 acres of land, through which the line of the Port Chester Railroad will pass. They also own in Westchester County about 300 acres.

EQUIPMENT WANTED FOR CALIFORNIA ROAD

The Ocean Shore Railway Company, which recently let contracts to C. E. Loss, of New York, for the construction of the 81-mile double-track electric railway, connecting Santa Cruz with San Francisco, is in the market for the electric equipment of its initial installation. The call for proposals issued by Sidney Sprout, the company's electrical engineer, includes forty multiple-unit car equipments, each of four 125-hp, direct-current motors. The sub-stations call for ten 500-kw, 25-cycle rotary transformers, 550 volts to 650 volts on direct-current side, and thirty 250-kw static transformers. Eight of the sub-stations will be located at points on the line according to the load, while two will be mounted on cars, so as to be portable. One rotary and three static transformers will be installed in each sub-station. The main power station will be erected at Balboa, a new town, 1 mile north of Halfmoon Bay, near the water, so that a salt-water pumping system can furnish condensing water for the engines. Two 2000-kw, three-phase, 2300-volt, 25-cycle generators are called for, each to be direct connected to a vertical condensing engine. Seven step-up transformers, to 30,000 volts, will be required, three to each generator and one extra. There is an alternative of three 1500-kw generators with three engines, and ten 750-kw transformers. Switchboards for generating and sub-stations are to be included in the proposals, as well as exciters and auxiliaries. Water-tube boilers are specified, equipped for burning oil fuel. The company's capital stock is $5,000,000, and the road when completed and fully equipped will represent an expenditure of nearly $6,000,000, it is said. W. E. Dean is president and A. D. Bowen general manager of the company, which is located at 561 California Street, San Francisco.

C. E. Loss, the contractor, has taken the grading of 67 miles of the roadbed, the remaining 14 miles having been constructed by the company from Santa Cruz northward. He has twelve months in which to complete the contract, but the bridge work and track laying will be rushed, and the road placed in operation sooner if possible. The contractor will commence operations at Ocean View, which is the base point, about 6 miles south of Francisco, and work toward the freight terminals. One of these is at Army and Illinois Streets, and the other at Army Street and San Bruno, in the packing house district. As soon as the franchise is granted by the supervisors ground will be broken within the city, and the roadbed graded from freight terminals through the Pedro Valley toward Halfmoon Bay.

One branch of the road will be built across the west end of Golden Gate Park, paralleling the ocean beach, and thus securing

an entrance to the Richmond district. A car line through the park will be an innovation, but the Ocean Shore officials expect to secure the privilege without serious opposition. Several hotels and pleasure resorts will be constructed at points along the new scenic route, which keeps close to the ocean the greater part of the distance. It is the intention to despatch single cars from the terminals hourly. When travel is heavy, however, trains will be made up to suit the traffic.

KENTUCKY PROPERTIES SOLD

Official announcement is made that negotiations have been closed by which the ownership of the Lexington Street Railway Company's system, including the gas, the electric light plant, two ice factories and the street car system, is acquired by a syndicate of Philadelphians, at the head of which are J. Levering Jones and Chandler Brothers. In addition to the public utility companies of Lexington, the syndicate has purchased the Blue Grass Traction Company, owning the interurban lines from Lexington to Paris and to Georgetown, the Central Kentucky Traction Company, owning the interurban lines from Lexington to Versailles, and the Frankfort Power & Light Company. The amount involved in the purchase of the properties is $8,000,000.

MEETING OF CANADIAN STREET RAILWAY ASSOCIATION

At the last meeting of the Canadian Street Railway Association, held at St. John, N. B., Aug. 30 and 31, it was decided that the convention shall be held semi-annually in the future. The next meeting will be held in London, Ont. The papers which were considered at the meeting in St. John were as follows: "Street Railway Accounts," John M. Smith, comptroller, Toronto Street Railway Company; "Uniforms and Decorations Thereon and Their Effect Upon Street Railway Employees," D. McDonald, manager, Montreal Street Railway Company; "Mutual Benefit Association for Employees and the Best Methods to Aid and Assist Them," P. Dubee, secretary, Montreal Street Railway Company.

PITTSBURG RELIEF ASSOCIATIONS AT BANQUET

The feeling of good fellowship which exists between the Pittsburg Railway Company and its employees was demonstrated on the evening of Sept. 14, when an enjoyable social meeting of the various relief associations of the company was held at Duquesne Garden. S. L. Tone, vice-president; W. B. Carson, secretary; John Murphy, general superintendent; Clarence Burleigh, general trial attorney, and other officials of the company, together with the inspectors, despatchers, division superintendents and the officers of the relief associations, were present. In all more than 250 persons sat down to the elaborate dinner which opened the entertainment. During the dinner the guests were entertained with orchestral selections. Then came a vaudeville show by professional talent, during which a stereopticon was used to show photographs of men prominent in public life and of the officers of the company. The first picture was that of President Roosevelt, which served to introduce the following printed announcement: "But there are other presidents. This one has the 'delighted' smile for every employee, and the smile does not wear off." Then came the picture of President James D. Callery. Next came the announcement, "Fairbanks is all right, but we go Uncle Sam one better, having two vice-presidents. Reed this one." The picture of Vice-President James H. Reed was shown, followed by this announcement: "This one adds Tone to the business and the tone is a high one." Then there was presented a picture of Second Vice-President S. L. Tone. Next came the announcement, "The man at the controller," which preceded the likeness of General Superintendent John Murphy. Then came the picture of Superintendent of Transportation P. J. Callaghan, followed by the pictures of eleven division superintendents, as follows: M. J. Maxwell, John Day, J. S. Shedd, Chas. E. Long, F. R. Wilhelm, J. E. Caller, M. J. Loftis, C. C. King, William Mischler, J. M. Fleming, Thos. Harrington.

Following the photographic reproductions were a number of comedy moving pictures, beginning with "A good old 5-cent trolley ride." Street cars figured very prominently, also, in the other pictures which were presented to the accompaniment of ringing the gong, bell cord, register, etc. The meeting closed with short addresses on live topics by officials of the company and members of the relief associations. A. S. McSwigan, manager of amusements of the company, acted as stage manager, musical director and toastmaster.

CONSOLIDATION OF THE BOILER COMPANIES

A consolidation of great interest to the engineering world has just been consummated through the amalgamation of the water tube boiler business of the Aultman & Taylor Machine Company, of Mansfield, Ohio, and the Stirling Company, of Barberton, Ohio, as a result of which The Stirling-Cahall Boiler Company will be organized with a capital of $4,500,000.

The position of the new company will be unique in that it will be in a position to supply to the trade practically every type of water-tube boiler on the market, for in addition to manufacturing boilers of the Stirling and Cahall horizontal and vertical types, it is said it will shortly take up and place upon the market an improved water-tube boiler of the water-leg type. Its policy will be aggressive, and the same methods that have forged the Stirling and Aultman & Taylor companies to the front will be pursued by the new company.

Details in respect to the organization of the company have not, it is said, been worked out, but it may be safely assumed that the consolidation will be one of the organizations as well as of the plants.

An aggressive policy will be maintained in the export department through the foreign connections of the Stirling Company in its offices in Johannesburg, S. A. R.; Havana, Buenos Ayres, Yokohama, the Hawaiian Islands, etc., as well as through its stockholdings in the Stirling Boiler Company, Ltd., of Edinburgh, which is interested in the water-tube boiler business of Great Britain and the Continent.

The Stirling Company was organized in 1890, and in 1898 established its marine department, securing control of the United States patents on the Niclausse, Yarrow and Mosher boilers, and its growth has been little short of marvellous, since its sales in eight years have shown an increase of nearly 800 per cent. The history of The Cahall Sales Department of the Aultman & Taylor Machinery Company has been an equally honorable and creditable one, and the new company will start with enviable prestige and with every facility for both manufacturing and selling. The general offices will be at 111 Broadway, New York.

STREET RAILWAY PATENTS

[This department is conducted by Rosenbaum & Stockbridge, patent attorneys, 140 Nassau Street, New York.]

UNITED STATES PATENTS ISSUED SEPT. 12, 1905

799,085. Car Truck; Harry M. Pflager and Clarence H. Howard, St. Louis, Mo. App. filed June 21, 1905. The center plate through which the king-bolt extends is held by and adapted to be adjustable within a pocket in the top of the truck bolster. The center plate is removably fixed to the bolster.

799,110. Cover for Third Rails; William G. Taylor, Forest City, Pa. App. filed Dec. 3, 1904. An ordinary T-rail is supported by L-shaped standards in such a manner that contact is made with the under side of the rail, and a cover of non-conducting ceramic material encases the upper portion of the rail in such a way as to leave air passages between the tread and base thereof.

799,117. Car Brake; William S. Washburn, Brocton, Mass. App. filed Jan. 3, 1905. The brake is supported by a horizontally-arranged pivotally-mounted lever, the end of the lever from which the brake is supported being substantially in the plane of the movement of the brake as it is applied.

799,118. Car Brake; William S. Washburn, Brocton, Mass. App. filed Jan. 16, 1905. A brake-supporting lever having intermediate of its ends a bearing to rest on a car-axle box, the portions of the lever which come opposite the rim of the wheel when the lever is in place being offset laterally.

799,213. Trolley Catcher and Retriever; Charles F. Wilson, New York, N. Y. App. filed Jan. 24, 1905. A spring drum and ratchet arrangement for controlling the trolley cord.

799,264. Motor Suspension for Electric Motors; Edward D. Priest, Schenectady, N. Y. App. filed Feb. 11, 1905. Two motors hinged together and mounted upon opposite sides of the driving axle and provided with a common support upon the axle, one end of each motor being supported in the usual manner from the truck frame.

799,295. Bolster; Edwin H. Benners, Elizabeth, N. J. App. filed Nov. 28, 1903. Comprises a top plate, a narrower bottom plate and inclined side webs connecting them, the side webs being approximately straight from the top to the bottom plates.

799,315. Truck; Richard J. Edwards, Galena, Ill. App. filed Dec. 13, 1904. The truck bolster contains raceways for balls upon which the body bolster bears.

799,316. Car Truck; Richard J. Edwards, Galena, Ill. App. filed May 27, 1905. Consists in combination of a truck bolster and a body bolster, of blocks secured to the truck bolster, cap-blocks movable thereon, and springs between the cap-blocks and blocks, the said parts forming the side bearing for the body bolster.

799,330. Car Bolster; John Green, St. Louis, Mo. App. filed Jan. 29, 1904. Comprises top and bottom members and side members connecting the top and bottom members to form a substantially triangular cross-section.

799,419. Trolley; William S. Tichenor, Owensville, Ind. App. filed Feb. 4, 1905. The axle of the trolley wheel is mounted in roller bearings in the harp.

799,606. Car Truck; Gustav Lindenthal, New York, N. Y. App. filed Oct. 23, 1903. Spherical-ended rockers support the car body on opposite sides of the central pivot.

PERSONAL MENTION

MR. CALVIN ALLEN has become real estate and tax agent of the Indiana Union Traction Company in place of Mr. Horace Stilwell.

MR. E. B. DUTCHESS, formerly with the Fort Wayne & Wabash Valley Traction Company, has been appointed Peru superintendent of the company, to succeed Mr. Millard Bechtol, who has resigned.

MR. GEORGE C. MOREHOUSE, who on Aug. 10 resigned as secretary and assistant treasurer of the Rochester Railway Company, of Rochester, N. Y., has accepted the agency of New York State for the Rochester Waste Machine, which is manufactured by the Oil & Waste-Saving Machine Company, of Philadelphia. Mr. Morehouse will have his headquarters in Rochester.

MR. CHARLES E. A. CARR has resigned as general manager of the London Street Railway Company, of London, Ont. Mr. Carr has been with the company about ten years. Under his supervision the conversion of the lines to electricity was carried out. No one has yet been selected to succeed Mr. Carr. It is understood that Mr. Carr has accepted an important position in the United States, an announcement regarding which will soon be made.

MR. A. J. BLACK, chief engineer of the power station of the Indiana Union Traction Company, at Anderson, Ind., has resigned to take a position with the Chicago & Milwaukee Electric Railroad. Mr. Black will spend some time inspecting large plants recently erected, and will then take charge of the construction of a large, new power house which the Chicago & Milwaukee Electric Railway Company expects to build at some point on the lake shore north of Chicago.

MR. W. C. SPARKS, on Oct. 1, will become superintendent of roadway of the Indiana Union Traction Company, assuming part of the duties formerly performed by Mr. A. S. Richey, who recently resigned as chief engineer. Mr. Sparks has been in the track department of the Indiana Union Traction Company for a number of years, and has done much toward bringing the company's track up to the high state of perfection which now exists. He has recently been superintendent of construction.

MR. DANIEL ROYSE has resigned his position as editor of the "Street Railway Review," to take effect Oct. 14. Mr. Royse joined the "Review" staff in December, 1896, and since February, 1901, when he succeeded Mr. H. H. Windsor, has served as managing editor of the journals owned by the Kenfield Publishing Company, including for a time "Steam Engineering," as well as the "Street Railway Review" and "Brick." The publishers announce that Mr. Lawrence E. Gould, who for some time has been associate editor, will succeed Mr. Royse as editor of the "Review."

MR. F. A. HARRINGTON, of Albany, superintendent of the Mohawk division of the New York Central Railroad, and one of the best known railroad men in Central New York, has been elected by the combined New York Central interests in control of the Schenectady Railroad as the president of the Schenectady Railway to succeed Mr. Hinsdill Parsons, of the General Electric Company, who resigned a couple of months ago when the road passed from General Electric control. Mr. Harrington will continue to reside in Albany, it is stated, and will also continue his duties with the Central Company. New directors of the Schenectady Company were chosen recently, and the board is now constituted as follows: Mr. F. A. Harrington, Mr. Edward F. Peck, of Schenectady, general manager; Mr. A. J. Culver, vice-president of the Delaware & Hudson Company; Mr. John Carstensen, vice-president of the New York Central; Mr. Horace E. Andrews, of Cleveland, Ohio; Mr. T. B. Dixey, Mr. Axel Akstrom, Mr. George E. Emmons and Mr. W. T. B. Emmet. The last two directors are holdovers from the old directorate, representing the General Electric interests.

MR. G. H. KELSEY, formerly master mechanic and electrical engineer of the Western Ohio Railway Company, has resigned, to become superintendent of power for the Indiana Union Traction Company, with headquarters at Anderson, Ind. In this position he will have charge of the power houses and everything pertaining to electrical distribution. Electrical distribution on this system was formerly in charge of Mr. A. S. Richey, chief engineer, whose resignation to accept a professorship at Worcester Polytechnic School was recently announced. The steam end of the power plant was formerly in charge of Mr. A. J. Black, whose resignation is announced elsewhere.

MR. JOHN W. CHIPMAN, formerly secretary and general manager of the Indianapolis & Eastern Electric Railway, is dead. Mr. Chipman had not been well for more than a year, and at the time of his death was in New England, with a view to rest and a respite from the cares that had undermined his health. Mr. Chipman organized the company that constructed the Greenfield line, one of the first roads to enter Indianapolis. The line was subsequently extended to Dublin and New Castle under his supervision. Mr. Chipman retained connection with the road until its control passed to a syndicate a few months ago. He was vice-president of the Indiana Electric Railway Association, in the management of which he took an active interest, and was well known to electric railway interests throughout the entire West.

MR. W. G. CARLTON, of the Chicago Edison Company, has just been appointed superintendent of power of the electrical zone of the New York Central & Hudson River Railroad Company. In this capacity Mr. Carlton will have charge of the two main electric power stations which the company is building near New York, the eight sub-stations and the transmission system. He will report to the electrical department. Mr. Carlton has been associated with the Chicago Edison Company for the last twelve years, and is at present assistant to the chief operating engineer. He was born in Warren, Ill., Feb. 20, 1869, and is a graduate of Cornell University, of the class of 1892. After leaving Cornell he spent a year in taking the students' course with the General Electric Company, at Lynn, after which he entered the construction department of the Chicago Edison Company.

MR. WALTER H. WHITESIDE was elected president of the Allis-Chalmers Company, as announced in the last issue of this paper. This is an indication that there will be no change in the policy of the company, for Mr. Whiteside has been in full charge of the operations of the organization, with the title of vice-president and general manager, during the absence in Europe since April last of his predecessor in office. Mr. Whiteside joined the Allis-Chalmers interests in July, 1904, when he accepted the position of general manager of sales. He came at a time when the company, which had just taken over the Bullock Electric Manufacturing Company, needed the injection of a vigorous and energetic personality into its sales force. The task with which Mr. Whiteside was confronted was one which would have baffled a man with less determination, less energy and less force of character. Not only did he have to become familiar with all the intricacies of the company's varied products, but the new interests and the old had to be consolidated, and the sales organization had to be enlarged and its efficiency increased. With what success Mr. Whiteside has met in his efforts, the increase in the volume of the company's business and the crowded shops, and the reopening of the old south foundry at Milwaukee, testify. In taking up this higher and more responsible position, Mr. Whiteside has behind him not only the confidence of his organization, but a long and varied business experience, in which he has filled many executive positions. His achievements have won him recognition as a man of marked administrative ability. Mr. Whiteside is a member of the American Institute of Electrical Engineers, of the Engineers' and Lawyers' Clubs, of New York, of the Midday Club, Chicago, and of the Milwaukee Club.

W. H. WHITESIDE

E. C. FOSTER

JOHN I. BEGGS

RICHARD McCULLOCH

W. CARYL ELY

F. G. JONES

OFFICERS AND EXECUTIVE COMMITTEE AMERICAN STREET RAILWAY ASSOCIATION

C. G. GOODRICH

J. J. STANLEY

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T. C. PENINGTON

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F. R. HENRY

ISAAC McQUILKIN

J. W. LESTER

W. G. ROSS

P. S. YOUNG

ARTHUR L. LINN, JR.

OFFICERS AND EXECUTIVE COMMITTEE
STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA

G. B. WILCUTT

E. M. WHITE

F. E. SMITH

H. H. ADAMS

J. MILLAR

F. G. SIMMONS

C. F. BAKER

J. S. DOYLE

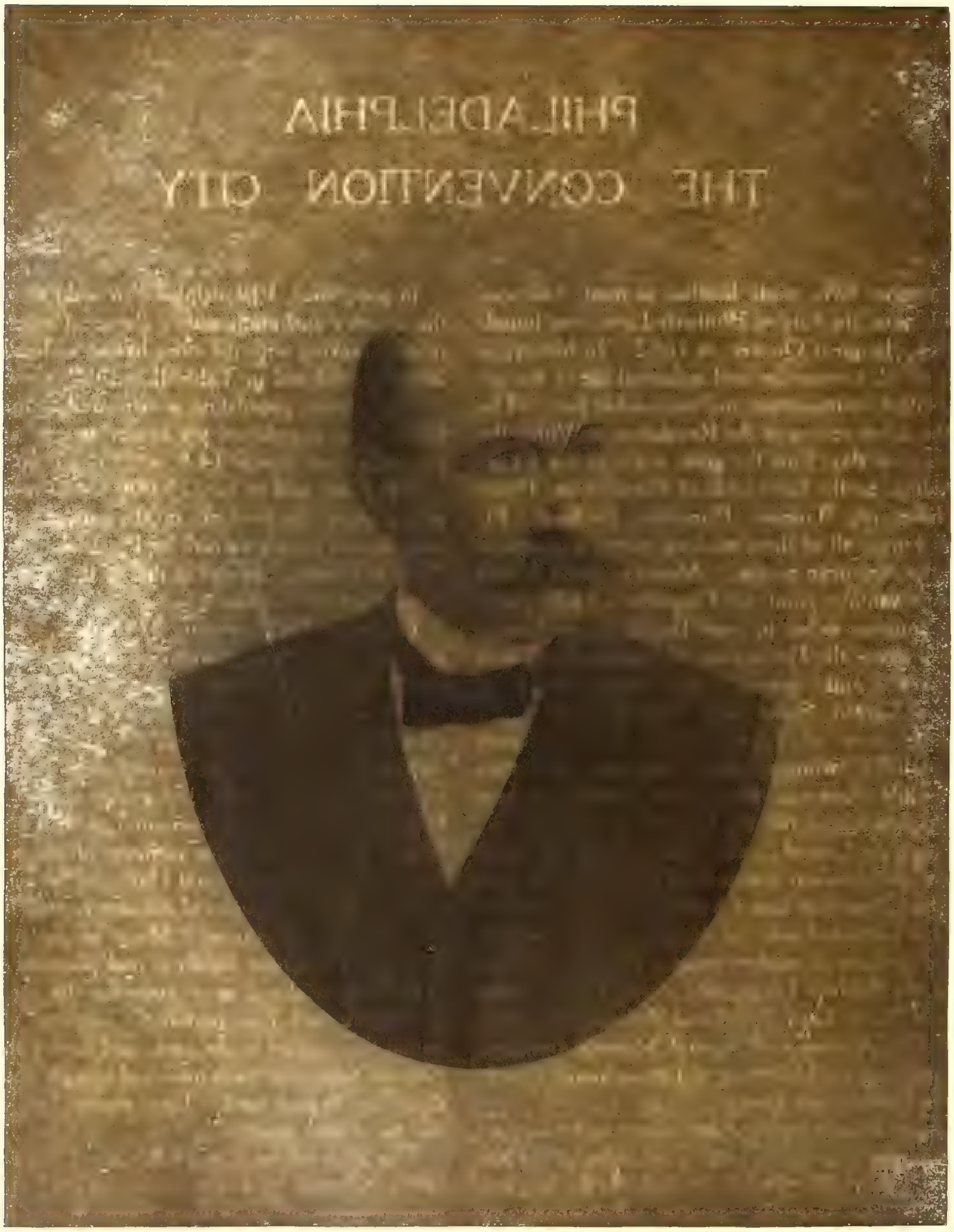
OFFICERS AND EXECUTIVE COMMITTEE AMERICAN RAILWAY MECHANICAL AND ELECTRICAL ASSOCIATION

W. H. McALONEY

D. F. CARVER

E. W. OLDS

S. W. MOWER



MR. JOHN B. PARSONS, President of the Philadelphia Rapid Transit Company, is a prominent figure in the electric railway interests of the country, and has established a high reputation, both as an organizer and as an operating manager. The present efficiency and high standing of the Philadelphia street railway system are due more to him than to any one individual. Mr. Parsons began his street railway career in Philadelphia in 1870, when he entered the service of the People's Passenger Railway Company as clerk. He was promoted rapidly and was elected president of the company in 1886. In 1887 he was called to Chicago to take charge of the West Chicago Street Railway Company. In January, 1897, he returned to Philadelphia to accept the position of vice-president and general manager of the Union Traction Company, and in October, 1898, was elected president of the company. Upon the organization of the Philadelphia Rapid Transit Company he was elected its president.

Street Railway Journal

PHILADELPHIA
THE CONVENTION CITY

As the school histories have made familiar to most American school boys, Philadelphia, the City of Brotherly Love, was founded by William Penn, the great Quaker, in 1682. In history, in science, and in the social, commercial and industrial life of the nation, the city has played an important and memorable part. The town was one of the storm centers of the Revolution. Within the range of vision on a clear day, from the great tower of the Philadelphia public building, lie the battlefields of Brandywine, Paoli, Germantown, Whitemarsh, Trenton, Princeton, Redbank, Ft. Mifflin and Valley Forge, all of them marking events momentous in the early life of the American people. Almost within a stone's throw from the same vantage point are Carpenter's Hall, where assembled the first congress called to resist British encroachment; Independence Hall, where the Declaration of Independence was drafted and signed, and where, after the war, the Constitution of the United States was framed, and which is now the resting place of Liberty Bell; Betsey Ross's house, where a humble woman sewed together the stars and stripes of the first American flag; Penn Cottage, where William Penn lived and transacted the business of the Colony; Congress Hall, where the United States Congress met for many years, and where Washington was inaugurated president. Within the confines of the city limits are found buildings and sites whose names are inseparably associated with the scientific, artistic, educational and industrial progress of modern times. Among these are Cramp's ship yards, the Baldwin Locomotive works, United States Mint, League Island Navy Yard, Frankford Arsenal, American Academy of Fine Arts, Academy of Natural Sciences, Commercial Museum, Girard College, University of Pennsylvania, Franklin Institute, and the Philadelphia Bourse.

The list of inventions, discoveries and institutions that have had their birth in Philadelphia is nearly as long as the string of the kite flown by the immortal Franklin. Philadelphia claims the first law school in America, the first American volunteer fire company, the first mint in the United States, the first medical school and the first college of pharmacy in America, the first paper mill, the first pianoforte ever manufactured, the mariners' quadrant, the first city waterworks, the first hospital, the first public library, the first experimental railroad track laid down in the United States, old Ironsides, the first locomotive erected in the new world, the first daguerreotype or photograph of a human face, the first English Bible published in America, the first daily newspaper, the first turnpike road, the first experiments for moving water vessels by steam, and of course, the first demonstration of the theory that lightning is electricity.

Impressive statistics concerning the modern city very easily can be quoted to the point of tiresomeness. The city limits now include an area of 129 square miles, and Philadelphia stands in point of area third among the cities of the United States, New York City having 326 square miles and Chicago 191 square miles.

In population, Philadelphia also ranks third among the cities of this country and ninth among the great cities of the world. Her relative ranking with the cities having upwards of a million population is exhibited in Table II. on the following page.

The present population is estimated at approximately 1,400,000. The population per square mile is about 10,000. The population per acre is 14.8

There are said to be 275,000 separate homes within the corporate limits, this tendency on the part of her citizens to have separate houses having earned for Philadelphia the appellation of the "City of Homes," as well as that of the "City of Brotherly Love," exemplified by its name.

Fairmount Park, covering 3341 acres, is the largest public park in America. Many portions of this great tract have been left in their original state, with wooded vales, hills, rocks and groves as nature made them. Other portions have been beautified by the art of the landscape gardener. The park is the site of the Zoological Garden, one of the most complete in America; Memorial Hall, erected during the year 1875 as one of the Centennial Exposition buildings, and left as a memorial of that great event; the Smith Memorial, erected to the memory of the soldiers and sailors of Pennsylvania; Horticultural Hall; the Sunken Gardens and many monuments and examples of statuary erected by the city or donated by philanthropic citizens. Many of the natural charms of the place, as well as the buildings and points of interest, have in late years been rendered more accessible by the electric lines of the Fairmount Park Transportation Company, which are laid wholly within the confines of the park, and during the summer season afford the only convenient means of moving about the great area included in the park tract. These electric lines are not operated during the winter months.

The Philadelphia City Hall, erected at a cost in excess of $24,000,000, with its tower measuring 547 ft. 11¼ in. from the ground to the tip of William Penn's hat at the apex, is, with the single exception of the House of Parliament in London, the largest public building in the world.

As a port of entry and sailings, both for passengers and merchandise, the city is exceeded in importance only by New York among the American cities. The value of the foreign maritime traffic aggregates over $50,000,000 per year. In ship and locomotive building, and in many special lines of industry, the city ranks first.

The Pennsylvania Railroad, Philadelphia & Reading Railroad and the Baltimore & Ohio Railroad, with their branch and leased lines, connect Philadelphia with all parts of the country. There are 1000 regular inward and outward bound passenger trains daily.

The city has over 20 miles of water front navigable by ocean steamers of the largest tonnage, and there are direct freight and passenger steamship lines to England, Belgium, Germany, the West Indies and many of the important ports of the United States.

ANALYSIS OF TRANSPORTATION CONDITIONS IN PHILADELPHIA

All of the older section, and the greater part of the present city of Philadelphia, are located on a long peninsula between the Delaware and Schuylkill Rivers. This peninsula is about 2 miles wide at Market Street, which is its narrowest point until just before the Schuylkill River flows into the Delaware River at League Island, some five miles below the City Hall. Practically all of the important shipping interests of the city are confined to the frontage on the Delaware River, which is kept open in winter from Philadelphia south by the passage of many ferry boats and other traffic, although it is frozen over for some distance down from Trenton. For a long time the Delaware River ferry boats furnished the only means of transportation from Philadelphia to the New Jersey shore, but within the last few years an extensive bridge has been built across the river just north of Philadelphia by the Pennsylvania Railroad. This bridge connects this company's main line with its Camden Atlantic Division, and thus furnishes an all-rail route from Philadelphia to its largest and nearest seashore resort—Atlantic City.

The Schuylkill River, which forms the western boundary of the old city, is navigable for only a short distance from its mouth, or to the Fairmount Park dam. Thence it extends north and west through Fairmount Park, past Manayunk, Norristown and Reading, to its source in the Blue Mountains. Crossing the Schuylkill at various points during its passage through the city of Philadelphia, are some eight or nine railroad and highway bridges, over which there is a constant stream of traffic. The latest of these bridges is that now being built by the Philadelphia Rapid Transit Company just north of the present Market Street Bridge, to carry two surface tracks and two elevated railway tracks. The Schuylkill River can be considered in no sense, therefore, as a barrier to the extension of the city westward. In fact, it has not so proved, and, while the city is growing north rapidly, it is developing west at an even more rapid rate, and one of the most important questions for the future will be the proper care of the traffic from west of the Schuylkill River into the business districts. That the Philadelphia Rapid Transit Company fully appreciates this situation is indicated by the construction first of the West Philadelphia section of its underground and elevated rapid transit system, and by the provisions which have already been made and are being continued to care for the rapid increase of population in this district.

North and northwest of Philadelphia are a great many most attractive suburban residential districts whose beauty is famous. Prominent among these suburban towns are Germantown, which lies within the city limits of Philadelphia; Ardmore, Bryn Mawr, Wayne and West Chester. Southwest of the city limits there is practically a continuous succession of residences and manufacturing establishments, extending along the river in a section a mile in width, to the Pennsylvania and Delaware State lines, 17 miles in a direct line from the Philadelphia City Hall and almost to the city of Wilmington.

Table I. gives the population of the city for the last four decades, and Table II., the populations of the thirteen largest cities of the world. From the latter it will be seen that Philadelphia is the third largest in this country, and ranks ninth among all of the world's largest marts.

TABLE I., SHOWING POPULATION OF PHILADELPHIA BY DECADES

Year	Population	Per Cent Increase
1870	647,022	...
1880	847,170	30.9
1890	1,046,964	23.6
1900	1,293,697	23.6
1906 (estimated)	1,400,000	8.1

TABLE II., GIVING POPULATION OF LARGEST CITIES OF THE WORLD

City	Population
London	4,536,541
New York	3,437,202
Paris	2,714,068
Berlin	1,888,848
Chicago	1,698,575
Vienna	1,674,957
Canton	1,600,000
Tokio, Japan	1,440,121
Philadelphia	1,293,697
St. Petersburg	1,267,023
Calcutta	1,125,400
Constantinople	1,125,000
Peking	1,000,000

TRAFFIC DISTRICTS

The business center of Philadelphia is confined practically to a section about 1½ miles square, extending from Fifteenth Street east to the Delaware River, and from Callowhill Street on the north to Walnut Street on the south. Fortunately for the city, the Pennsylvania and Reading Railroads, both of which do a large commuter business, extend to or into this district, and the New Jersey commuters from across the Delaware can be landed directly at its eastern border. Table III. shows the number of passengers arriving at and departing from these municipal railroad stations and those transported by the ferries during 1904. Comparatively little additional transportation in this district is required by the army of commuters who use the steam railroad and ferry lines in reaching their office work. Nevertheless, the vast majority of the working population of the lofty buildings which line the business streets of Philadelphia reside within the city itself, as in all large cities, and this class is entirely dependent upon the purely urban lines for transportation.

TABLE III., SHOWING NUMBER OF PASSENGERS ARRIVING AT AND DEPARTING FROM THE PRINCIPAL STEAM RAILROAD AND FERRY TERMINALS IN PHILADELPHIA DURING 1904

Railroads—	
Pennsylvania Railroad, Broad Street and West Philadelphia:	
Arriving	8,968,104
Departing	8,898,016
Philadelphia & Reading, Market Street Station:	
Arriving	8,108,986
Departing	7,617,361
Total of these two railroads	33,592,467
Ferries—	
Market Street, Philadelphia, and Federal Street, Camden.	16,272,563
Vine Street, Philadelphia, and Cooper's Point, Camden	1,283,354
Shackamaxon Street, Philadelphia, and Cooper's Point, Camden	510,514
Total ferries	18,066,431
Total of above railroads and ferries	51,658,898

The district in Philadelphia which has been defined as the business district, and which has been bounded, includes as well the financial district, which for the most part is located along Fourth, Fifth and Sixth Streets, between Market Street and Walnut Street; the theater and hotel district, which is centered on Market and Chestnut Streets, between Eighth and Fifteenth Streets, and also on South Broad Street, and a considerable portion of the manufacturing district, which clusters along the steam railroad tracks, extending between Callowhill and Green Streets. The other manufacturing districts of the city lie to the northeast, in Kensington and Richmond, along the Delaware River, and to the

AMERICA'S LIBERTY BELL

INDEPENDENCE HALL

THE PHILADELPHIA CITY HALL

BROAD STREET LOOKING NORTH, SHOWING SKYSCRAPER HOTELS AND OFFICE BUILDINGS ON EITHER SIDE AND CITY HALL IN DISTANCE

PANORAMA OF PHILADELPHIA, TAKEN FROM COMMONWEALTH BUILDING, AT TWELFTH AND CHESTNUT STREETS, SHOWING 80 DEGREES OF THE HORIZON

THE SKYLINE OF PHILADELPHIA FROM THE CAMDEN WATER FRONT

BIRD'S-EYE VIEW OF PHILADELPHIA AND PART OF FAIRMOUNT PARK, TAKEN FROM A BALLOON ONE MILE HIGH

THE NEW GIRARD AVENUE BRIDGE OVER THE SCHUYLKILL RIVER INTO FAIRMOUNT PARK

southwest of the city, along or near the Schuylkill. The finest residence district of the city is on North Broad Street and neighboring streets, near Spring Garden, although many of the older aristocratic families reside along the western part of Chestnut, Walnut and parallel streets south of Market Street. Chestnut Street and Market Street, from Eighth to Fifteenth Street, are recognized as the leading thoroughfares for the largest retail stores, while Eighth Street appeals more to those shoppers who are seeking bargains.

CONDITIONS WHICH AFFECT TRANSPORTATION

Topographically, Philadelphia possesses certain advantages, as well as disadvantages, from a transportation standpoint. One of the principal points in its favor is that the city is located on what is practically a plain or plateau, which rises from the Delaware River by a slight acclivity. With the exception of the Schuylkill River, which, as has already been described, is hardly an obstacle, there are then no natural barriers or grades westward until beyond a distance of some 5 miles from the City Hall. The sharpest grades are along the Schuylkill River in the neighborhood of Fairmount Park, and further on in the direction of Manayunk, but hardly any portions of the city proper are at an elevation of greater than 100 ft. above tide water.

A second advantage which Philadelphia possesses from a transportation standpoint is that a very large proportion of the residents live in separate houses. In fact, the city as stated is familiarly known as the "City of Homes," and many of these houses, especially those at some distance from the center of the city, have some ground around them. This makes the city one of magnificent distances, so that transportation is a necessity.

Another consideration favorable to surface transportation is that the streets are laid out on the rectangular system. Practically the only exceptions are Ridge and Germantown Avenues, which extend diagonally northwest across part of the northern end of the city, and Passyunk Avenue, which extends diagonally southwest across a part of the southern end of the city. Most streets running north and south are numbered, and those extending east and west are named. The blocks are nearly square, but not entirely so, as the north and south streets average about eight to the mile, and the east and west streets ten to the mile. Unfortunately, this spacing has been found to be too great, and the result is that between a great many of the main streets intermediate streets, or alleys, have been constructed. This fact accounts for most of the named north and south streets, which do not add anything to the attractive appearance of the city. The original designers of the city were equally unfortunate in the width which they selected for the streets. They provided, it is true, two broad thoroughfares—one, Broad Street, extending north and south for a distance of 10 miles, and the other, Market Street, which runs east and west for 6 miles, and intersects Broad Street at the square on which the City Hall is located. Each of these streets is about 70 ft. wide from curb to curb. Most of the other streets, however, and in fact practically all those in the older section of the city, are only 26 ft. from curb to curb, and 50 ft. from building line to building line. In fact, 90 per cent of the streets in Philadelphia are limited to this width.

This consideration compelled the construction, which is almost universal in Philadelphia, of a single track to each street, with the cars running down one street and back on a parallel street. In constructing a loop route of this kind, adjoining streets are not always used. Early in the history of street railroading in Philadelphia, the different lines were operated by different companies, and, as the franchises were sought, the most desirable two unoccupied streets within the same neighborhood were selected. As the public became familiar with these combinations of the streets, the routes have been largely retained, so that one line, for instance, runs south on Fourth Street and north on Eighth Street; another line, south on Seventh Street and north on Ninth Street; another, south on Fifteenth Street and north on Thirteenth Street, etc. The combinations of east and west lines are largely the same character, although somewhat more complicated, but all routes have, of course, been modified to a considerable extent since all the companies came under one organization In addition to its north, south, east and west lines, the Philadelphia Rapid Transit Company has a third system of lines, known as the "L" lines, and which run on routes that are a combination of both directions.

TABLE IV.—SHOWING TRAFFIC AT BUSY TRACK INTERSECTIONS

Crossing	Market St. and 8th St.		Chestnut St. and Fourth St.			Ridge Ave., Spring Garden and Twelfth St.		
Kind of crossing	Two tracks crossing one track		One track crossing one track			Triangular crossing—2 tracks crossing 2 tracks and 1 track		
Width of Streets between Curbs	Market St. 68 ft. Eighth St. 26 ft.		Chestnut St. 26 ft. Fourth St. 26 ft.			Ridge Ave. 34 ft. Spring Garden St. 88 ft. Twelfth St. 26 ft.		
Day Selected	July 8, 1905		July 8, 1905			July 8, 1905.		
Busiest Hour Selected	5 P. M. to 6 P. M.		5 P. M. to 6 P. M.			5 P. M. to 6 P. M.		
TRAFFIC.	Headway in Seconds.	Number of Cars in Hour.	TRAFFIC.	Headway in Seconds	Number of Cars in Hour.	TRAFFIC.	Headway in Seconds.	Number of Cars in Hour.
E. bound on Market St.	28	126	E. bound on Chestnut St.	34	106	N. bound on Ridge Ave.	90	40
W. bound on Market St.	21	166	S. bound on Fourth St.	36	99	S. bound on Ridge Ave.	90	40
						S. bound on Twelfth St.	120	30
Total E. and W. bound	12	292	Grand Total at Intersection	17	205	Total N. and S. bound	....	110
N. bound on Eighth St.	36	99				E. bound on Spring Garden St.	180	20
						W. bound on Spring Garden St.	90	40
Grand Total at Intersection	9	391				Total E. and W. bound	....	60
						Grand Total at Intersection	21	170

THE CONGESTION PROBLEM

This system of single tracks on narrow streets, which has just been described, results in two very serious obstacles to satisfactory street railway operation. In the first place, it greatly multiplies the special work and street crossings. This will be realized from the fact that there are over 1100 street railway crossings on the Philadelphia Rapid Transit system, in addition to 400 surface steam railroad crossings. Another unfortunate, but necessary, consequence entailed by this arrangement of narrow streets is the congestion at the street corners. At intervals of about every 600 ft. through the center of the district every east and west line has to cross a north and south line, and between 5 and 6 o'clock in the evening, when these crossings are crowded with delivery wagons, drays, automobiles and other vehicles, it would require more than the traditional skill of a London "bobby" to keep all of the traffic moving. Flagmen are located at some of the most congested corners, and the skill with which these men pass the cars over the intersecting tracks is remarkable, and could have been acquired only through long years of experience. Some figures showing the actual number of cars passing particularly busy corners are presented in Table IV.

This table has been prepared to represent three characteristic types of crossings as existing in Philadelphia, viz.: (1)

a single track crossing a double track, which is typical of all of the crossings on Market Street; (2) a single track crossing a single track, which is the kind of crossing by far the most prevalent in Philadelphia; (3) a triangular crossing, of which there are only a few in the city. The figures given in this table are in no sense the maximum number of cars which have been passed during an hour at these respective crossings, but were compiled during the preparation of this article as indicative of the rush-hour traffic during an average summer day in Philadelphia.

As the cars pass out into the suburbs, the congestion grows less, so that there is a striking difference between the speeds within and outside the congested area. This is clearly brought out in Table V., which has been prepared from the schedules of the five or six principal east and west and north and south lines. As will be seen, there is a difference in running time, which varies from 2 to 4 miles per hour.

The congested conditions at certain crossings in Philadelphia are probably no worse than those in certain other large cities.

TABLE V.—SHOWING SCHEDULE RUNNING TIMES WITHIN CONGESTED DISTRICT AND FOR ENTIRE RUN WITH AVERAGE SPEEDS PER HOUR

NORTH AND SOUTH LINES.	TOTAL RUN.		RUN IN CONGESTED PORTION OF CITY.			SPEED IN MILES PER HOUR	
	Length of Run, Miles.	Time of Run, Minutes.	LIMITS TAKEN.	Length of Run, Miles.	Time of Run, Minutes.	In Congested Portion.	Outside Congested Portion.
Second and Third Sts.	18.42	141		3.83	37	6.21	8.41
Fourth and Eighth Sts.	26.54	162		3.83	37	6.21	10.90
Fifth and Sixth Sts.	19.24	139	South St. on South, and Girard Ave. on North	3.83	36	6.38	8.98
Tenth and Eleventh Sts.	11.63	89		3.83	32	7.18	8.21
Twelfth and Sixteenth Sts.	16.75	114		3.83	32	7.18	9.44
EAST AND WEST LINES.							
Market St.	13.42	99		4.26	41	6.23	9.45
Chestnut and Walnut Sts.	12.72	90		4.26	40	6.39	10.15
Spruce and Pine Sts.	15.35	104	Delaware River on East, and Schuylkill River on West	4.26	37	6.91	9.93
Lombard and South Sts.	11.15	82		4.26	34	7.52	8.61
Arch St.	14.65	96		4.26	37	6.91	10.56
Lancaster Ave.	12.50	95		4.26	41	6.23	9.16

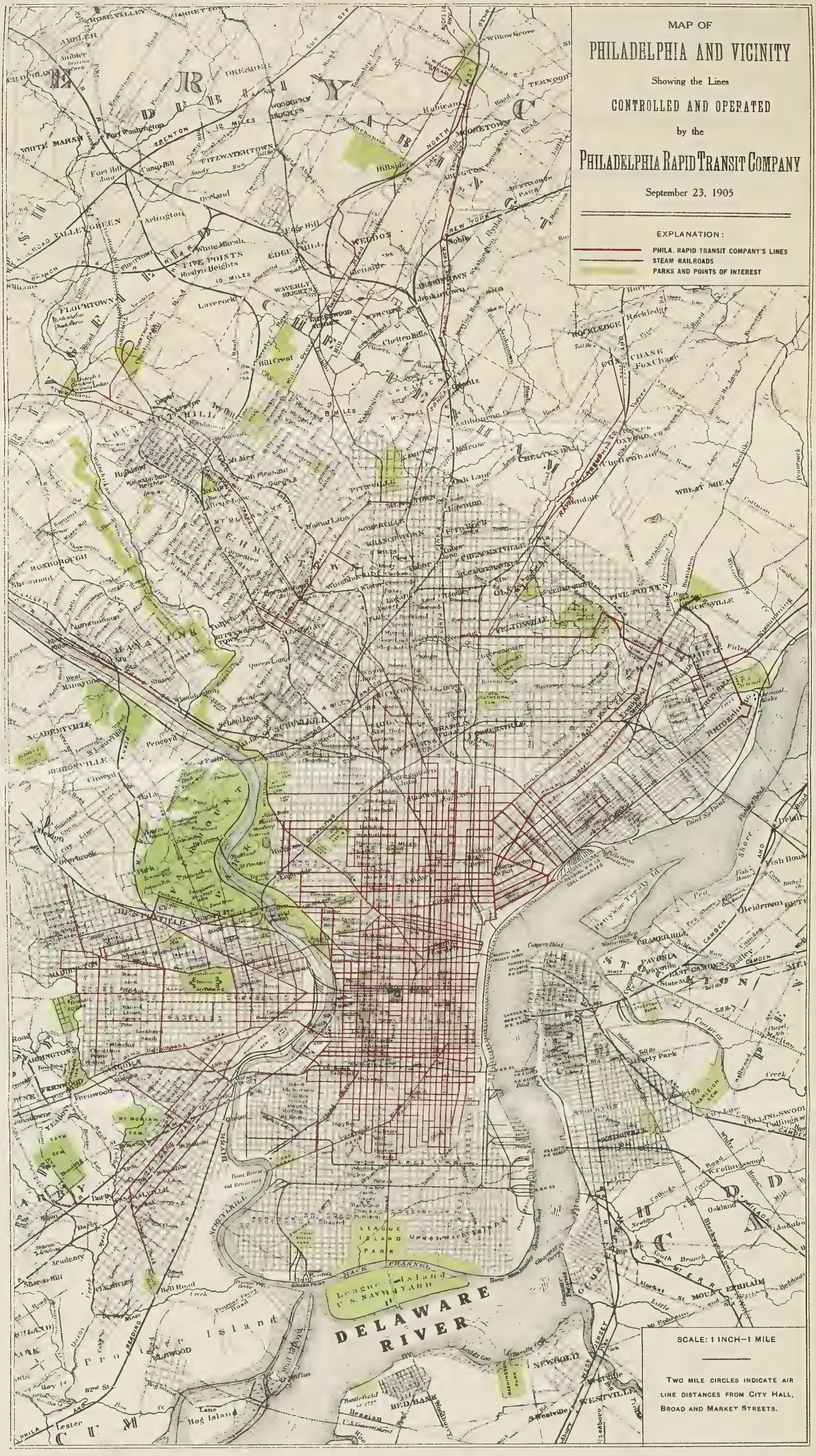
There is the difference, however, that whereas in New York, Boston, Chicago, Brooklyn and other cities where this trouble is encountered there is severe congestion at certain points on the system, the condition in Philadelphia is much more prevalent and occurs at a large number of places all over the central part of the city. If it was not for the early completion of the subway and elevated systems, the condition would be a serious one, and would undoubtedly militate against the industrial progress of the city. Reducing the delay to dollars and cents, we find that approximately nine-tenths of the business population of Philadelphia, through this condition, is obliged to waste an extra quarter or half hour each day in going to and returning from business. If we capitalize this time according to the salaries paid or money value of the time of the passengers, the aggregate amounts to an enormous sum. While the subway will relieve the situation somewhat, the subject is clearly one which, in the minds of a disinterested outsider, should receive the serious attention of the city authorities. The only relief available is the regulation of other traffic, because the streets cannot be made wider and the cars are carrying all the people they can. In Philadelphia, as in New York up to within recently, the street car possesses no greater privileges on the public highway than any other vehicle, and the progress of cars, not only during the rush hours, but at all times of the day, is seriously delayed by the disregard which drivers of drays and other vehicles for the transportation of bulky material pay to the rapid progress of the car. It is no uncommon sight, especially on the streets nearest the river, like Second and Third Streets, to see a car held up for five minutes or longer while the driver of a coal or brewery wagon takes his time to get off the track or deliver his load in a leisurely manner. The adoption and vigorous enforcement of "rules of the road," somewhat similar to those now in force in New York, but even more strict in their application, seem one of the most essential requirements in Philadelphia.

One other source of relief ought to be suggested, although its adoption would run counter to the Philadelphia traditions. The founders of the city, who made the mistake of establishing too narrow a width for practically all the streets in Philadelphia, did adopt the wise provision of laying out the two broad thoroughfares, Market Street and Broad Street, which cross the city north and south and east and west, as already explained, and with a commendable forethought of possible future expansion and the need of good means of access between all parts of the city, provided that these streets should extend through what is still practically the closely inhabited portion. Market Street has been used for commercial purposes, and has possessed car tracks almost since the introduction of street cars in Philadelphia, but Broad Street, the only other highway in Philadelphia which deserves the name of avenue, has been guarded against encroachment with a jealousy comparable only to that which has been adopted with Fifth Avenue in New York, the Thames Embankment in London and the Unter den Linden in Berlin. The comparison with New York is not fair, however, because Fifth Avenue is paralleled at intervals of less than 800 ft. by ten other avenues of equal width, upon which car tracks are

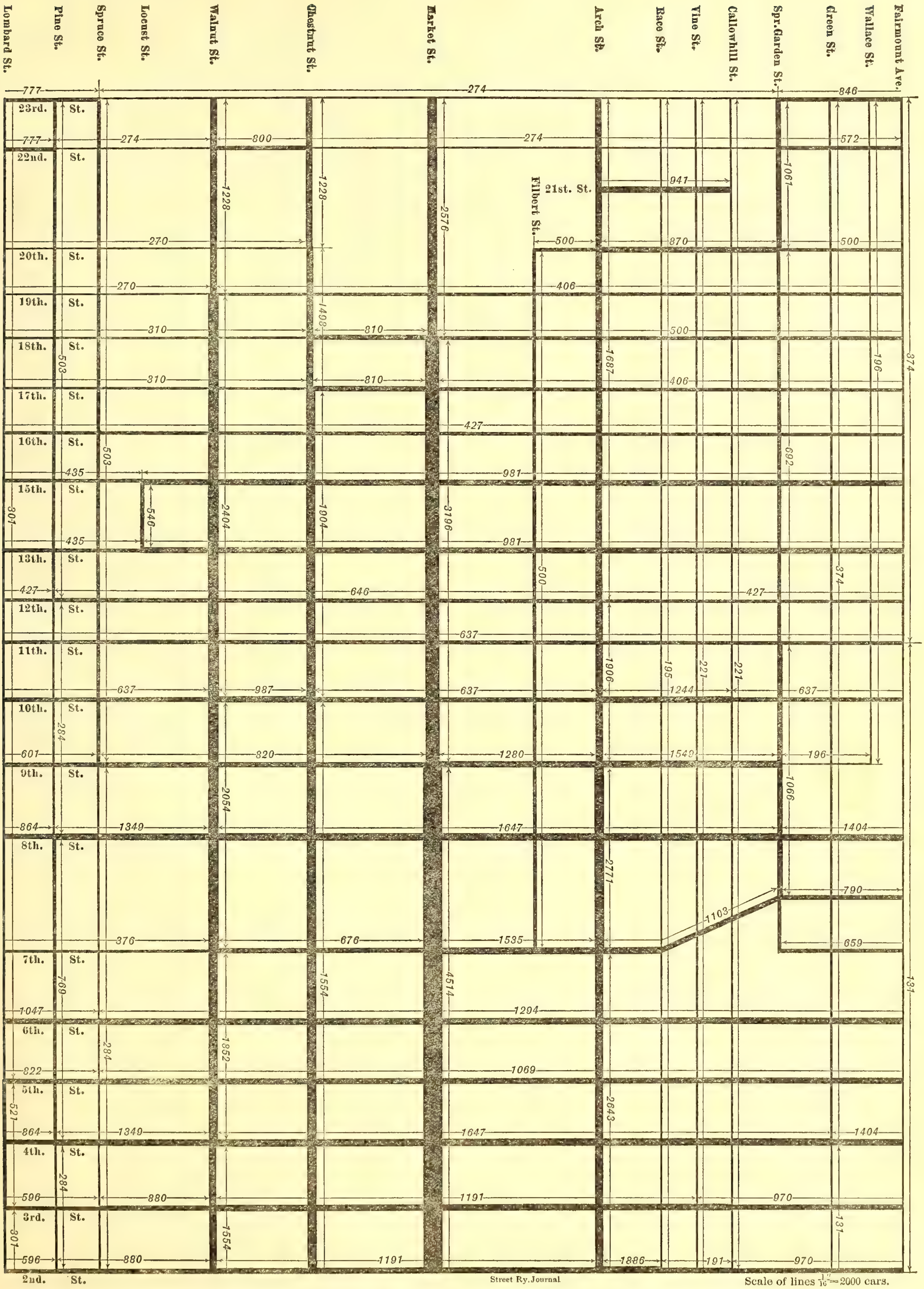
TABLE VI.—SHOWING CAR MILES AND PASSENGERS CARRIED ON SIX PRINCIPAL NORTH AND SOUTH AND EAST AND WEST LINES AND "L" LINES FOR YEAR ENDING JUNE 30, 1905.

	Car Miles.	Passengers Carried.
Six Principal North and South Lines:		
Second and Third, Frankford	1,506,791	8,960,541
Fourth and Eighth, Chestnut Hill	2,463,191	14,100,559
Fifth and Sixth, via Berks St	1,445,343	8,713,289
Tenth and Eleventh	1,556,385	10,900,304
Twelfth and Sixteenth	1,633,904	14,079,492
Thirteenth and Fifteenth, Erie Ave	1,423,054	10,578,841
Six Principal East and West Lines:		
Market, Sixty-third and Vine Sts	1,336,808	10,609,188
Market St., Haddington	1,379,522	9,043,323
Market St., Lancaster Ave	1,479,835	10,220,726
Chestnut St., Darby	1,706,632	9,857,402
Lombard and South Sts	1,198,712	6,938,778
Girard Ave., Sixty-third St	1,667,553	10,798,369
Six Principal "L" Lines:		
Columbia Ave	1,479,130	10,617,015
Seventeenth and Nineteenth Sts	1,504,651	11,614,385
Seventeenth and Eighteenth Sts	767,948	8,059,284
Nineteenth and Twentieth Sts	657,953	6,104,879
Berks and Montgomery Sts	825,737	6,206,960
McKean St., Seventh and Ninth Sts	1,494,624	8,726,899
Total of all North and South Lines	28,500,420	165,537,343
Total of all East and West Lines	27,108,938	148,662,218
Total of all "L" Lines	14,134,412	88,694,684
Grand Total of all Lines	69,743,770	402,894,245

built. In Berlin the situation is largely the same as in New York, and the avenue itself is short and its equipment with tracks would not appreciably relieve the traffic situation, while the Thames Embankment will undoubtedly be equipped within a few years. This must ultimately be the course adopted in Philadelphia, as the actual cost to the city and to its residents of devoting the only available and satisfactory street for north and south travel to lumbering stages and to the automobiles and other carriages of the wealthy is enormous. When this is done and the surface transportation in Philadelphia is supplemented by a subway extending under the entire, or the greater part of, both Market and Broad Streets, the traffic situation will be greatly relieved.



Prepared and Engraved for The Street Railway Journal, by J. L. Smith, Philadelphia



SCHEMATIC DIAGRAM, SHOWING BY WIDTH OF LINE THE TRAFFIC ON THE PRINCIPAL DOWNTOWN LINES IN PHILADELPHIA

TRENDS OF TRAVEL

The map on page 477 is a schematic diagram of the central part of the city, showing the extent of travel in terms of the total number of cars during twenty-four hours, for an average day during last July. For convenience in comparison, this map is not drawn to linear scale, but the width of the lines showing each street is drawn to the scale of 1-16 in. to 2000 cars per twenty-four hours. The actual number of cars on each section of track is also indicated by figures.

This map clearly brings out the congestion on certain lines and corners already described, and will, it is thought, help to elucidate the problem which has already been discussed. The method will also, it is thought, find some use in parallel cases in other cities. As will be seen, the Eighth Street line is the heaviest north and south line, although in passengers carried it is nearly equaled by the Twelfth and Sixteenth Street line. The Market Street line, which is double track, is the heaviest east and west line.

Table VI. shows the amount of traffic on the six principal lines of each kind, as well as the total on each kind. It will be seen that there is a slightly larger traffic north and south than east and west. The preponderance of the north and south travel is north of Market Street, and of the east and west travel is west of Eighth Street. The east and west travel east of Eighth Street is principally on the lines extending to and from the Market Street ferries running to Camden, and is consequently upon the Walnut Street, Chestnut Street, Market Street and Arch Street lines. The two last are double-track lines.

Table VII. gives the monthly variation in passengers and car mileage for the different classes of lines in Philadelphia. It will be seen the traffic is heaviest in summer, both as regards passengers and car-miles. The column giving passengers per car-mile shows that the highest figures are attained in the late fall and spring months, viz., in October, November and December, and in April, May and June. The reason for this is that during the summer, while more passengers are carried, they ride longer distances, while the ratio during the winter months is undoubtedly explainable by the inclement weather.

TABLE VII.—SHOWING VARIATIONS BY MONTHS OF THE DIFFERENT CLASSES OF LINES FOR THE YEAR ENDING JUNE 30, 1905.

MONTHS.	NORTH AND SOUTH LINES.		EAST AND WEST LINES.		"L" LINES.		ALL LINES.		
	Passengers.	Car Miles.	Passengers.	Car Miles.	Passengers.	Car Miles.	Passengers.	Car Miles.	Passengers Per Car Mile.
July	14,754,182	2,748,844	12,813,000	2,364,924	7,113,270	1,192,851	34,680,452	6,306,619	5.5
August	14,554,511	2,722,476	12,593,680	2,354,041	7,068,877	1,194,789	34,217,068	6,271,306	5.4
September	13,924,771	2,350,924	12,418,468	2,227,312	7,242,937	1,163,908	33,586,176	5,742,144	5.8
October	14,004,208	2,278,381	12,816,015	2,243,659	7,641,619	1,186,102	34,461,842	5,708,142	6.0
November	13,176,297	2,186,124	12,045,725	2,170,693	7,379,319	1,144,232	32,601,341	5,483,049	5.9
December	13.310,489	2,213,568	12,166,831	2,224,642	7,805,727	1,191,002	33,283,047	5,629,212	5.9
January	12,359,363	2,195,287	11,287,441	2,209,322	7,019,878	1,167,334	30,666,682	5,571,943	5.5
February	10,874,736	1,975,407	10,002,473	2,011,184	6,227,461	1,055,571	27,104,670	5,042,162	5.3
March	13,097,509	2,240,157	12,002,543	2,287,698	7,421,969	1,203,904	32,522,021	5,628,735	5.7
April	13,718.751	2,212,616	12,753,000	2,255,020	7,547,647	1,161,099	34,019,398	5,731,759	6.0
May	15,523,629	2,523,462	14,120,923	2,417,370	8,132,172	1,239,347	37,776,724	6,180,179	6.1
June	16,238,897	2,853,174	13,642,119	2,343,073	8,092,808	1,234,273	37,973,824	6,430,520	5.9
	165,537,343	28,500,420	148,662,218	27,108,938	88,693,684	14,134,412	402,893,245	69,725,770	

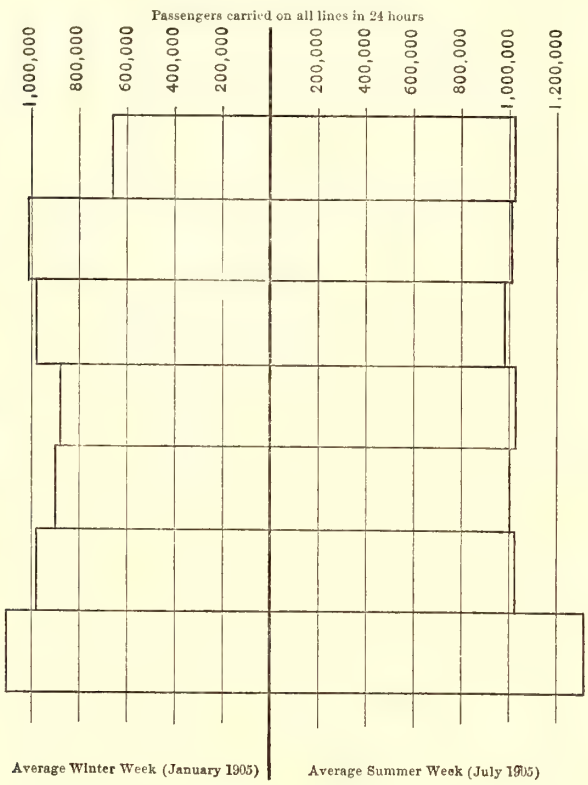


DIAGRAM SHOWING BY DAYS PASSENGERS CARRIED ON ALL LINES DURING AN AVERAGE WEEK IN WINTER AND IN SUMMER

TABLE VIII.—SHOWING THE VARIATION IN PASSENGERS CARRIED FOR AN AVERAGE WINTER WEEK AND AVERAGE SUMMER WEEK, ALL LINES.

	Passengers Carried (Winter Week) January, 1905.	Passengers Carried (Summer Week) July, 1905.
Sunday	667,018	1,092,767
Monday	1,017,024	1,077,112
Tuesday	983,323	986,376
Wednesday	884,658	1,081,882
Thursday	917,730	1,013,753
Friday	969,365	1,048,570
Saturday	1,103,777	1,335,376

Table VIII. gives the daily variation of passengers carried by all lines for an average winter week and an average summer week. It will be seen that the day of least travel in winter is Sunday, and in summer is Tuesday. The heavy traffic on Sunday in summer is an indication, of course, of the amount of excursion or pleasure traffic which occurs on that day. In both weeks a large traffic is indicated on Saturdays and Mondays, with Saturday showing the highest figure. The latter fact is partly accounted for by the fact that Saturday is a half-holiday in many offices, banks and business offices, especially in summer, and many persons use this period for excursions. The larger traffic figures of both days is also largely attributable to the fact that most wage-earners receive their pay on Friday night or on Saturday, and this makes it possible for their families to do their purchasing either on Saturday or the following Monday. The other variations have no great significance, and are undoubtedly due to the weather or other local conditions which influence passenger travel. A greater aggregate of travel is shown in summer than in winter. This is due entirely to the pleasure travel, as the lines which cater to business and shopping travel, like the Twelfth Street and Sixteenth Street line, show a decrease during the summer months on account of the absence from the city of a large number of business men and their families.

HISTORY, ORGANIZATION AND FINANCIAL CHARACTERISTICS OF THE PHILADELPHIA RAPID TRANSIT COMPANY

To begin at the beginning of transportation matters in Philadelphia, it is necessary to trace back to the period from 1792 to 1814, during which time there were built several turnpike toll roads from Philadelphia to outlying towns. A number of the franchises of these old turnpike companies were afterward utilized for the construction of street railway lines. In 1830, the area of Philadelphia, which had not been enlarged since the grant of the original charter by Penn, embraced about two square miles and contained a population of about 80,000. As the place grew in size, the citizens demanded quick, regular and cheap conveyance from the business centers to the outskirts of the city. This demand was felt and recognized as early as 1831, and in that year the first regular horse omnibus line was established and made hourly trips from Schuylkill, Seventh and Chestnut Streets down Chestnut Street to the Merchants' Coffee House in Second Street. The line was known as "Boxall's Accommodation," but it was not a paying venture and its life was short. The next attempt was the inauguration of a regular omnibus line in 1833, which accommodated travel between the navy yard and Kensington by way of Second Street and Beach Street; this line flourished. New omnibuses were added and other routes were established, and in a short time a regular omnibus service was running on all the principal streets. The fares at first were 10 and 12½ cents, but these were soon reduced to 6 and, in some cases, to 5, 4 and 3 cents, where competition was keen. For 23 years these vehicles were the only regular means of local travel.

The first horse railway operating vehicles over a permanent track was introduced in 1858 by the Philadelphia & Delaware River Railroad, which was first incorporated to build a steam road from Kensington to Easton. Failing to carry out their plans for constructing a steam railroad, the promoters conceived the idea of utilizing the Philadelphia end of their project as a horse railway, in accordance with the experiments with horse traction which had already been successfully carried out on the New York & Harlem Railroad in the city of New York. Under new charter rights, the road was extended to Frankford (now an important section of the city of Philadelphia), and in 1861 the title of the company was changed to the Frankford & Southwark City Passenger Railway Company. The first lines were laid in Fifth and Sixth Streets and to Frankford. The first horse car ran Jan. 21, 1858.

The success of this project led almost immediately to the establishment of similar passenger railways on other streets, and in 1858 and 1859 some fifteen or twenty companies were organized and built tracks. Cars began running on Market Street to Eighth Street in July, 1858; on Tenth and Eleventh Streets on July 29, on Race and Vine Streets on Sept. 28, and on Spruce and Pine Streets on Dec. 4 of the same year.

The entrance of so many independent street railway companies into the comparatively restricted area of the city, as then constituted, almost immediately developed a strenuous and disastrous competition for business, and at the outset it became evident to the promoters of the various enterprises that the life, to say nothing of the financial profit, of all the companies required some kind of a working agreement or alliance if any of the companies was to retain its existence. This recognition of the futility of useless competition, as early as 1859, resulted in a call, which was issued by James Verree, president of the Second and Third Street Passenger Railway Company, inviting the presidents of all the other companies to meet at his office for the purpose of considering matters of interest pertaining to passenger railways. This meeting resulted in the formation of a Board of Presidents of street passenger railway companies, in which ten separate companies were represented at the outset, but which gradually included the presidents of most of the other companies. This alliance was in effect a working agreement as to rates of fares, transfers and other details of operation. The board remained in active existence until the formation of the Union Traction Company, in 1895, when the policy of unity which it had been created to maintain was perpetuated by actual merger of the various corporations.

During the early period of horse railway operation, the fare was 5 cents for any distance over the lines of the respective companies. After a number of the crosstown roads had been built, a system of exchange tickets was devised by which passengers might be transferred from the lines of one company to those of another. At first the rate for an exchange ticket was 7 cents, but about the time the Civil War broke out, in consequence of the high price of horse feed, the single fare was increased to 7 cents and the charge for exchange tickets to 9 cents. At a later period the single fare was reduced to 6 cents. In a later year the present system of straight 5-cent fares and a charge of 8 cents, or 3 cents extra, for an exchange ticket, was inaugurated.

The institution of free transfers on any of the lines was made on Jan. 1, 1880, at which time the Union Passenger Railway Company consolidated several of the independent roads and established a system of free transfers over all of the branch routes included in the united system. At that time the longest ride was about 5 miles. The transfers were printed in different colors, one color for each day for eight days, so that the same color did not come on the same day of the week for 56 days. The transfers were not bound in pads, but the conductors carried them loose in their pockets and there was about 40 per cent of waste. The pad system was started ten years ago, in July, 1895. Some of the earlier forms of transfers and exchange tickets are reproduced on the next page as a matter of historic interest.

The following table shows the results of operation for all of the companies and gives an idea of the street railway situation in the city up to the year 1890.

TABLE IX.—STATEMENT OF MILEAGE, PASSENGERS CARRIED AND GROSS EARNINGS OF ALL STREET RAILWAY COMPANIES IN PHILADELPHIA FOR SEVERAL YEARS.

Year.	Miles of Track	Passengers Carried.	Gross Receipts.
1870	205	59,020,618	$3,662,066
1875	311	87,205,387	5,615,885
1880	359	99,045,515	5,251,375
1885	381	117,171,681	6,524,740
1890	403	164,458,842	7,869,659

SUNDAY CARS

The development of transportation matters in Philadelphia was marked by a number of incidents which in the light of present day ideas seem rather humorous. For instance, for a number of years the street cars were not run on Sundays. Efforts made by one of the companies to run Sunday cars resulted in a lawsuit, and not until 1867, when the Supreme Court handed down a decision to the effect that the running of a railway car on Sunday was not a breach of the peace, were street cars operated on every day in the week.

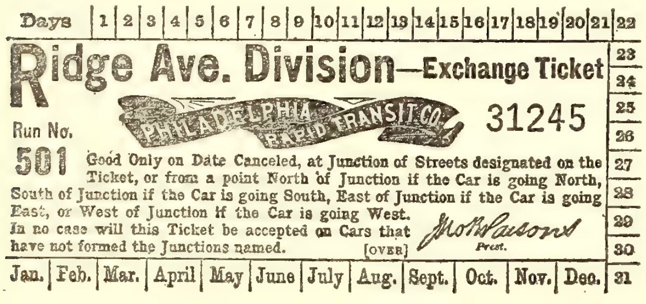
THE RACE QUESTION

While the contention over the question of Sunday cars was going on, another issue appeared that aroused new discussions. This was the question of the admission of negroes to the same cars occu-

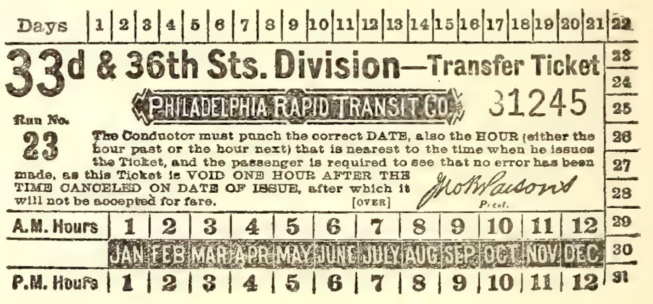
pied by white people. As Philadelphia was virtually a Southern city, the race question was a lively one, and from the first colored people were denied the privilege of riding in the cars. After the Civil War, however, the sentiment in this regard began to change, and in 1867 an act was passed by the Legislature admitting colored people to the street cars on equal terms with their white neighbors.

INTRODUCTION OF MECHANICAL TRACTION

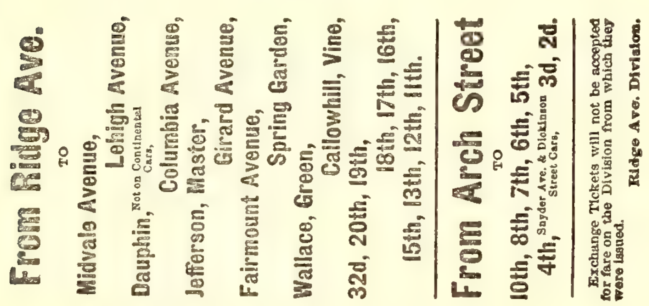
Up to the year 1885 all of the passenger railways in the city were operated with horse traction. The growth of the city and the increase in traffic soon brought about an imperative demand for better means of propulsion, and all of the companies began to give serious attention to several forms of mechanical traction which were then just beginning to be discussed. About this period a number of cable roads had been laid down in different cities and the cable seemed to promise the best solution of the transportation problem in large cities. The first company to change from horses was the Philadelphia Traction Company, and in 1885 a cable line was laid down on Market Street. The first installation was rather crude, the roadbed being laid with 40-lb. tram rail. The following year the cable system was extended to several other lines, although it was not generally adopted throughout the city. In 1890 three or four of the companies made thorough experiments with various forms of storage battery cars, which were then receiving considerable attention in New York and other large cities, but no permanent results were secured from this form of traction. By 1891 and 1892 electrical operation with the overhead trolley had been demonstrated as feasible and economical in several cities, and the companies in Philadelphia soon recognized that this was the coming system for passenger railways. In 1892 the Philadelphia Traction Company equipped one of its lines with electricty, and the results were so successful that all of the companies began to substitute electricity for horses, and by the end of the last decade practically all of the lines had been changed over.



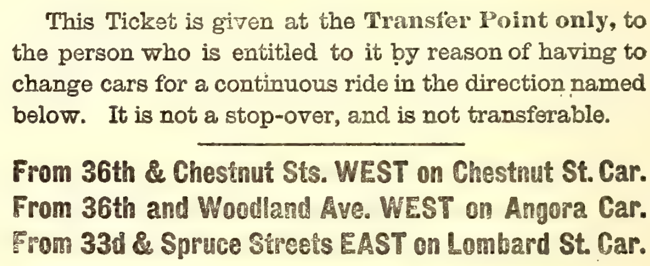
FACE OF SAMPLE EXCHANGE TICKET USED IN PHILADELPHIA



FACE OF SAMPLE TRANSFER TICKET USED IN PHILADELPHIA



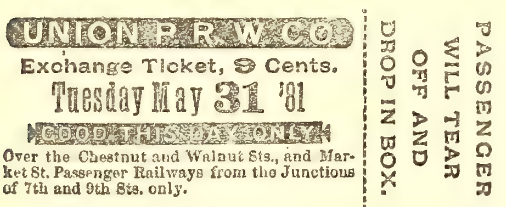
REVERSE SIDE OF EXCHANGE TICKET



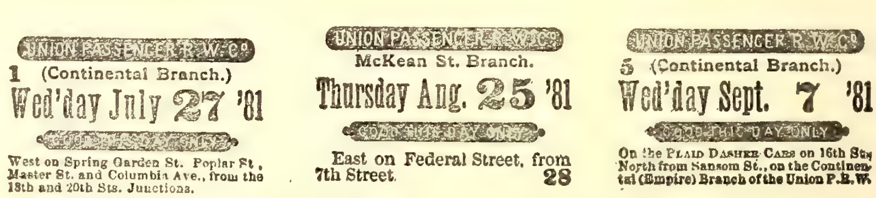
REVERSE SIDE OF TRANSFER TICKET

THE STRIKE OF 1895

The close of the year 1895 was marked by an unfortunate conflict between the company and its employees, brought about ostensibly by failure to agree on questions of hours of work and pay. However, the real point at issue was the question as to whether or not the company should be permitted to assume the full responsibility of operating its lines without dictation from outside agitators. Failing to secure recognition of their organization, the men inaugurated a general strike on the morning of Dec. 17. The company repeatedly agreed to meet a committee of the employees, as such, and adjust all differences, but firmly adhered to its original refusal to treat with outside organizations. On the morning of the strike, a few cars were run under police protection, but by night-fall the company decided to call in its cars in order to avoid rioting. On the following morning more cars were placed in service, and by the third day the company was able to assume its schedules with some degree of regularity. Late on Friday night the strike was declared off, but it was renewed again on Saturday, when the company refused to reinstate some of the leaders in the strike movement. For three days more the people of Philadelphia were required to suffer the inconveniences of disordered schedules and were kept in constant apprehension of violence. At the end of this period, however, the company and its men came to an agreement on the matter of hours and pay and, although attempts were made by some of the discredited leaders to renew the strike, within a short time the situation quieted down to normal conditions.



SAMPLE OF EXCHANGE TICKET IN USE IN PHILADELPHIA TWENTY-FIVE YEARS AGO



SAMPLES OF TRANSFER TICKETS IN USE TWENTY-FIVE YEARS AGO

CONSOLIDATIONS AND FAMILY TREE

In the meantime, the work of merging the various independent companies into larger systems was going on and, as will be noticed from the "Family Tree" accompanying this article, the number of companies gradually decreased, until the street railways of Philadelphia and the suburbs were controlled by practically four great systems, the People's Traction, the Electric Traction, the Philadelphia Traction and the Hestonville, Mantua & Fairmount Passenger. In 1895-6 the first three of these controlling companies were merged into the Union Traction Company, and in 1898 the fourth, known as the Hestonville system, was also absorbed, thus bringing all the properties under one management. The Philadelphia Rapid Transit Company was incorporated under the laws of Pennsylvania on May 1, 1902, and immediately acquired by lease all of the properties controlled by the Union Traction Company. Since that time the parent company has secured franchises for surface railways on certain streets not covered by the Union Traction system, and for elevated and underground railways on several principal streets of the city. The result of these consolidations gives the company complete control of the entire transportation systems of Philadelphia. In 1898 the Union Traction Company had in operation about 448 miles of track. Keeping pace with the growth of the city, new lines have been built and extensions made to existing lines, increasing the total trackage operated to about 545 miles at the present time.

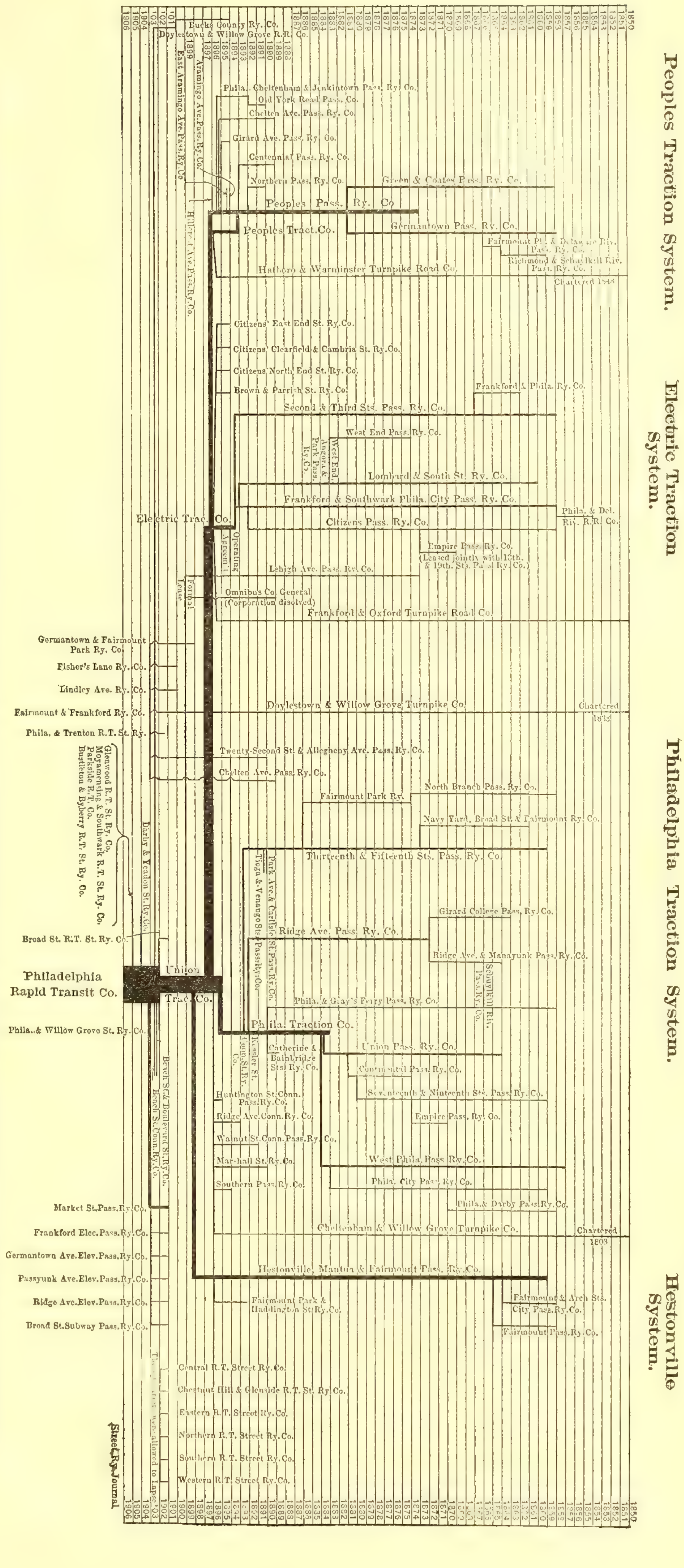
Practically all of the mergers of the underlying companies have been on the basis of long-time leases at guaranteed rentals on sliding scales. These leases were assumed by the Union Traction Company, and have since been assigned to the Philadelphia Rapid Transit Company.

The Philadelphia Rapid Transit Company has an authorized capital of $30,000,000, divided into shares of $50 par value. Prior to 1905, $15 per share had been paid in. On Jan. 20, 1905, a call of $5 a share was made, and last August an additional payment of $5 per share was due. The company has no funded debt of its own, but has assumed the leases and payment of interest on the underlying securities of the Union Traction Company and of the subsidiary companies.

EXCHANGE TICKETS AND TRANSFERS

The system of selling exchange tickets is a distinguishing feature of street railway transportation in Philadelphia, and is a concession made to the riding public of the city and suburbs as a result of the consolidation of the various independent lines under one management. Before the final merger, a passenger wishing to go from one portion of the city to another frequently had

FAMILY TREE OF PHILADELPHIA RAPID TRANSIT COMPANY, SHOWING DATES OF INCORPORATION AND DATES OF MERGERS OF ALL UNDERLYING COMPANIES



to pay two, or sometimes three, 5-cent fares to reach his destination. Several years before the actual consolidation, a number of the independent operating companies, by joint agreement, issued what were known as "exchange tickets" between connecting lines, for a charge of 3 cents in addition to the 5-cent fare, giving a continuous ride for 8 cents. When the present management took over the various independent properties many of the routes were rearranged, enabling passengers from virtually every part of Philadelphia to reach the downtown districts for a single 5-cent fare. If a passenger wishes to pass through the central portion of the city and continue his ride in another direction, the system is arranged so that he may do so by paying 3 cents additional and taking an exchange ticket. The exchanges are printed in two colors, a light green for the east and west lines, and yellow for the north and south lines. The tickets are bound in pads of 100, and are issued by the conductors upon the payment of the fare. The tickets bear a double number, one indicating the run number of the conductor issuing the same, and the other the consecutive serial number for the particular run. At present there are four series of run numbers in use, corresponding to the old divisions prior to the last consolidation. When the conductor issues an exchange ticket he punches the day and month of issue, but tickets are accepted for passage at any time without regard to the time limit.

When the conductor sells an exchange ticket he registers one fare on the cash-fare register, and all exchange tickets collected are also rung up on the same register. At the end of the day's work, therefore, the conductor must turn in 5-cent cash fares or exchange tickets collected to the total amount of the register indication. He must also turn in an additional amount of cash equivalent to 3 cents for each exchange ticket sold. As before stated, the exchange tickets are numbered consecutively and the conductor is charged with the number of tickets delivered to him, when he commences his day's work. The difference between the number delivered and the number returned at the end of the day gives the total number to be accounted for.

Inasmuch as the exchange tickets are good until used, it is possible for the regular patrons of the street cars to secure transportation at an average cost of 4 cents for each ride, providing they care to take the trouble of buying an 8-cent exchange whenever they pay their fare. As a matter of fact, a considerable number of the regular riders make it a practice to buy these tickets whether they intend to use them immediately or not, and it is a frequent sight to see passengers when asked for fare produce a number of old exchanges and sort out the right one for the particular line on which they may be riding. To many managers this fact that patrons of the road can secure two separate and distinct rides for 8 cents may seem undesirable. The system has one good feature, however, which would not be possessed in a system of selling straight ride tickets for 4 cents each. This feature, and it is a very important one, is that in practice the 4-cent fare is available only to those persons who patronize the lines frequently and regularly, and this is the class that should be most favored by a street railway company if any distinction is made. The stranger

TABLE X.—SHOWING PASSENGERS CARRIED, POPULATION AND RIDES PER CAPITA IN PHILADELPHIA.

YEAR.	Passengers Carried.	Population.	Rides Per Capita.
1865	25,013,398	*600,000	41
1870	59,020,618	†674,022	87
1875	87,205,387	*750,000	116
1880	99,045,515	†874,170	113
1885	117,171,681	*950,000	123
1890	164,458,842	†1,046,964	157
1897	228,102,758	*1,220,000	187
1898	238,939,353	*1,244,348	192
1899	259,527,668	*1,269,021	204
1900	292,237,924	†1,293,697	226
1901	302,225,286	*1,318,330	229
1902	325,801,963	*1,343,003	240
1903	365,908,051	*1,367,676	268
1904	390,532,689	*1,392,349	288

* Estimated. † U. S. Census. ‡ Police Census.

in the city, as well as those who ride only occasionally and those to whom the reduction of one cent is no object, pay the 5-cent fare. The system is conducive to short-distance riding, as a person will very frequently ride on a car if he happens to have an exchange ticket good on that line, whereas if he had to pay a 5-cent cash fare he would be more inclined to walk.

In addition to the exchange tickets, the company has in force an extensive system of free transfers which has been carefully worked out, with the end in view of enabling suburban residents to reach the city for a single 5-cent fare. The transfer tickets are printed in red in order that they may be readily distinguished from the exchange tickets. The conductors do not register the transfers collected. The free transfer privilege has also been extended to certain lines on which the cars turn off at right angles to the general direction of travel, with the view of permitting passengers who wish to continue their ride in the same direction to do so without additional cost.

TABLE XI.—SHOWING GROSS INCOME AND OPERATING EXPENSES, ALL LINES.

YEAR.	Gross Income.	Operating Expenses.	Ratio of Operating Expenses to Gross Income.
1896	$10,759,705	$5,707,435	.53
1897	10,907,451	5,260,583	.49
1898	11,236,437	4,619,375	.41
1899	12,036,266	4,793,366	.39
1900	13,249,819	5,624,898	.42
1901	13,431,680	5,836,185	.43
1902	14,118,158	6,402,338	.45
1903	15,436,573	7,234,893	.47
1904	16,096,363	7,993,315	.49

At the present time there are 68 different forms of exchange tickets and 70 different forms of transfers in use. The general design of the face and back of exchange tickets and transfers will be understood from the engravings on page 480. It will be noticed that on the back of each ticket is printed the names of the lines on which it will be accepted.

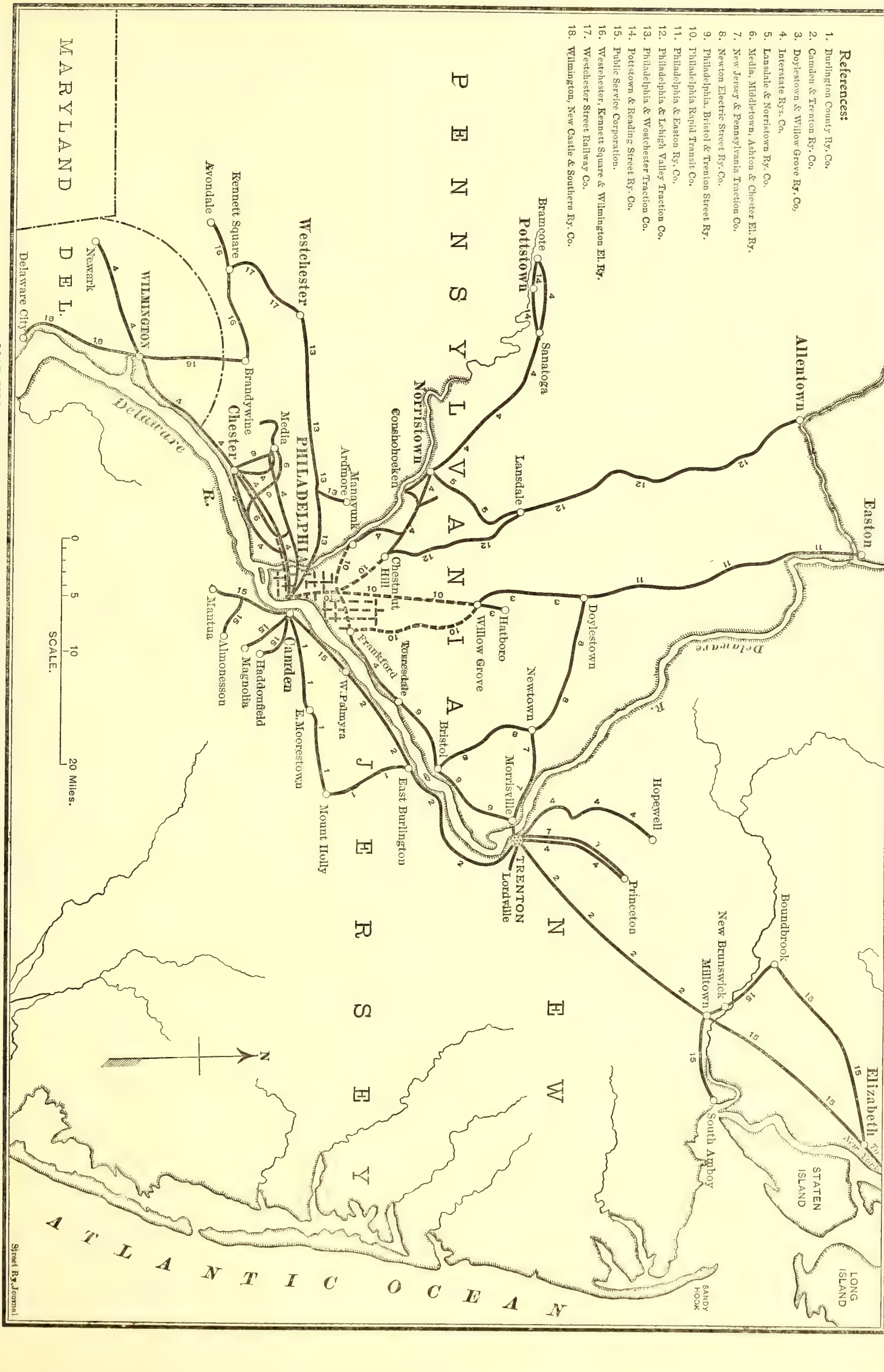
The relative proportion of number of exchanges, free transfers and cash fares will be understood from the following extract from the company's report for the year ending June 30, 1905:

Cash fares	143,798,644
Five-cent tickets	1,024,737
Number of transfers issued	31,699,934
Number of exchanges sold	111,717,048
Number of exchanges received	111,105,956
Frees	3,576,926
Total passengers carried	402,893,245

CONDITION OF EMPLOYEES

In the matter of generous consideration of the welfare of the men in its employ, the Philadelphia Rapid Transit Company is taking a broad and eminently fair attitude. Under the system of schedules as described elsewhere in this issue, no man is required to work in excess of eleven hours, and practically all of the regular employees are able to perform their day's work in approximately ten hours. The pay is in excess of $2 per day, and even the men on the extra list, by reason of the arrangement of schedules adopted, are able to make a good living wage, and for the majority of the extra runs the pay is the same as that of the regular men. The company has the welfare of its men sincerely at heart, believing that aside from philanthropic considerations, the interests of the company and its employees are identical, and the management is constantly working toward the end of creating a spirit of harmony and mutual good will between the corporation and its employees.

In view of this attitude, it is interesting to contrast the condition of the men at the present time and the situation as it was in the horse-car days. For instance, in 1885 the average pay for drivers was 12 cents an hour and the average time worked, accord-



MAP SHOWING ALL INTERURBAN ELECTRIC RAILWAYS RUNNING OUT OF PHILADELPHIA

ing to Bulletin 57 of the Bureau of Labor, was 15 hours, 11 minutes and 17 seconds. Of a total of 912 men, fifty worked 12 hours or less than 13, fifty worked 13 hours or less than 14, 155 worked 14 hours or less than 15, 372 worked fifteen hours or less than 16, 235 worked 16 hours or less than 17, and fifteen worked 17 hours or less than 18. Although these hours seem excessive, the day's work was no longer than in neighboring cities, as at the same time the average time of the drivers in Pittsburg was 15 hours, 41 minutes and 24 seconds. On the whole, the conductors worked slightly longer than the drivers in both cities, but the stable men a somewhat shorter time. To-day the average pay in Philadelphia is 20 cents an hour for both conductors and motormen and the day is 10 hours.

TAXES

Under the franchise and ordinance conditions now in force the company is paying to the city and State, in the form of taxes and paving charges, over 11 per cent of its gross receipts; and in this matter of taxes, it would appear that the company is doing its full duty to the municipality and Commonwealth.

In the form of direct taxation, the company pays to the city an annual car license of $50 for each car that it operates, and also an additional license fee of $50 on all cars that cross the various bridges over the Schuylkill River. As most of the routes cross one or another of these bridges, the company is paying into the city treasury $100 per car per annum on practically its entire rolling stock equipment.

The company also pays for many of the underlying companies a tax of 6 per cent on all dividends in excess of 6 per cent paid by these companies during the year. There is also a real estate tax of approximately $1.50 for each $100 of valuation on power houses, car houses and other properties owned by the company.

To the State the company pays a tax of 8 mills on the gross receipts of the entire property, a tax of 5 mills on the appraised value of its capital stock, and a tax of 4 mills on the par value of all loans and bond issues of all the underlying companies.

In addition to all these tax obligations, which last year amounted to $1,060,897, the franchises under which the roads are being operated require that the company must pave the entire surface from curb to curb on all streets upon which it has tracks. This includes not only laying the pavement, but maintaining it in good condition and renewing it when it is worn out. In case the company desires to renew its roadbed on any street or change the position of the rails, under these franchise conditions it is required to relay the entire paving, amounting in most cases to repaving the whole street, so far as the surface is concerned. The amount of pavement thus maintained by the company aggregates 6,685,000 square yards, of which about 4,300,000 square yards are belgian block, 1,500,000 square yards are asphalt, and the balance macadam, brick and cobble. In the company's books the expense of taking care of paving is charged to maintenance of way and not to taxes.

If to these charges are added the indirect taxes, such as the removal of snow and ice and the free transportation of firemen, policemen, and city officials, it would appear that the company is the largest single taxpayer in the county.

TABLE XII.—PERCENTAGE DISTRIBUTION OF GROSS RECEIPTS.

	Philadelphia.	New York.	Brooklyn.	St. Louis.	Boston.	Pittsburg.	Baltimore.	Minneapolis.	Average of United States
Year ending	June 30, '04.	June 30, '04.	June 30, '04.	Dec. 31, '04.	Sept. 30, '04.	Mar. 31, '05.	Dec. 31, '04.	Dec. 31, '04.	June 30, '02.
Operating expenses	49.66	55.38	58.39	52.76	69.40	54.06	52.77	50.22	57.3
Taxes	6.59	5.42	4.98	4.88	7.44	4.07	41.18	21.03	5.3
Interest and miscellaneous deductions	42.38	45.58	27.40	24.52	16.49	45.13			26.6
Net income	1.37	......	9.23	17.84	6.67	......	6.05	28.75	10.8
TOTAL	100.	106.38	100.	100.	100.	103.26	100.	100.	100.

TABLE XIII.—OPERATING EXPENSES IN CENTS PER CAR MILE.

	Philadelphia.	New York.	Brooklyn.	Boston.	Pittsburg.	Baltimore.	Minneapolis.
Maintenance of Way and Structures	1.47	1.17	1.08	1.72	1.83	1.83	1.40
Maintenance of Equipment	1.14	2.00	2.16	1.70	1.81	1.50	2.08
Operation of Power Plant	1.19	1.45	2.63	1.95	8.47	2.24	2.77
Operation of Cars	5.85	9.23	6.65	9.37		4.66	6.20
General	1.72	3.70	2.53	3.12	2.22	2.07	3.00
TOTAL	11.38	17.55	15.05	17.86	14.34	12.30	15.46

PASSENGERS CARRIED AND RIDES PER CAPITA

Table X. shows the passengers carried, population of Philadelphia and rides per capita for all lines for five-year intervals from 1865 to 1890, and also for 1897 to 1904 by years. The early figures in this table for population were derived from a pamphlet recently issued by Chandler Brothers, bankers, of Philadelphia. The population for the even decades were obtained from the Census Reports. Those marked "estimated" were obtained by interpolation between the census figures. The diagram on page 485 corresponds to table X., and shows by years since 1897 the total receipts, number of passengers carried per day and rides per capita. As will be seen, the average yearly increase in receipts during the last seven years has been 7.6 per cent.

TABLE XIV.—PERCENTAGE DISTRIBUTION OF OPERATING EXPENSES.

	Philadelphia.	New York.	Brooklyn.	Boston.	Pittsburg.	Baltimore.	Minneapolis.	Buffalo.	*Seventeen Largest Companies
Maintenance of way and structures	12.97	6.67	7.16	9.61	12.79	14.89	9.08	8.25	8.1
Maintenance of equipment	10.01	11.42	14.32	9.53	12.65	12.22	13.48	8.89	12.8
Operation of power plant	10.42	8.23	17.50	10.94	59.09	18.19	17.92	15.46	12.7
Operation of cars	51.45	52.56	44.19	52.42		37.90	40.11	47.11	47.3
General	15.11	21.10	16.80	17.48	15.48	16.80	19.42	20.29	19.1
TOTAL	100.	100.	100.	100.	100.	100.	100.	100.	100.

* For June 30, 1902.

GROSS RECEIPTS

Table XI. gives the report of gross receipts and operating expenses for all the Philadelphia lines. An analysis of the percentage distribution of gross receipts among operating expenses, taxes, interest and net income for Philadelphia, and as practiced in the seven other largest properties in the country from which such

STATUE OF BENJAMIN FRANKLIN IN FRONT OF POST OFFICE

CHESTNUT STREET, ABOVE NINTH STREET—THE BROADWAY OF PHILADELPHIA

Plate VI

PENNSYLVANIA RAILROAD BROAD STREET STATION, BROAD AND MARKET STREETS OPPOSITE CITY HALL

PHILADELPHIA & READING TERMINAL ON MARKET STREET

BROAD STREET LOOKING SOUTH FROM CITY HALL

THE LOOP AT FOOT OF MARKET STREET, NEAR ENTRANCE TO CAMDEN FERRIES

CORNER OF EIGHTH AND MARKET STREETS, LOOKING NORTH ON EIGHTH STREET—ONE OF THE CITY'S BUSY INTERSECTIONS

figures are obtainable, is presented in Table XII. The figures for New York and Brooklyn represent the operation of the New York City Railway Company and of the Brooklyn Heights Railroad Company, as reported to the Railroad Commissioners, and not of all the lines in the respective territories. The final column in this table presents the average for all the companies in the United States not doing a lighting business.

The examination of this table reveals immediately two very interesting facts. The first is that Philadelphia is the only city among those selected in which an operating ratio of less than 50 per cent obtains, and that it has an operating ratio of 7.6 points less than the average rate in the United States. This of itself is a distinction of which any company might be proud, coupled as it is with the fact that the ratio has been less than 50 per cent ever since 1897, or for eight years. Such a fact immediately stamps the Philadelphia Rapid Transit Company as a corporation whose methods are worthy of the most careful study, and which, in the opinion of the editors of this paper, justifies the devotion of an entire issue of the STREET RAILWAY JOURNAL to a consideration of its methods and policies.

Another striking feature of the report is the fact that the fixed charges of the Philadelphia Rapid Transit Company, including taxes, amount to practically 49 per cent of its gross receipts. When the Union Traction Company, the predecessor of the Philadelphia Rapid Transit Company, was organized it assumed

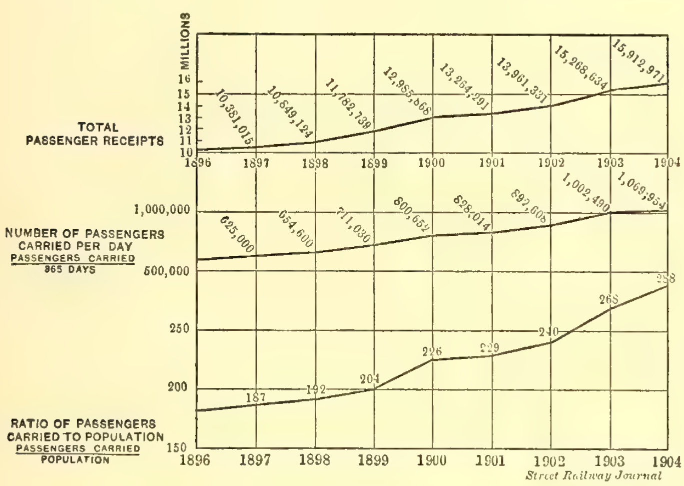


DIAGRAM SHOWING RECEIPTS, PASSENGERS CARRIED AND RIDES PER CAPITA FOR LAST EIGHT YEARS, ALL LINES

such a very large amount of obligations than many predictions were made that the company would never be able to carry them out. Moreover, a number of the underlying companies were leased on a sliding scale, so far as guaranteed dividends were concerned, which still further emphasized the gloomy prognostications of those who took an unfavorable view of the company's financial future. Many of the same forecasts were repeated in 1903, when the lease of the Union Traction Company to the Philadelphia Rapid Transit Company went into effect, especially as the dividend guaranteed on the Union Traction stock increased on a gradually-increasing amount, commencing with $1.50 per share in 1903, and ending with $3 in 1909, after which it continues at this figure. Nevertheless, the company has been able to earn a net income ever since its organization. The subsidiary companies, which were leased on a sliding scale, have all, with the exception of the Union Traction Company, now reached their maximum rental basis. The only additional charges on the system, outside of the Union Traction stock assumed by the new company, have been $1,480,000 on Union Traction collateral trust 4s; 500,000 on Doylestown & Willow Grove 4s, and $1,000,000 on Philadelphia & Willow Grove 4½s, making a total increased yearly fixed charge of $124,000. For this reason, with the increased traffic, it is fair to assume that the percentage of fixed charges in proportion to the income will gradually decrease.

ANALYSIS OF OPERATING EXPENSES

From a study of the percentage distribution of gross receipts, the first step is naturally a consideration of the distribution of the operating expenses among the five main divisions of expenses. This is shown in Table XIII. The fiscal years are the same as those stated in Table XII., and the same cities are included, with the exception of one in which this division is not made public. As cost of operation varies largely with the wages paid, and as the latter is dependent to a considerable extent on the cost of living in each city, it is difficult to make comparisons from Table XIII. as to the relative amounts chargeable to the different items of expenses. For this reason, Table XIII. should be studied in connection with Table XIV., which gives the percentage distribution of operating expenses. In Table XIV., the final column gives the average for the United States during the year ending June 30, 1902, of the seventeen largest companies in the country. These companies, referring to them by the names they then bore, are: The Boston Elevated Railway Company, Cleveland Electric Railway Company, Cleveland City Railway Company, Interurban Street Railway Company, of New York; Third Avenue Railroad Company, of New York; Brooklyn Rapid Transit Company, United Railways & Electric Company, of Baltimore; St. Louis Transit Company, United Traction Company, of Philadelphia; Chicago City Railway Company, Chicago Union Traction Company, International Railway Company, of Buffalo; Crosstown Street Railway Company, of Buffalo; Cincinnati Traction Company, United Railroads of San Francisco; Jersey City, Hoboken & Paterson Street Railway Company, and North Jersey Street Railway Company, of Jersey City. The aggregate operating expenses of these seventeen companies were $56,809,980, or about two-fifths of the total operating expenses of all the street railway companies in the United States. The selection of these large city companies as an average for comparison is also more desirable than the average of all of the roads in the United States, because they are all strictly urban systems. The fiscal years covered in these two tables are the same as for those given in Table XII.

The first feature which will strike the reader from a study of Table XIII is that the operating expenses in cents per car-mile is less in Philadelphia than in other cities. Carrying the study still farther, it will be seen that, compared with most of the other cities, the saving is in the last four items on the list, and not in maintenance of way and structures. This is due largely to the fact that the Philadelphia company has carried on for the last few years an extensive amount of track reconstruction, which has been charged into this first item, and also that its expenses for paving are charged to this account. The cost of operation of cars per car mile is lower than the same item in any other city except one. Comparing the items with that of the average of all large cities, as shown in Table XIV., the items for Philadelphia which are larger are maintenance of way and structures, and operation of cars. Those smaller are maintenance of equipment, operation of power plants and general. These later items are those which are most susceptible of reduction by very careful management. On the other hand, the cost of maintenance of way and structures depends largely upon the policy of the company in this respect, while that of operation of cars depends more upon the average wages in the district covered and in the speed of the cars than in any other two factors.

It would be most interesting to compare the cost of "operation of cars" in Philadelphia and other cities on the car-hour basis, as this is really the only proper unit to use in a final analysis. Unfortunately, very few of the companies in this country publish reports giving this figure, and the average for the United States or for any group of roads on the car-hour basis has not been worked out by the census authorities. The car-hour basis is employed by the Philadelphia Rapid Transit Company, however, and, in the year ending June 30, 1904, the company ran 9,193,971 car-hours. The passenger earnings per car-hour were $1.7368, and

the miscellaneous earnings per car-hour were $0.0153, making gross earnings per car-hour of $1.7521; the operating expenses per car-hour were $0.87. The detailed figures of operation of cars per car-hour in Philadelphia is given in Table XVI.

Table XV. presents a distribution of operating expense per car-

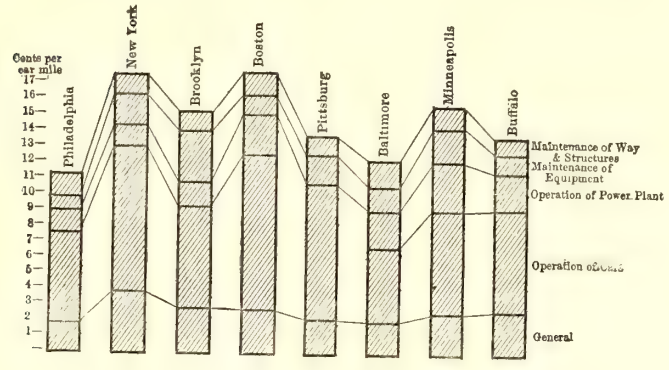


DIAGRAM SHOWING EXPENSES PER CAR-MILE

mile for the five largest companies in the country, whose reports on this subject are matters of public record, viz.: Philadelphia Rapid Transit Company, New York City Railway Company, Brooklyn Rapid Transit Company, Boston Elevated Railway Company, and the International Railway Company, of Buffalo. The fiscal years in each case are for those ending June 30, 1904, with the exception of Boston, which is for the year ending Sept. 30, 1904, and the figures in all these cases are taken from the reports of the Railroad Commissioners. Owing to the form of accounts required by the Massachusetts Railroad Commission, by which all of the expenses of power, including maintenance, are grouped together, a satisfactory comparison cannot be made of the power figures of this city with those of other large cities. The New York power figures are also affected by the fact that a considerable amount of power is sold. For this reason, a proportional reduction has been made in the case of this company in this table, as well as in Tables XIII. and XIV.

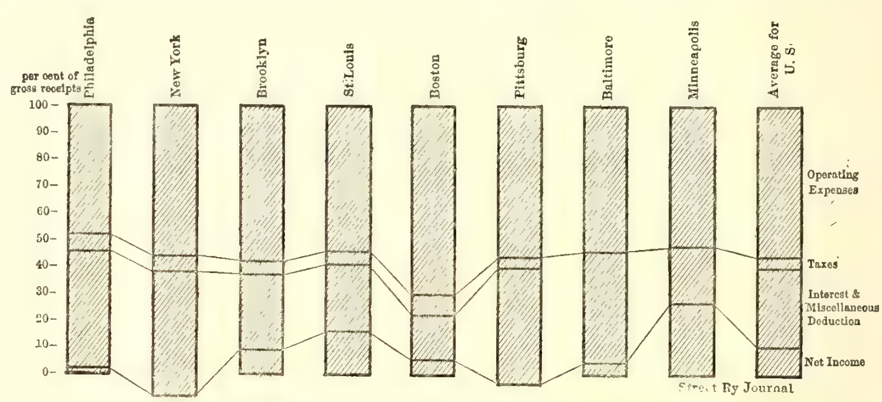


DIAGRAM SHOWING PERCENTAGE DISTRIBUTION OF GROSS RECEIPTS

The final two columns in Table XV. give the distribution of op-

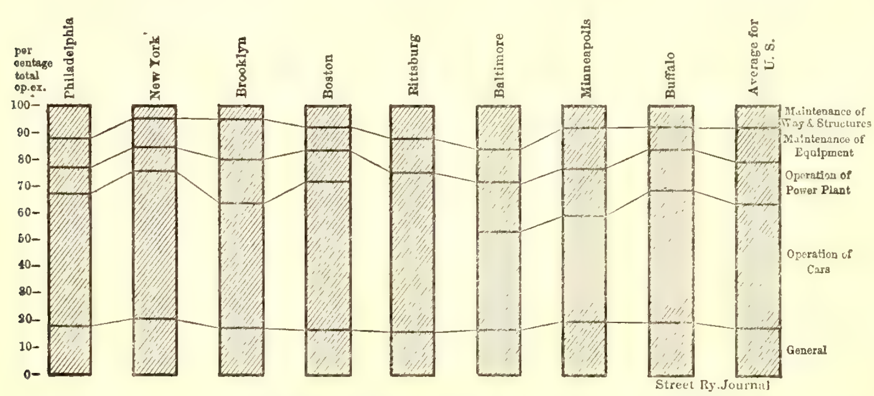


DIAGRAM SHOWING PERCENTAGE DISTRIBUTION OF OPERATING EXPENSES

erating expenses in percentages of the total for the Philadelphia Rapid Transit Company and for the seventeen largest companies already mentioned. This table presents some very interesting comparisons.

TABLE XVI., SHOWING TRANSPORTATION EXPENSES PER CAR-HOUR, PHILADELPHIA RAPID TRANSIT COMPANY

Wages of conductors	19.89
Wages of motormen	19.92
Wages of miscellaneous car service employees	1.39
Wages of car house employees	1.17
Car service supplies, cleaning and sanding tracks	2.39
Removal of ice and snow	.14
Total	44.90

SOME OPERATING FACTORS

The remarkable showing in Philadelphia can be attributed largely to a number of causes. The first and foremost of these must undoubtedly be the excellent organization which the company possesses. This alone could not account for the situation as it is found in Philadelphia, but the fact remains that there is a remarkable esprit du corps among the officers and employees of the Philadelphia Rapid Transit Company, from the president down, which manifests itself in a constant endeavor to secure the best results possible in every branch of the work. Undoubtedly this condition has been brought about largely by the policy of the company in retaining the services of its ablest men, and in making most promotions in its service from the ranks. There are two policies which may be followed in the management of any large industry or transportation corporation. One is to take men from outside for responsible positions, and this policy is often accompanied by one of frequent or fairly frequent changes in officials occupying responsible positions. The other policy is that of giving the preference to the older men in a company whenever there is any opening for advancement. Arguments can be cited in favor of each method, but the fact remains that it always takes a new man some time to become acquainted with local conditions, especially in a street railway system, and that, other things being equal, the older man will give the best service. This, at any rate, has been the general policy adopted by the Philadelphia Rapid Transit Company, and there is hardly a head of any department in Philadelphia who has not been connected with the system for ten or twelve years, while some of those who occupy the most responsible positions have been connected with street railway service in Philadelphia during practically all of their active lives. This condition has obtained in spite of the fact that during the last fifteen years there have been a large number of consolidations, and at least three different active presidents.

Other reasons which have tended to bring about this remarkable result are described in detail in the pages which follow this article, and which are intended to be a summary of the practice in operating methods of the Philadelphia Rapid Transit Company. Two, which, although important, can be summarized briefly, will be described below, leaving the more extended discussions of the different branches of work to separate articles. These are the system of fire insurance, which was established in 1895, and the method of providing for depreciation.

FIRE INSURANCE

The Philadelphia Rapid Transit Company carries its own fire insurance, covering all its properties, rolling stock and equipment. When the Union Traction Company was organized in 1895, it was deemed feasible, owing to the wide territory over which its properties extended, for the company to assume its own fire risks by setting aside a certain amount of the original capital to be invested as a nucleus from which to start a fire insurance fund. Accordingly, the sum of $250,000 was set aside and invested in the securities of some of the underlying companies. The directors of all the lesser companies agreed to accept the fund as sufficient guarantee for the clause in their leases, which compelled the lessee company to insure their properties in fire insurance companies of recognized standard. A statement was prepared showing the amount of premium which the company would naturally be required to pay to insurance companies for the same insurance, and agreements were made whereby one-twelfth of this amount was to be set aside monthly as a fund from which to pay fire losses. This is not merely a book credit, but each month a check is properly drawn and deposited to the credit of the fire insurance fund. Since the inception of this arrangement a considerable sum has been accumulated, and from time to time is invested in underlying securities of the parent company. At the end of the fiscal year ending June 30, 1904, the fire insurance fund consisted of the following:

3650 shares Philadelphia Traction Company stock;
4674 shares Union Traction Company stock;
$100,000 Electric and People's 4 per cent stock trusts;
$20,000 Union Traction Company 4 per cent collateral trust mortgage gold bonds;
$420,000 in first mortgage on real estate;
$1,437.60 in ground rents and $47,393.71 in cash.
Total valuation, $1,154,427.98.

Up to the end of the last fiscal year, fire losses aggregating $75,522.26 have been paid out of this fund.

TABLE XV.—DISTRIBUTION OF OPERATING EXPENSES.

	Per Car Mile.					Percentage of Total.	
	Philadelphia.	New York.	Brooklyn.	Boston.	Buffalo.	Philadelphia.	Seventeen Largest Companies.*
Maintenance of Way and Structures:							
Track and roadway	1.135	.620	.550	1.130	.904	9.97	5.2
Electric lines	.273	.457	.281	.353	.181	2.40	2.2
Building and Equipment	.067	.093	.247	.233	.063	.59	.7
Maintenance of Equipment:							
Steam plant	.087	.097	.209	(‡)	.039	.76	.9
Electric and cable plant	.024	.110	.120		.036	.21	.8
Cars	.582	.850	.710	.....	.587	5.11	6.2
Electric equipment of cars	.406	.940	.692	1.012	.467	3.57	3.8
Miscellaneous equipment	.039	.035	.150	.673	.037	.34	.5
Miscellaneous shop equip.	.....	.....	.273	.016	.067	.....	.6
Operation of Power Plant:							
Power plant wages	.232	.327	.625		.216	2.04	2.7
Fuel for power	.920	.951	1.602		.267	8.08	7.2
Water for power	.009	.108	.186	1.953	.004	.08	.5
Lubricants and waste	.014	.059	.032		.011	.12	.2
Miscellaneous supplies	.012		.092		.007	.10	.3
Hired power	.....	.....	.096		1.637	.....	1.8
Operation of Cars:							
Superintendence of Transportation	.....	.749	.362		.253	.....	2.4
Wages of conductors	2.594	6.469	2.326		2.357	22.79	18.8
Wages of motormen	2.597		2.281	8.096	2.265	22.82	18.6
Wages of miscellaneous car service employees	.334	.545	1.166		.935	2.93	2.1
Car service supplies		.176	.062	.085	.092		
Miscellaneous car service expenses	.312	.063	.216	.364	.253	2.74	4.8
Cleaning and sanding track		.002	.038	.....	.100		
Stable equipment	.....	1.018	†.038	.050	§.005		.....
Removal of ice and snow	.018	.205	.157	.589	.268	.16	0.6
Station and signal expenses and cleaning tracks	.....	.....	.....	.187	.....		.....
General:							
Salaries of general officers and clerks	.189	.279	.300	.432	.436	1.66	2.5
Printing and stationery	.039	.....	.023		.041	.34	.3
Miscellaneous office expenses	.041	.145	.044		.044	.36	.4
Store expenses and advertis'g	.....	.....	.041	.654	.104	.....	.2
Stable expenses	.015	.....	.....		.046	.13	1.4
Miscellaneous gen'l expenses	.180	.025	.065		.157	1.58	1.3
Damages		1.669	1.239	1.165	1.556		7.8
Legal expenses in connection with damages	.967	1.018	.423	.527	.066	8.49	2.3
Miscellaneous legal expenses	.070	.091	.070		.070	.61	.7
Rent of buildings	.006	.059	.016	.102	.071	.53	.3
Rent of track and terminals	.....	.228	.039	.018	.....	.....	.6
Insurance	.213	.191	.266	.224	.223	1.87	1.2
						100.	100.

* For June 30,1902. † Freight, mail and express. ‡ Included in transportation
§ Hired equipment.

Comprising an important factor in this general scheme of self-insurance is a thorough and systematic inspection of all the properties covered in the insurance fund, with the end in view of preventing fires. If anything, this inspection is more thorough than the usual inspections specified by the old-line insurance companies. The company employs two inspectors whose entire time is devoted to visiting the various car houses, power houses and buildings of every sort in regular and frequent rotation, and whose duty it is to report in minute detail the condition in which all premises are found. They are also charged with the responsibility of calling attention to any irregularities or conditions that might increase the fire hazard. The inspectors make daily report to the general manager on a blank which includes some fifty questions, each one of which calls for an answer touching some detail in relation to the fire risk.

In addition to these rigid inspections, once every six months an outside expert examiner is engaged to make an independent inspection of all the properties. His reports serve the purpose of checking the work of the company's regular inspectors, and his recommendations in the line of reducing risks of fires are given most careful consideration.

At all of the principal buildings owned by the company the precautions against fire include the placing of hose and other flame-fighting apparatus at advantageous points, and the designating of these points by notices painted on the walls near each piece of apparatus, which notices also emphasize the necessity for keeping these locations free from accumulations of dirt and rubbish that would interfere with the prompt handling of the fire-fighting equipment.

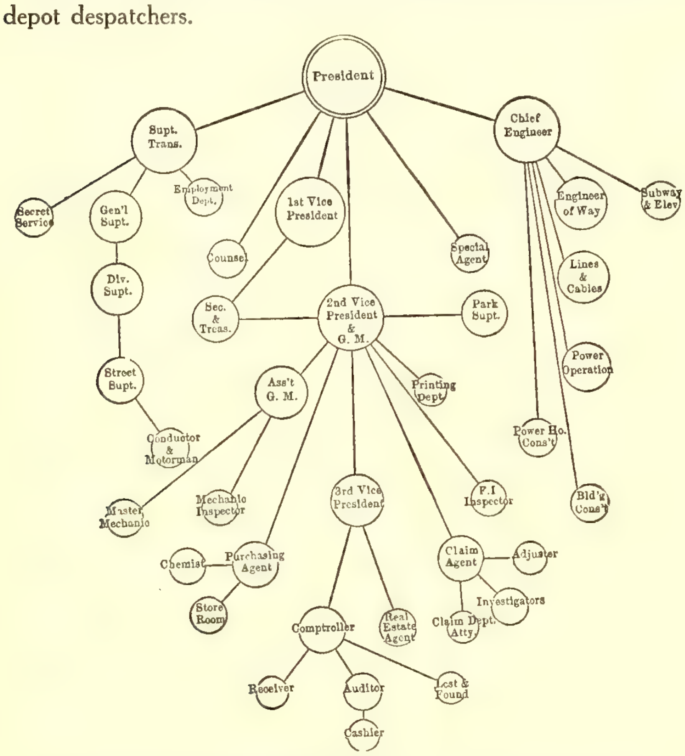
DEPRECIATION RESERVE

The Philadelphia Rapid Transit Company is one of the few companies in the country which charges off at stated periods certain amounts for depreciation and places them in the reserve fund. This plan was inaugurated in 1898 and has been continued regularly ever since. A division is made in the depreciation fund between the three heads of depreciation of roadway and track, power account, and an accident or damage fund. The amounts charged off for these three items at the present time are respectively 7 per cent of the gross receipts for the roadway and track item, 6 per cent for the power account, and 5 per cent for the damage account. The charges to depreciation account are not carried in the balance sheet, but the amounts are expended each year, and charged up to operating expenses.

OPERATING METHODS IN PHILADELPHIA

OPERATING ORGANIZATION

As will be noticed from the organization diagram published in this connection, the head of the operating department is the superintendent of transportation, who reports directly to the president. The superintendent of transportation has direct charge of the secret service and the employment bureau. The actual operating force is headed by the general superintendent, who reports to the superintendent of transportation. Under the general superintendent there are seventeen division superintendents and forty street superintendents who represent the division superintendents on the street, and are responsible for the maintenance of schedules, conduct of employees on cars and other matters coming directly under the operating department. These men perform the duties usually assigned in other cities to what are termed "street inspectors." A noteworthy feature of the operating organization is the fact that there are no regular despatchers at the depots for starting cars and crews on the runs. As told elsewhere in this issue, the posted schedules themselves cover all the duties usually performed by depot despatchers.



ORGANIZATION OF DEPARTMENTS, PHILADELPHIA RAPID TRANSIT COMPANY

President, John B. Parsons.
First V.-P., Geo. D. Widener.
Sec. and Treas., R. B. Selfridge.
Second V.-P. and Gen. Mgr., Chas. O. Kruger.
Assist. Gen. Mgr., F. H. Lincoln.
Third V. P., Alexander Rennick.
Compt., J. D. Hiestand.
Special Agent, Jas. J. Springer.
Chief Engineer, W. S. Twining.
Supt. Transportation, Jas. Bricker.
Gen. Supt., Walter Ellis.
Head of Secret Service, H. A. Bricker.
Head of Detective Force, H. C. Silcox.
Park Supt., Geo. C. Wynkoop, Jr.
Master Mechanics, Frank Wampler and R. G. Oliver.
Pur. Agt., W. L. Maize.
Chemist, L. Cass.
Storeroom Keeper, H. J. Nece.
Auditor, W. J. Kelly.
Receiver, R. L. Walker.
Cashier, Geo. C. Shelmerdine.
Head Clerk Lost and Found Dept., W. W. Dwier.
Real Estate Agent, Thos. B. Foote.
Claim Agent, S. L. Rhoades.
Asst. Claim Agent, H. L. Goshorn.
Supt. of Printing Dept., J. S. Skinner.
Engineer of Way, H. B. Nichols.
Assistant Engineer of Way, Geo. B. Taylor.
Assistant Engineer, C. B. Voynow.
Acting Supt. of Lines and Cables, Jas. Heywood.
Asst. Supt. Lines and Cables, E. E. Gilmore.
Supt. of Power Operation, Charles Hewitt.
Asst. Supt. Power Operation, E. O. Macfenan.
Supt. Building Construction, R. C. Heath.
Electrical Engineer, A. B. Stitzer.
Engineer Subway and Elevated, C. M. Mills.
Asst. Engr., Subway and Elevated. F. R. Fisher.

POSTING SCHEDULES

The method of making schedules and posting assignments to runs at the operating depots is somewhat unique. As far as this matter is concerned, the actual car numbers are disregarded and the cars are operated under what are termed "block numbers." For purposes of illustration, the "block number" may be defined as the day's work for a car, in distinction to a "run number," which represents a day's work for a crew.

After the headway for a given line has been decided upon for the entire twenty-four hours, the leaving times of the cars are plotted in chart form, as may be understood by reference to the accompanying time table. The trips to be made by each car during the day are arranged in columns, and this group of trips for each car is given a block number, which stands at the head of the particular column. It does not necessarily mean that the same car will run on the given block number all day, but in the event of a breakdown or any other cause, any car can be at once assigned to fill out any block run.

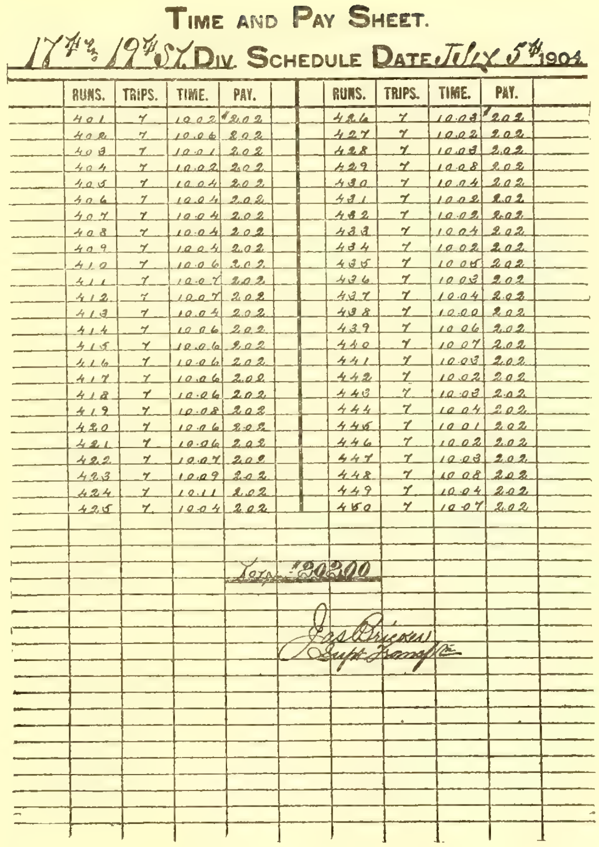
The runs for the car crews are based upon the block numbers; that is, each block number representing a day's work for a car, is divided into two, three or more sections, as the conditions may require, and the crews are assigned in accordance with these divisions. By reference to the accompanying time table, the system may be more clearly understood. For instance, a crew is assigned to run No. 401. By referring to the run guide, which is shown on the lower half of the time table (the time table for each run being posted in blue-print form at the despatching depot), the conductor and motorman find that the first part of their day's work is to be performed under first section of block 425. Referring then to the block numbers at the head of the columns in the upper half of the time table, they find that under block No. 425 the first car is scheduled to leave at 5:48. For this particular line the time necessary to make a round trip (as indicated by the time chart printed on the schedule) is 1 hour and 20 minutes. The crew would therefore be due back at the depot, after making the round trip, at 7:08. According to the second figure under the block No. 425, the next car under this block will leave at 7:18, thus giving in this particular instance a lay-over of 10 minutes. Starting out at 7:18, and taking 1 hour and 20 minutes for the round trip as before the car is due at the depot at 8:38, and the next leaving time, as shown by the third figure in the column, is 8:46. Taking 1 hour and 20 minutes as before the car is due back at the depot at 10:06. This completes the first section of block 425, as indicated by the heavy line drawn across the column. From this the crew understand that they have completed the first part of their day's work. Referring back to the run guide, they find that the second section of their day's work is to be performed under the second section of block 404. Referring as before to the block numbers in the upper part of the time table, the men understand that their next trip is to be made on the car scheduled to leave the depot at 11 o'clock. They, therefore, have a lunch relief from 10:06 to 11. Taking out their car at 11 o'clock, they make the round trip as before in 1 hour and 20 minutes, and are due back at the car house at 12:20. According to the next figure given in the column under block 404, the car on the next trip is to leave at 12:28, giving in this instance a lay-over of 8 minutes. The car makes this run in 1 hour and 20 minutes, and is due back at 1:48. The next leaving time in the column is 1:56, and, taking the time of the round trip as 1 hour and 20 minutes, as before, the car is due back at 3:16 and leaves on its next trip at 3:24. After making this round trip, the car is due at the depot at 4:44, and this particular crew know that they have then finished their day's work, inasmuch as the space opposite run 401 in the run guide under their section is blank.

From the explanation given it is believed the principle upon which the time tables are formed will be understood. It will be seen that the chief aim is to give all the men, including regulars and extras, a chance to perform a full day's work, and this is accomplished by dividing the block numbers or car runs into sections and then combining these sections in such a way as to give every man

an opportunity to do a fair day's work, and thereby earn a fair wage. This method of arranging schedules does away entirely with tripper runs, and the extra men know if they are assigned to a run at all they will earn as much as the regular men.

In execution, the block numbers are designated by two small wooden signs about 4 ins. x 6 ins., which are painted black with the block number in white figures. Two of these small block signs are hung on each car, one over each platform just under the hood. As before stated, as far as the operating department is concerned, the actual car numbers are disregarded, and the conductor and motorman carry out their assignment of runs entirely in accordance with the block numbers. It is the duty of the depot foreman to have cars in waiting on the car house floor with block numbers in place in the order they are to leave, as called for by the schedule. This arrangement avoids all unnecessary shifting of cars in order to bring certain car numbers in rotation on the car house floor, as any car available can be run out under any given block number, and in the event of it becoming necessary to call in a car for any defect or other cause, the block number is merely shifted to the first available car without disarranging the schedule or causing confusion in the minds of the crews as to what car they are to take out on any trip. Each division of the road has its own series of block numbers, the numbers on the first division, for instance, running from 1 to 100; on the second, from 201 to 300, and so on.

In conjunction with the time table for each division or line, there is printed a "time and pay sheet" for the given schedule. The corresponding "time and pay sheet" for the Seventeenth and Nineteenth Street Division, which has just been discussed, is also reproduced herewith. This is an average schedule, and it will be seen that all the crews on this division make seven trips in the day,


TIME AND PAY SHEET.

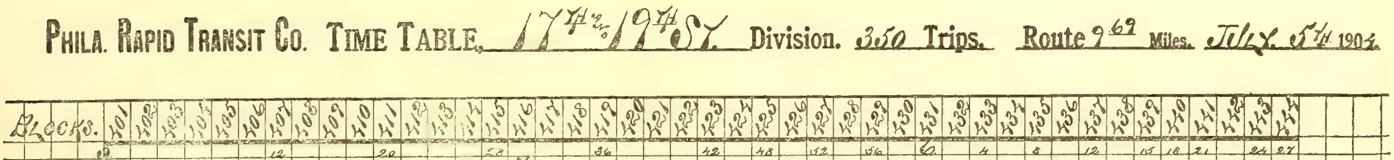
17th & 19th St. DIV. SCHEDULE DATE July 5th 1904

RUNS.	TRIPS.	TIME.	PAY.	RUNS.	TRIPS.	TIME.	PAY.
401	7	10.02	$2.02	426	7	10.03	$2.02
402	7	10.06	2.02	427	7	10.02	2.02
403	7	10.01	2.02	428	7	10.03	2.02
404	7	10.02	2.02	429	7	10.08	2.02
405	7	10.04	2.02	430	7	10.04	2.02
406	7	10.04	2.02	431	7	10.02	2.02
407	7	10.04	2.02	432	7	10.02	2.02
408	7	10.04	2.02	433	7	10.04	2.02
409	7	10.04	2.02	434	7	10.02	2.02
410	7	10.06	2.02	435	7	10.05	2.02
411	7	10.07	2.02	436	7	10.03	2.02
412	7	10.07	2.02	437	7	10.04	2.02
413	7	10.04	2.02	438	7	10.00	2.02
414	7	10.06	2.02	439	7	10.06	2.02
415	7	10.06	2.02	440	7	10.07	2.02
416	7	10.06	2.02	441	7	10.03	2.02
417	7	10.06	2.02	442	7	10.02	2.02
418	7	10.06	2.02	443	7	10.03	2.02
419	7	10.08	2.02	444	7	10.04	2.02
420	7	10.06	2.02	445	7	10.01	2.02
421	7	10.06	2.02	446	7	10.02	2.02
422	7	10.07	2.02	447	7	10.03	2.02
423	7	10.09	2.02	448	7	10.08	2.02
424	7	10.11	2.02	449	7	10.04	2.02
425	7	10.04	2.02	450	7	10.07	2.02

Total $202.00

Jas. Bickey
Supt. Transp.

TIME AND PAY SHEET USED IN CONNECTION WITH TIME-TABLE


PHILA. RAPID TRANSIT CO. TIME TABLE, 17th & 19th St. Division. 350 Trips. Route 9.69 Miles. July 5th 1904.

RUN GUIDE.

Runs.	1st Section Block.	2nd Section Block.	3rd Section Block.	Trips.
401	425	404	-	7
402	435	416	-	7
403	408	430	-	7
404	410	432	-	7
405	418	440	-	7
406	423	444	-	7
407	424	402	-	7
408	428	406	-	7
409	434	-	412	7
410	420	-	436	7
411	426	405	-	7
412	430	411	-	7
413	432	415	-	7
414	401	408	-	7
415	407	410	-	7
416	411	418	-	7
417	415	420	-	7

RUN GUIDE.

Runs.	1st Section Block.	2nd Section Block.	3rd Section Block.	4th Section Block.	Trips.
418	419	422	-	-	7
419	423	424	-	-	7
420	427	426	-	-	7
421	429	428	-	-	7
422	431	434	-	-	7
423	433	-	438	-	7
424	439	-	442	-	7
425	440	431	-	-	7
426	444	433	-	-	7
427	402	435	-	-	7
428	406	437	-	-	7
429	-	-	414	436	7
430	-	435	423	-	7
431	-	442	427	-	7
432	-	412	430	-	7
433	-	414	432	-	7

RUN GUIDE.

Runs.	1st Section Block.	2nd Section Block.	3rd Section Block.	Trips.
434	-	436	434	7
435	403	429	-	7
436	404	439	-	7
437	412	-	404	7
438	414	-	416	7
439	437	421	-	7
440	441	425	-	7
441	443	-	441	7
442	405	-	443	7
443	409	-	401	7
444	413	-	403	7
445	417	-	407	7
446	421	-	409	7
447	416	-	410	7
448	436	-	413	7
449	438	-	417	7
450	442	-	419	7

TIME POINTS.

From 15th and Cumberland St.

To	Girard	Ave.	12.	
"	Chestnut	St.	12.	24
"	2nd and Walnut	"	15.	39
"	10th " "	"	7.	46
"	19th " "	"	6.	52
"	So. Garden	"	8.	1.01
"	Columbia	Ave.	9	1.10
"	15th and Cumberland	St.	10.	1.20

Note—The time opposite each block number is out into service, at which the runs are formed.

This schedule shows starting time from 15th and Cumberland Street.

Before leaving a Terminal or Junction point or other place, you will know your car properly signed.

Approved
[illegible]

Jas. Bickey
Supt. Transp.

TYPICAL TIME TABLE, SHOWING METHOD OF POSTING RUNS AND BLOCK NUMBERS

and work approximately 10 hours, or a few minutes over, the odd number of minutes varying for the different runs, but each man that works under this schedule is paid $2.02 for his day's work. It will be understood that it is impossible to work out all of the schedules in order to let all the men perform their day's work in 10 hours, but this is the object aimed at, and none of the schedules calls for more than 11 hours' work. The company pays 20 cents an hour, and gives the men the benefit of any odd minutes that may be required by the particular division.

As an aid in the making of schedules, it is the practice to sta-

tion men at designated points, and these men report on special blanks the condition of each car as it passes, with respect to the load, as, for instance, "very heavily loaded, could take no more;" "heavy, but room for more;" "medium, standing room half taken;" "seated load;" "seats not all taken."

ASSIGNMENT OF RUNS

Regular employees are given the choice of runs according to their seniority standing. As runs become vacant, regular men can be advanced (as long as they are not changed from one line to another) to better runs, and the runs that are left are filled from the extra list. If there are runs to fill on more than one line operated from the same depot, the choice of line, as well as choice of vacant run on it, is given to the first extra man (allowing him to choose), and this course is followed until all vacant runs are filled. No changes are made or vacancies filled except on the first day of each month, except in the case of a run being vacant for three days or more for any cause. In that event the run is filled by the oldest extra not engaged, until such time as he may be called for a regular position or the man to whom it belongs returns.

Announcement of assignments to runs is made each day by means of "a slate," which is put out each evening at a regular time suitable to the requirements of each depot, and after the slate is posted, no man is excused without reporting, as this would disarrange the slate. Regular men have the same runs every day, and on the first of each month are allowed to make their choice of runs that may have become vacant during the previous month, the order of choosing being dependent upon the standing of the men on the seniority list.

The slate arrangement for extras is made upon the following rating:

First—New men, just taught and turned in for work.

Second—Men that have finished serving time for violation of any rule.

Third—Men who made their report, but did not receive work.

Fourth—Men who were excused without reporting.

Fifth—Men who made their report and were excused; unless in case a man sees he is going to get a run that is objectionable to him, and on that account is excused, he will then stand the same as though he had worked on the run.

In case of sickness, the employee must send word to his regular reporting place by special messenger before his reporting time is up, otherwise it is called a miss. No telephone or telegraph message is accepted. A regular man's run is held for him two months on account of sickness, after which time it is filled in the regular way. Should he return to work after this time, he is placed to the best advantage at the first opportunity until a vacancy occurs on the line and in the class to which he belongs, when he is so placed. Extra men do not lose seniority positions on the list on account of sickness.

The rules governing conductors and motormen in cases where reporting time is missed are as follows:

1. In case a regular man wishes to be excused from duty, he should ask the day before, and if excused such runs should be marked up from the top of extra list (as it would stand on the next day) in the order of the reporting time of the runs to be filled.

2. A regular man missing his report, which is ten minutes before the leaving time of his car, will be given 5 a. m. report, one day for each hour or part of hour missed, and in that time to receive work only after all extras get work that want it.

3. No extras are carried to relieve men who may miss their second car, as at dinner, supper or swing time; in such case regular men, also extras who are holding regular runs, will be given one week on the extra list for each hour or part of hour missed, to the extent of four hours. To start, serving time will be placed at the bottom, after which they will be treated as other extras are, except no hold-down will be given during time of suspension.

4. Extra men will not all be required to report at one time, but each man will be given a reporting time on the slate each day, by which he will be marked present or missed, as the case may be. For example: A man has 5 o'clock report, he will notify the man who has charge of the slate that he is present, when he will be so marked; he then holds himself in readiness to be called for duty unless excused by one in authority to do so, or in case the report was not made until after 5 o'clock, the man would then be marked missed, and how much; he would, however, hold himself in readiness for work in case all other men got work that had made their report. The extra men's reporting time will be carried along at intervals according to the requirements, and those that catch runs that finish late will be given all the advantage on next day's report consistent with the proper handling of the work.

EMPLOYMENT DEPARTMENT

All conductors and motormen are employed by the employment bureau. Applicants must be at least 5 ft. 6 ins. in height and between the ages of 22 and 40. Conductors must weight 125 lbs. and motormen 145 lbs. The men must be of good physique, sound in mind and body, and of good reputation and character. Physical examination is made by inspection only. All applicants must have good eyesight. During the summer months the company accepts from 600 to 800 applicants a month, but 25 per cent of these, for one reason or another, never go to work. On the average, the department is able to accept about 50 per cent of the total applicants presenting themselves each month. Applicants must give the names of two former employers and three reliable references. It requires the services of five men to run the employment department. The company now has about 3250 motormen and the same number of conductors in its employment. The men are paid 20 cents an hour.

When an applicant for the position of motorman has been accepted and his references have been found satisfactory, he is required to spend three days on the instruction car in order to become familiar with the general method of handling controllers, switches and other parts of the car. The instruction car is a regular passenger car which has been assigned to this service. It is the practice to place the car in charge of a competent instructor, who takes from seven to ten of the new men at a time and makes trips over one of the light traveled lines. On these runs the instructor explains so much of the mechanism of the car as the motormen are required to know, and each of the new men is in turn required to handle the controller. After this period of instruction, the recruits are sent to the depots to which they have been assigned, and each man spends about seven days riding on the front platform with an older motorman so as to learn the routes. During these seven days the new recruit spends a portion of the time in the car house and is instructed by the mechanical foreman in regard to the parts of the car and their uses.

If the instructor is able to certify as to the competency of the new man, he is examined by the division superintendent. At this examination the man must show his knowledge concerning the running time, streets along the route and all other rules and regulations pertaining to the running of cars. After passing the examination satisfactorily, the employee's name is placed on the extra list for work, until such time as he becomes a "regular," when he is advanced according to seniority. In the case of prospective conductors, the applicant is required to spend four or five days in training with an older conductor, and is then placed on the extra list.

EMPLOYEES' RECORDS

Two sets of records of conductors and motormen are kept, one in the office of the superintendent of transportation and one in the general superintendent's office. The file in the general superintendent's office includes records of each man, showing secret service reports, public complaints, reports of street inspectors, etc. The secret service reports are sent to the office of the superintendent of transportation, and comprise the record kept in that office. In both of these record files the papers referring to each man are numbered and are fastened together, the papers themselves constituting the record.

CONDUCTORS' ACCOUNTS AND PAYING EMPLOYEES

The cash turned in each day by conductors is not sent to the company's main office, but is deposited by the depot superintendent in local banks near the operating car houses. This avoids unnecessary handling of the money and does away with hauling large quantities of currency through the streets. The method of handling the money from the conductor to the bank is as follows:

When the conductor has finished his day's work his first duty is to turn in his cash receipts to the receiving clerk at the depot. The clerk counts the money in the presence of the conductor and enters the amount under the amount as given on the way bill by the conductor. The two sums should of course correspond. The receiving clerk then puts his initials on the way bill, this serving as a receipt to the conductor for the money. This procedure avoids all disputes as to the amount of cash turned in by conductors.

When the returns from all conductors have been received the receiving clerk bags the money, places it in a safe and the next morning it is deposited in the bank by the division superintendent or his assistant.

After the conductor has turned in his cash, he puts all the tickets, exchanges, transfers and free passes collected for the day into a bag and drops this bag into a safe in the presence of a clerk, who initials the way bill as a receipt to the conductor for the bag. The conductor then turns over his way bill, together with unused exchange tickets and transfers and punch, to the proper clerk. The bags containing the tickets and transfers are collected from the various depots each day by special cars, and are taken to the general receiving office, where they are opened by the counting clerks. Each bag contains what is known as a "short way bill," which is a memorandum inserted in the bag by the conductor at the time he ties up the tickets and transfers collected during the day. This memorandum shows the exchange tickets received, the 5-cent tickets, the "frees," the transfers, exchange tickets sold, the 5-cent fares and total passengers and total cash. Each bag is opened separately by a clerk who counts all the tickets and compares the account with the entries on the short way bill. If the numbers correspond, the clerk checks the short way bill with a blue pencil mark. If the two accounts do not agree, the clerk recounts the tickets. If there is a difference of twenty or more the clerk calls the forewoman, who counts over the tickets, making the third count. The forewoman either verifies the original or makes correction. This count is accepted as final.

The short way bills are written up on sheets, which are afterwards checked with the transcriptions of the way bills turned in by the depot receiving clerks.

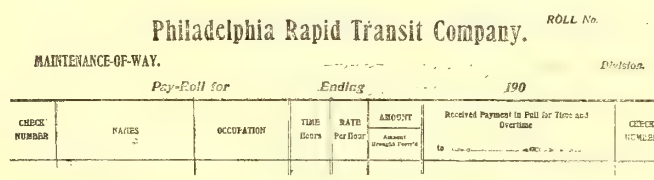
All employees of the company, with the exception of day laborers in the track department, are paid by checks drawn on local banks near the depot or shop. After the pay rolls are made up for each week a check is deposited by the company in each bank to cover the total amount of the pay checks drawn on the bank. Employees are paid four times a month, and the pay rolls are made up on the 7th, 14th, 21st and last day of the month.

The pay rolls for conductors and motormen are made up by the clerks at the depots. After the pay rolls have been certified the individual checks are drawn, signed and sent to the respective depots. The men call at a window in the depot for their checks and sign their names on the pay roll as a receipt.

In the case of employees in the motive power and lines and cables departments, the pay rolls are made up from the daily time cards, properly certified, and the checks are written out by a paymaster who delivers same to cashier's office for verification and signature of auditor. Each employee in these departments makes out daily a time card which is approved and signed by the engineer or foreman and sent to the general office. The pay rolls and checks are delivered to the paymaster, who delivers the checks to the men upon identification by the foreman or engineer in charge. The proceedure in the case of shop employees is practically the same.

The method of paying off the men in the track department is as follows:

The laborers are engaged by the division foreman, and are given brass checks which bear the monogram "P. R. T. Co." and number. The division timekeeper visits morning and afternoon the various locations in his division where work is progressing and takes down the time of the men in his time book. The men have to tell him their number or show the check. The timekeeper turns in the statement of time to the office of the division foreman on a form (which also gives the location and job number), and then the division clerk sends it in the morning to the office of the engineer-of-way on a form stating the numbers of men, the numbers of hours, the rate and amount of each man, as well as the job on which they worked. From the job sheets mentioned the division clerk also makes out four times a month (on the 8th, 15th, 22nd and end of month) a pay roll (see Form 253), which is certified by the timekeeper, who is under bond. This roll is sent to the engineer-of-way for inspection. The paymaster checks the totals with those sent up on the second form mentioned, makes out the pay envelopes, has the engineer-of-way certify it and sends it down to the cashier, who



Philadelphia Rapid Transit Company. ROLL No.

MAINTENANCE-OF-WAY. Division.

Pay-Roll for Ending 190

CHECK NUMBER	NAMES	OCCUPATION	TIME Hours	RATE Per Hour	AMOUNT / Amount Brought Forw'd	Received Payment in Full for Time and Overtime to	CHECK NUMBER

FORM 253.—HEADING OF PAY ROLL SHEET FOR TRACK DEPARTMENT

fills up the envelopes, which, together with the pay roll, are sent to the auditor and general manager for inspection and approval. The pay roll and envelopes then go back to the paymaster, who goes around in a wagon to the various locations where the men are working and hands the envelopes to the men, who have to show their brass checks and sign the pay roll, in the presence of the foreman of the job. When a man is not present on the job on pay day he has to obtain a certified order from the division foreman to the engineer-of-way, and this order, if corresponding with pay roll, is retained in the engineer's office and the man is given an order on the cashier, from whom he gets his money.

CONDUCTORS' WAY BILLS

The card or sheet upon which the conductor enters the record of his day's work, known usually in other cities as the day card, in Philadelphia is called a way bill, and is of course devised to meet the special conditions in Philadelphia brought about by the sale of 8-cent exchange tickets. The form of the way bill is illustrated on the following page.

Each conductor is given a way bill when he begins his day's work and is instructed to keep upon this an accurate account of each half trip, so as to show the total number of passengers carried, cash and tickets received, exchanges sold and transfer tickets issued. The way bill must be made out plainly and blank spaces are provided for inserting the name of the division, the run numbers, the block numbers, conductor's name and number, motorman's name and number, and date; also the starting time from each end of the route as well as the car number operating on each trip.

As has been outlined, the instructions to conductors provide that at the close of the day's work and after the way bill has been properly made out, all cash received must first be turned in to the receiving clerk, who counts the money and enters the amount on the way bill, signing his initials. The conductor must then count his tickets in order to be sure they are correct as shown on the way bill, and place them in a bag, which must be securely fastened and deposited in the receiving safe. The bags must be

deposited in the safe by the conductor personally in the presence of the station master or person in charge at the time, who is instructed to raise the lid of the safe and see that each and every conductor drops a bag in the opening. No way bill or tickets must be turned in by the conductor nor received by the station master or person in charge until the receiving clerk has receipted on the way bill for the amount of cash received and the bag has been deposited in the safe.

REGISTER STATEMENTS.

Register No.
Ending,
Commencing,
Total,
Register No.
Ending,
Commencing,
Total,
Register No.
Ending,
Commencing,
Total,
Register No.
Ending,
Commencing,
Total,
Total Registration,

STATEMENT OF EXCHANGE TICKETS.

Ending,
Commencing,
Total Sold,

STATEMENT OF TRANSFER TICKETS.

Ending,
Commencing,
Total Issued,

Referring to Rule No. 40 in "Book of Rules,"

IN CASE OF EMERGENCY, CALL

Bell Phone "MARKET 4407"
Keystone Phone "MAIN 951"

In making up this Way-Bill all totals must balance correctly.

STATEMENT OF PASSENGERS.

Passengers.		$	Cts.
	5ct. Fares,		
	8ct. Exchanges Sold,		
	8ct. Exchanges Received,		
	5ct. Tickets Received,		
	Free Tickets Received,		
	Totals,		

Each trip must show the Car number used.

In all cases the starting time on the Schedule is the OUT trip, the return is the IN trip.

When on time, put down the Schedule time leaving each end; when not on time, put down the actual time.

In no case add Passengers of one trip, or part of trip, to those of any other trip. Each trip, or part of trip, must show for itself

FORM 103.—REVERSE SIDE OF CONDUCTORS' WAY BILL

CONDUCTORS REPORT OF DELAYS

In the event of delays to cars while in service, conductors make report on proper blank, showing the block number, tine of day, time lost, number of passengers on cars, location and a full explanation of cause of delay. In case of a break-down, crippled car, broken wire, or other cause of delay or blockade, the conductor on the first car must call "emergency" on the telephone at once. The delay sheet must be filled out in every case when car is blocked for five minutes or over, and turned in at office at end of day's work.

BENEFIT ASSOCIATIONS

There is no general employees' benefit association, but each depot has its own association, the members of which comprise the employees working at or operating from the particular depot. Each of the depot organizations has its own constitution and by-laws, but most of them include sick and death benefits for the members. The company encourages these societies and furnishes suitable meeting rooms, all the printing required, and assists them in other ways.

STEAM RAILROAD CROSSINGS

There are about 400 crossings of street railway lines with steam railroads at grade. At the more important crossings the street railway company maintains its own flagman in addition to the crossing gates and flagman kept by the steam railroad company. At the less busy crossings, flagmen are not maintained, but the cars come to a full stop and the conductor goes ahead and signals the motorman when to proceed. At two crossings over which fast express trains are operated at frequent intervals, derailing switches have been installed and flagmen are stationed at these points to operate the derail.

The company's rule governing the action of employees at steam railroad crossings provides that the conductor must not allow his car to approach the railroad crossing beyond the point of safety without coming to a full stop. After the car has stopped, the conductor must announce the name of the street. After all the passengers who desire to do so have entered or left the car, the conductor must go forward to the center of the railroad crossing, and after having carefully looked in both directions and having ascertained that there is no danger, he must give the signal to the motorman to proceed. The motorman, before starting his car on this signal, must look back to assure himself that no passengers are entering or leaving the car by the back platform. At steam railroad crossings where the street railway company maintains its own crossing watchman, the conductor does not go ahead of the car, but gives the starting signal upon receipt of whistle or signal from the man at the crossing, and while the car is passing over the steam railroad tracks the conductor must give special attention to the trolley, so that in case it should leave the wire, the car would not be allowed to stand in danger without power.

STREET RAILWAY CROSSINGS

The large number of track intersections in Philadelphia call for special precautions to prevent accidents from collisions at these points. The rule governing the movement of cars at street intersections reads as follows:

By established custom and city ordinance, the cars running north and south have the right of way over cars running east and west, but this rule will not be accepted as an excuse in case cars come together while crossing intersecting streets. There must be no racing of cars to arrive at streets where lines form junctions with others, but when cars are due at the same point at the same time, and arrive there together, the car having the straight rail must hold back and allow the one having the curve to go ahead, in which case the first car will endeavor, as far as is consistent with safety,

Conductor, ... *Division.*
1st Block No. ... *Badge No.* ... *Motorman,* ... *Badge No.*
2d Block No. ... *Run No.* ... *Date,*

Car No.	Trip	Time	5 ct. Fares	Exch's Sold	TOTAL CASH		TICKETS RECEIVED			Total Passengers	Register Statements, Ending by Half Trips	EXCHANGE TICKET STATEMENTS, Ending by Half Trips	TRANSFER TICKET STATEMENTS, Ending by Half Trips	Transfers Received
					$	Cents	Exchanges	5 ct.	Free					
	1 OUT / IN													
	2 OUT / IN													
	3 OUT / IN													
	4 OUT / IN													
	5 OUT / IN													
	6 OUT / IN													
	7 OUT / IN													
	8 OUT / IN													
	9 OUT / IN													
	10 OUT / IN													
	11 OUT / IN													
	12 OUT / IN													
	13 OUT / IN													
	14 OUT / IN													
	15 OUT / IN													
Totals														

FORM 103.—FACE OF CONDUCTORS' WAY BILL USED BY PHILADELPHIA RAPID TRANSIT COMPANY

to move rapidly and thereby leave the proper headway for the car following.

The city ordinance covering this point provides that any person violating the provisions with respect to the movement of cars at intersections shall pay a fine of $10 for each offense.

MAIL CARS

The company is now operating nine regular mail cars, which carry mail from the central postoffice in Philadelphia to suburban postoffices. The railway company supplies the cars and the conductors and motormen, but aside from this the mail service is under the direction of the postoffice department. No attempt is made to collect from street letter boxes by these cars, but they are used exclusively for transferring mail between the central office and the branch offices. Mail received in bulk is sorted en route. The arrangement of the interior includes pouch racks, pigeon holes and sorting tables, the layout conforming to the standard specifications required by the United States Government, and now followed in all cities where mail is carried by the street railway company.

NEWSPAPER CARS

A service believed to be peculiar to Philadelphia is the employment of cars for delivering newspapers in bulk from the downtown newspaper offices to suburban points over the street railway lines. The newspapers are carried in cars from which all of the seats and interior furnishings have been removed. This service has grown from its inception, so that at the present time seven regular newspaper cars are operated on week days and nine on Sundays. The leading newspapers of the city, through a distributing agency, deliver the papers in bundles to the cars in the early morning hours. The cars leave the center of the city shortly after 3 o'clock in the morning, and deliver the bundles to the retail news dealers all along the routes. The company supplies the car and the crew, and the distributing agency takes charge of the distribution of the papers. The agency pays the street railway company in accordance with the total weight of the papers carried, irrespective of the distance covered. This service has proven exceedingly popular, as it enables the residents in the suburbs to have their morning papers with the same promptness as in the downtown districts.

CHARTERED CARS

The chartered car business now amounts to about $10,000 a year. Arrangements for special cars can be made by application to the superintendent of transportation, but owing to the normally heavy traffic on the park lines, over which special parties usually desire to go, the company does not attempt to make a special feature of chartered cars. For this service regular four-wheeled closed cars are usually utilized, as the double-truck cars are all required in the regular service. It is the policy of the company to lease special cars for day trips only, and it is seldom that orders are taken for chartered cars to be used during the evening.

The regulations relating to chartered cars require that all cars be paid for when ordered. In case of rain the excursion can be postponed to the next open date suitable to the party, or the money will be refunded. The following is the schedule of rates for special cars:

TO WILLOW GROVE:

	Per Car
Three cars or less (half or all day)	$10.00
Four to nine cars (half or all day)	8.50
Ten cars or more (half or all day)	7.00

TO CHESTNUT HILL, FOX CHASE, FRANKFORD, DARBY, HADDINGTON OR ANGORA:

	Per Car
Half day, straight trip	$6.00
All day, straight trip	8.00
Half day, exchange trip	8.00
All day, exchange trip	10.00

TO GEORGE'S HILL, LEMON HILL, ZOO GARDEN, STRAWBERRY MANSION, OR WISSAHICKON:

	Per Car
Half day, straight trip, Hunting Park	$5.00
All day, straight trip	6.00
Half day, exchange trip	8.00
All day, exchange trip	9.00

Button Club House—$6 one way, $10 round trip.

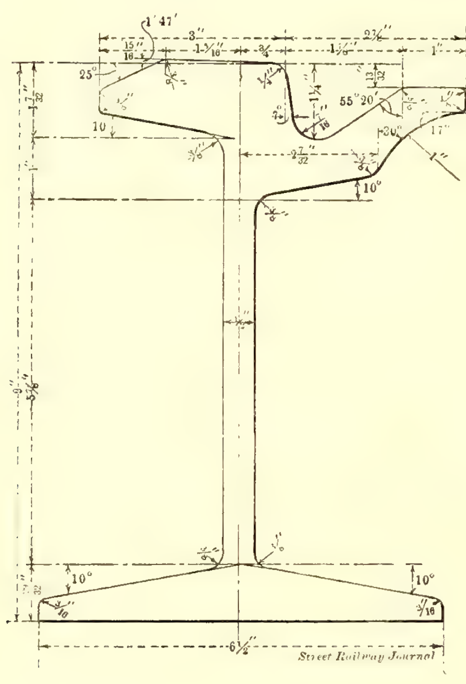
WAY AND ROADWAY MATTERS IN PHILADELPHIA

The system of the Philadelphia Rapid Transit Company now comprises 554.35 miles of track, of which 381.92 miles are single track, and 172.43 miles second track. Of this total, 25 miles are located in car houses. All street railway tracks in Philadelphia are laid to 5 ft. 2¼-in. (5.19-in.) gage.

In the work of maintaining and reconstructing this mileage, and also in building new lines, the way department has devised and adopted a number of standards in appliances, methods and processes, many of which are worthy of careful attention and study.

On straight track three sections of rail will be found to predominate; these are a 9-in. 90-lb. tram rail, an 8 25-32-in. 93-lb. tram rail, and a 137-lb. girder rail. The latter is a specially-designed section known as the Philadelphia Rapid Transit standard, and is now used in all reconstruction and new work in Philadelphia. This section has received considerable attention in the columns of the technical press, and it has been adopted in modified form in a number of the larger cities in the country. Its distinguishing characteristics may be briefly described as follows:

The web of the rail has been moved outward from the gage, presenting practically a center-bearing rail, as the load comes directly over the center of the web. In addition to this, more wear-



PHILADELPHIA RAPID TRANSIT STANDARD 137-LB. RAIL, LORAIN STEEL SECTION

ing surface is attained along the gage line, so that as the rail is worn it may be moved inward toward the center of the track, thus prolonging the life of the section indefinitely. With former designs of rail sections used in Philadelphia, after a certain amount of wear had taken place along the gage line, the neck of the rail became so weak that, owing to the eccentricity of load incident to heavy electric railway service, the head of the rail would bend down, and the life of the rail was dependent entirely upon the action of the section in this regard. A feature of the 137-lb. Philadelphia Rapid Transit section is its self-cleaning properties, due to the flaring shape of the throat of the groove. The rail offers very little obstruction to vehicle travel, as the design of the lip permits wagon wheels to turn out from the groove without difficulty. It will also be noticed that the head of the rail is 3 ins. wide, and this provides for the use in the future of wider wheel treads, toward which there is a decided tendency. At the same time, since a comparatively narrow wheel tread is still in use, the bevel at the back of the rail head prevents the wearing of false flanges in the rail. The groove is made deep to allow greater limits of wear in the rail head. The rail is rolled by the Lorain Steel Company, and its design was the result of a very careful study of all existing types of girder rails on the part of the engineers of the Rapid Transit Company and of the manufacturers.

In all new track and in reconstruction work, the company is using the Nichols-Voynow composite or zinc joint, which has been described in detail in the columns of this paper (see STREET RAILWAY JOURNAL for March 1, 1902). This joint, and the method of constructing it, may be briefly summarized as follows:

After the rails have been placed on the ties, but before they are spiked, the ends are all thoroughly cleaned by a portable sand-blast apparatus. Two fish-plates of special form, with twelve bolt holes, are also cleaned by sand blast, and then placed on the rail ends and held in position by two steel drift pins. A steel straight edge is laid on the head of the rail, and the tread of the two rails brought to an even surface by wedging. Temporary bolts are then placed in four of the holes in the rails and plates, and the remaining holes are reamed out to 1 1-32-in. diameter by a portable pneumatic reamer. The twelve rivets are then driven home by a portable pneumatic riveter, clamping the plates solidly to the web of the rail, but leaving, owing to the special shape of the plates, a space under the head, the tram and around the foot of the rail. Iron clamps furnished with asbestos cloth pads and clay dams are then placed in position, and the whole joint is warmed by fuel oil burners to a temperature of from 300 degs. to 400 degs., after which molten zinc is poured into these hollow spaces. The claim is that the introduction of this metal in a fluid state fills up the smallest interstices between the fish-plate and the rail, giving a continuous solid bearing throughout which is impossible with the ordinary fish plate, while the crystalline nature of zinc prevents any flowing or peening under continuous shock and vibration. It is also claimed that the zinc when poured on the hot clean metallic surface of the rail and plates will practically amalgamate with them, and give a true electrical joint, into which water and corrosion will not penetrate.

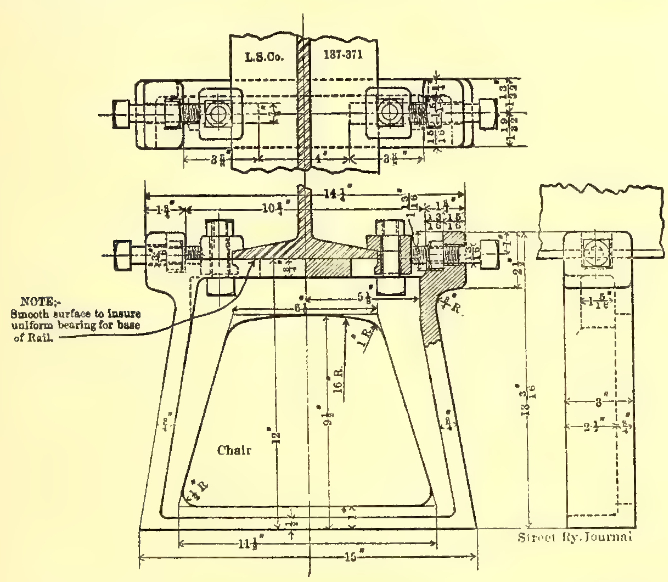
As explaining the results secured by this joint in actual service, both with respect to its mechanical strength and electrical conductivity properties, reference is made to a report of a committee appointed by the Franklin Institute for the purpose of investigating the merits of the invention. This committee reported that on a 2-mile section of track selected at random, it was impossible in any case to locate the joints without careful search, the rails showing a smooth and unbroken surface, with absolutely no appearance of greater wear at the actual joint, and no signs of hammering out of shape of the head of the rail. The wish of the committee was to select a defective joint for examination, but as none could be found which showed any signs of anything wrong, a joint was finally selected which indicated a slight depression on one rail due apparently to an original surface blister at that point. The paving was then removed from around this joint and several ties removed from under the rail, leaving the joint unsupported for a distance of 4 ft. to 6 ft. In this condition, close observation while heavy cars passed over the joint showed no apparent deflection whatever. All of the rivets in the joint were then cut and driven out, and observation while cars passed over the joint in this condition still showed no apparent deflection. The fish-plates were then wedged off, this taking very considerable force, and a close examination of the rail-joint revealed that rails and fish-plates showed clean metallic surfaces, with the peculiar whitish gray of the zinc coating. The committee further made an electrical test of some twenty rail-joints which had been in use about three years on Third Street, where the wagon traffic is very severe, and where

over 1000 cars per day pass over the joints. All but four joints in this test showed less resistance than the rail.

In making the electrical tests, the resistance of the joints was measured in terms of adjacent lengths of rail by the well-known Wheatstone bridge method. The resistance of a piece of standard rail was found to be 8.71 michroms per foot. The average resistance of the joints (30 ins. long) was .00002038 ohms (20.38 michroms). This is only 93.5 per cent of the resistance of the same length of rail, or the average joint was found to be 7 per cent better conductor than the same length of rail. The lowest joint was 44 per cent better, and the highest was 20 per cent worse. As a result of this investigation, the Franklin Institute last year awarded the John Scott premium and medal to the inventors. The manufacture of the joint is now controlled by the Lorain Steel Company.

In new track work the use of tie-rods has been practically abandoned, in accordance with the belief based on experience that the rods stretch and are generally inadequate to hold the rails to gage. In place of tie-rods, the rails are supported on specially-designed brace chairs, the special features of which will be understood from the diagram on Plate XII. The noteworthy improvement ment secured by the use of these braces is a combination of adjusting screws by which the rail may be shifted bodily over to the right or the left when bringing the rails to gage during construction or for adjusting the gage to compensate for wear in the rail head.

In practice, the chairs are attached to the ties before they leave the yard, by means of three lag screws. For this purpose a multiple drilling machine, built in the company's shops and illustrated on Plate XVI., is utilized for drilling simultaneously the six necessary holes in the tie. The vertical leg of the chair has two holes. The rails are punched with single holes as for tie-rods. After the rails are joined they are set slightly to wide gage. Standard ⅞-in. bolts are passed through the holes in the web, and engage a



DETAILS OF CAST-IRON YOKES FOR CONCRETE TRACK CONSTRUCTION

nut which is locked by a depression in the chair. By tightening these bolts, the rails are brought to exact gage, when a second ⅞-in. bolt is screwed in from the opposite direction, and when this second bolt is tightened up it presses against the inside of the web of the rail, thus holding the rails perfectly to gage. In the work first attempted, wherein brace chairs were utilized, the chairs were made of cast iron with the holes tapped. They were afterward made of pressed steel, using standard bolts and nuts. In the latest work, the chairs are made of malleable iron, which is slightly cheaper, and is also stronger. After the rails are in place on the brace chairs, and have been brought to exact gage, it is the practice to concrete in at the sides of the rail, filling the space inside the head and foot, this concrete serving to stiffen the rail and also to prevent the paving at the side of the rail from sinking.

The latest type of track construction where tracks are to be laid on the very heaviest traveled streets, such as Market, provides for the use of concrete foundations, and embodies a number of departures from concrete track construction as laid in other streets.

As will be seen from the illustration, in this work each rail rests upon a beam of concrete which is 18 ins. wide at the base and extends to a depth of 22 ins. below the surface of the paving. The two beams are joined by a bed of concrete 6½ ins. deep, extending across the track, the arrangement securing a single monolythic concrete foundation for the rails and roadbed, extending across the horizontal surface of the track and into the side trenches, beneath the rails. This mass of concrete extends along the track continuously, and at intervals has imbedded in it cross rods extending from rail to rail and acting as reinforcing rods, with their ends bent down into the side trenches in order to gain a firm anchorage in the side bodies. One of the features peculiar to the design is the placing in the concrete at intervals under each rail, of yokes. These are imbedded in the concrete, and comprise open frames with flanged sides, and provided at the upper ends with guide lugs, in which are adjusting screws, the inside ends of which bear against holding blocks that grip the foot of the rail, so that the rail is adjustable to exact gage by manipulating the screws.

In setting the rails, the horizontal trench is first excavated and surfaced. Temporary cross ties are then supported transversely in this trench, and the rails are laid thereon and roughly brought to gage. For these temporary ties it is customary to use a cross tie consisting of a wooden body surmounted by a metal channel member suitably secured thereto, and of a length greater than that of the body portion. The overhanging ends thus produced facilitate the adjustment and attachment of the rails, while the body portion is adapted to the operation of surfacing the rails by tamping up under the tie. The rail is clamped to the ends of these temporary ties by means of clips and nuts. Having secured the rails to the temporary ties, the side trenches are dug, the yokes or anchors hung upon the rails, and the concrete filled in. In this part of the process shims are interposed between the rail foot and the head of each yoke. In finishing the work, these shims, as well as the temporary ties previously mentioned, are removed, leaving the rails raised from the yokes, but adjustably held down upon the concrete by bolts passing down through the holding blocks. This construction will perhaps be more readily understood from the drawings themselves.

The principal benefit derived from this construction is the solidity and permanence of the structure, this being due as regards the stability of the rails in particular to the fact that they are supported continuously throughout their length upon the concrete. It should be observed that concrete as a general rule shrinks perceptibly in setting. In many experimental structures it has been found that it is not practicable to use supports, such as yokes, and expect to have the unsupported portions of the rails still remain in contact with the concrete after setting. The latter shrinks away from the rails inevitably, leaving them supported at comparatively widely-separated points. Hence no advantage is really gained by merely supporting the rails on yokes imbedded in the concrete, but by the use of shims, or distance pieces, as outlined, and means for forcing the foot of the rail down into close contact with the yokes and concrete structure after the concrete has settled, the rail is supported under its entire length, not upon the yokes only, but upon the concrete. In this case, the yoke serves as an anchorage to hold down the rail.

In further explanation of the principles upon which this construction is based, it may be stated, as the belief of the company's engineers in the way department, that under the action of variations in temperature as between the head of the rail and the foot, causing unequal expansion, and also, and primarily, under the rolling action of the wheels, there is uneven elongation of the rails in any track built for electric railway service. This uneven

elongation tends to spring the rail into a vertical curve. In track laid in paved streets this tendency can be detected by the wave-like motion imparted to the cars, and often can be observed by the naked eye. In ordinary tie construction the spikes, and also to some extent the paving, will in some measure resist this upheaving tendency and hold the rail to surface, and even if the rail itself bulges upward the trouble may be remedied to some extent by re-tamping. But in concrete construction, should the rail heave up, even in slight degree, there will be a hammer effect between the base of the rail and the concrete beam which will in a short time pulverize the concrete under the base of the rail and there will be no remedy. In the Philadelphia construction, the yokes or frames are put in not for the purpose of supporting the rail but for anchoring it to the concrete and preventing the heaving tendency mentioned. This end is further attained by the use of the temporary shims between the rails and the yokes, while the track is being surfaced, so that when the concrete has settled the shims may be removed. Afterwards, by means of the holding-down bolts and clips, the rail is forced down hard on the concrete beam between the yokes, thus making the chairs act as holding-down anchors only.

During the past year, about 8 miles of this concrete construction has been laid on the principal heavy lines in the down town streets, and it is being extended to other of the busiest lines. In all of this work, the Nichols-Voynow cast-zinc joint has been used.

In the work of renewing tracks now being carried out by the way department, it has been decided to put in the Nichols-Voynow joint where it is thought necessary to renew the rails entirely. When the ends of the rails are so far gone that the plates used in the cast-zinc joint will not restore the surface of the rail but the rails themselves are in fairly good condition, the joints are being cast-welded. On some lines where the rails are still in good shape and only certain of the joints are low, it is the practice to put in an offset plate joint, which is an ordinary fish-plate, with the receiving end offset to counterbalance the difference in heights due to wear between the ends of the abutting rails.

There are about 320 miles of bonded track. The standard cross bonds are No. 0000 6-ft. Columbia bonds inserted about every 150 ft. across the track. The standard joint bond is a No. 0000 6-in. bond placed under the trams of the rails. In special work, a No. 0000 40-in. bond is put in around the joint plates. Of course, where the zinc joint is put on no bonds are needed. A considerable number of bonds have been supplied by the Mayer & Englund Company.

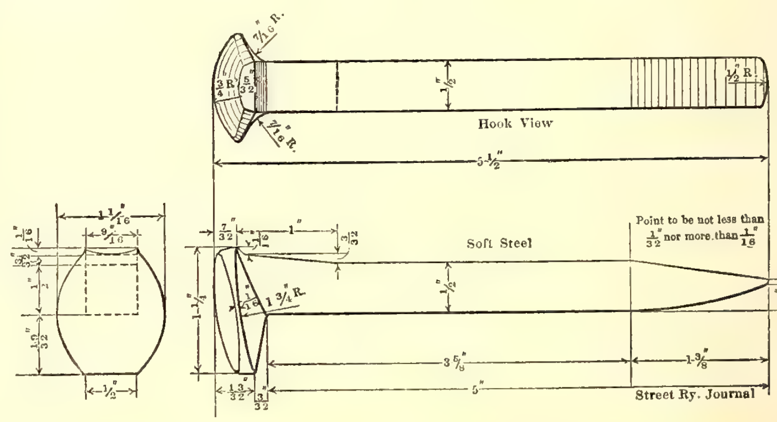
Manganese rails are used to some extent at points of great wear, notably for the curve on Market Street, opposite the Camden Ferry, shown on Plate VIII. The curve rails on this loop were designed especially for this location on account of the short radius of the curve, which is but 25½ ft. center radius. The layout, including rails, was furnished by Wm. Wharton, Jr., & Company. The inside rail weighs 165 lbs. to the yard and the outer rail about 200 lbs. to the yard, both of solid manganese construction. These rails have been in use since 1898, during which time an average of 4000 cars per day have passed around the loop. The wear on the head of the rail has been approximately 3-16 in. per year.

DETAIL STANDARDS

The work of establishing standards for the use of the way department has been made to cover not only general types of track construction, but has also been carried into many of the minute details connected with the department. These various standards which, after considerable trial have been found to be best adapted for the particular purpose they are intended to fill, have been reduced to blue-print sheets, the collection of drawings being known as the "Record of Standard Tools and Appliances for the Roadway Department." The drawings are made up into portfolios, the blue-print sheets being 12 in. x 9 in. with an upper edge of 1¼ in. for binding purposes. Sets of such drawings are kept in the offices of the general manager, the purchasing department, the division engineers, the division foremen, order clerks and chief clerk, so that whenever any tool or appliance is needed there can be no mistake about what particular article is meant. All the drawings in these portfolios bear the key letter "S", meaning standard, and are numbered consecutively. All the necessary information is put on the drawings, so that requisitions, orders, or instructions involving any of the company's standard tools or appliances may be prepared by merely referring to the drawing number.

When a particular appliance or process has been found to cover the requirements to the best advantage, and has been reduced to a standard, it is the usual practice to prepare complete specifications covering the particular appliance or process, and future orders are filled from these specifications. In this work of preparing standard specifications for supplies and material, the company's testing laboratory (described elsewhere in this issue) is of prime assistance in the matter of furnishing analytical data with respect to compositions and mixtures, as it is usual to include in requisitions exact requirements as to chemical compositions of materials and supplies.

The method of using this system of standard drawings and specifications may be illustrated by citing the single example of rail spikes. In order to meet the special requirements of track construction in Philadelphia, the engineers of the way department, after considerable study and experiment, have designed a special form of rail spike and this form in varying sizes has been adopted as standard in all track construction involving wooden ties. The drawing for a spike ½ in. x ½ in. x 5 ins. is reproduced herewith, and not only shows the novel design of the spike but also serves to illustrate the method of reducing the standards to drawings. Attention is called to the fact that in this form of spike the angle under the nose is exactly the same as the angle of foot of rail, thus giving the maximum bearing for the spike against the rail. This angle is about 10 degs., as compared with from 23 degs. to 25 degs., as found in the usual spike bought in the open market,



PHILADELPHIA RAPID TRANSIT STANDARD HOOK-HEAD SPIKE

and which gives contact for only a portion of the surface under the nose. Another feature of the P. R. T. standard spike is the curved bevel in front of the point. The reason for this is that when a spike is started under the tram of a rail it is impossible to drive the spike straight, for the tram of the rail prevents the workman from delivering a straight down blow. On this account it is necesary to start the spike at an angle to the web and the curved surface or bevel mentioned is designed with the idea of causing the spike to straighten itself under the blows of the hammer, and in practice this object is fully accomplished. Furthermore, in the back of the spike, at the head, there is a bulging or swelling of 3-32 in., designed as the result of observation to the effect that while a spike is being driven it usually moves to and from the rail at each blow, thus making an enlarged hole in the

tie, and with the ordinary form of spike this enlargement of the hole often leaves considerable space for moisture to accumulate. The bulge on the P. R. T. standard spike serves the purpose of plugging up the enlarged spike hole after the spike has been driven home.

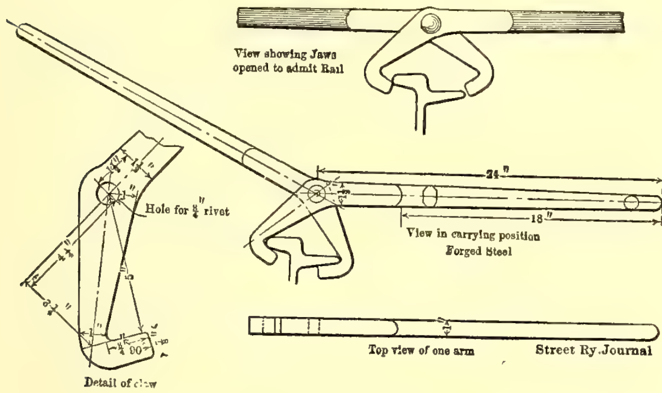
The company's specification covering the standard steel spike is as follows:

Chemical Composition.—All material for steel spikes must be of soft steel of uniform character, and manufactured by the open-hearth process, with carbon not to exceed .15 per cent, and not over .05 phosphorus.

Physical Properties.—Test pieces cut from full size bar must show:

a. Ultimate strength, 54,000 lbs. to 64,000 lbs. per square inch.

b. Elastic limit, not less than one-half the ultimate strength.



STANDARD RAIL TONGS

c. Elongation, not less than 25 per cent, measured in 8 ins.

The finished spike, when cold, must stand the following:

d. Bending test, 180 degs. flat on itself without fracture on outside of bent portion.

e. Twisting test, to stand two full turns without fracture.

f. Head test No. 1, head to be flattened in the direction of length of spike with one blow from steam hammer without fracture.

g. Head test No. 2, neck to be ground half through on inside of spike, spike to be fastened in vise so that bend can be made at ground part, and head flattened in the direction of length of spike with sledge hammer without fracture.

h. Driving test, a practical test of each spike by driving it home to the base of rail in a white oak tie, spike then struck a heavy blow with spike hammer sufficient to further embed spike and bend head slightly upward without sign of fracture.

Finish.—All spikes must be smooth, straight and not vary more than 1-64 in. in thickness nor ⅛ in. in length; have well-shaped symmetrical heads, sharp points, and in accordance with dimensions shown on accompanying plan.

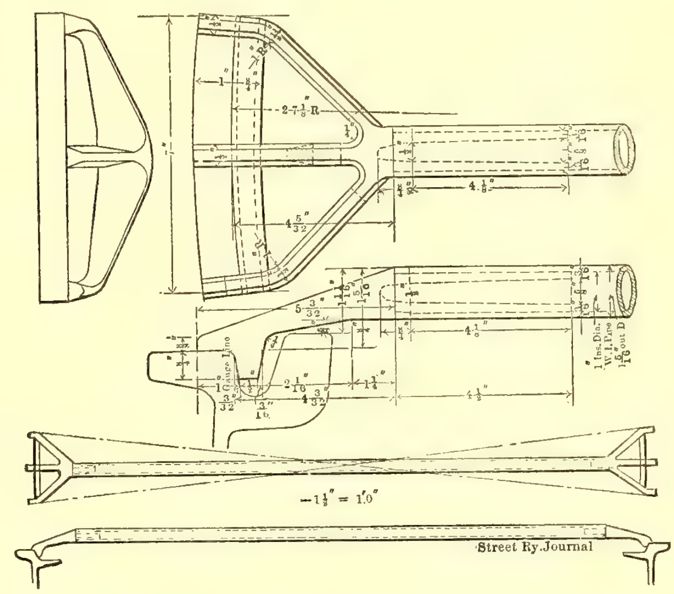
All spikes must be carefully selected and packed in kegs of 200 lbs. each, securely hooped.

Several other drawings from the portfolio are reproduced herewith.

The rail tongs shown on this page were designed to fold into compact form so as to take up little space on the repair wagon. It will be noticed that in this design the handles, when the tongs are closed, fit snugly together instead of bulging out as in the usual style.

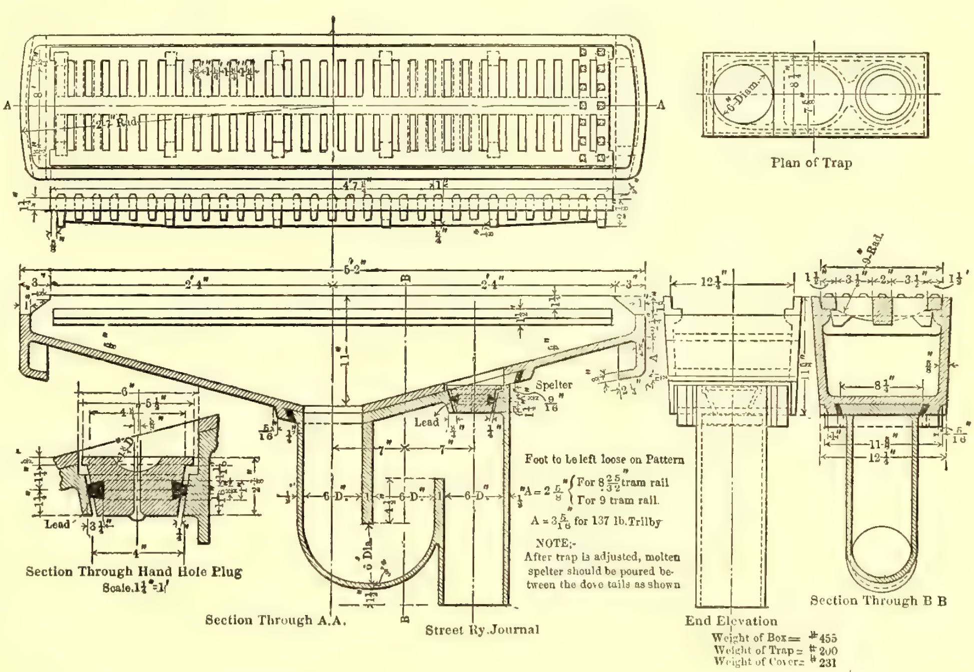
The gage rod designed for gaging track has an elongated guide shaped to a slight curve. The advantage secured is that even though the gage rod is not exactly at right angles to the rail, the guide will still give accurate gage.

One of the drawings shows the company's standard form of track drain, which has been designed to prevent sewer gas from escaping to the surface. The drain casing is made in two pieces, comprising the drain proper and the trap. These are assembled by means of a dovetailed recess at the bottom of the drain and a dovetailed projection over the top of the trap. The two sections are held together by means of spelter. The straight part of the



PHILADELPHIA RAPID TRANSIT STANDARD TRACK GAGE

trap which connects to the sewer pipe has a cast-iron plug which can be taken out by lifting up the cover of the drain. This is made for the purpose of cleaning the drain of any obstruction, especially during freezing weather. This plug has a lead ring cast around its sides, fitting accurately into the opening and designed to prevent any gases from escaping. The drain cover is



STANDARD TRACK DRAIN

cast iron and has two columns of openings, as shown, with sets of plugs extending across the face to prevent horses from slipping. At the bottom of the drain there are lugs to fit the fish section of the foot of the rail, so that the drain rests directly on the rail and there is no possibility of its sinking or shifting.

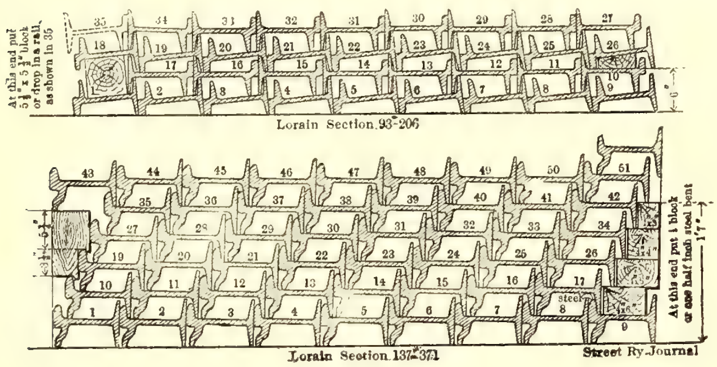
Even the method of piling rails in the store yard has been reduced to a standard, and a rail-piling diagram is included in the

portfolio of standard drawings. The diagram is reproduced on this page as being of possible interest to other companies. It was found that when rails were kept in quantities it became a question as to how to pile the rails in order to economize storeroom space as much as possible. By experiment it was found the method of piling as outlined in the diagram permits of stacking the greatest number of rails in the least possible space.

BRIDGE JOINT

One of the accompanying half-tone engravings shows the form of rail expansion joint used on the new Market Street bridge. This joint consists of two castings having elongated points for expansion, these castings being fitted into a box which is bolted directly to the buckle plates of the bridge. The ends of the casting are of the same cross section as that of the abutting rail and are joined up to these rails by standard fish-plates. These joints will permit of from 4 ins. to 6 ins. in variation in length of bridge rails without any appreciable bulging in rails or joints.

Another of the engravings makes clear the method of laying track on bridges. It will be seen the rails are supported on cast



RAIL-PILING DIAGRAM

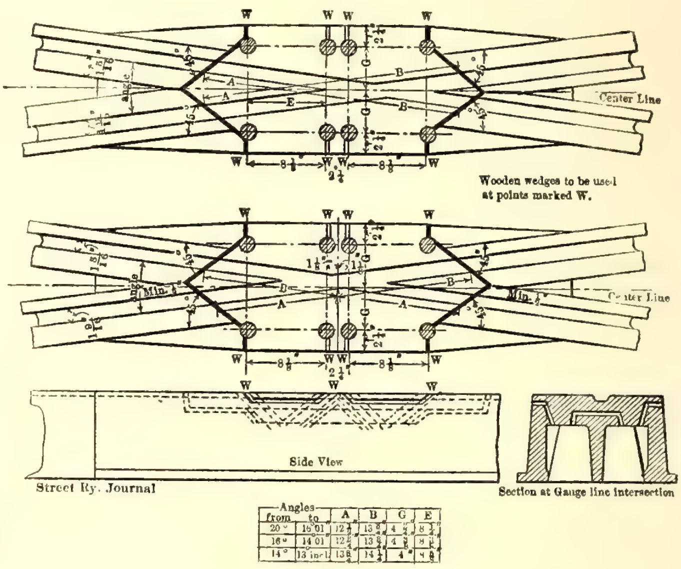
steel U-shaped chairs, which fit loosely around the rail and are riveted directly to the bridge structure. The space between the rail and the chairs is filled with spelter. Bolts pass through the web of the rail and chair to prevent the rail from creeping.

THE MANUFACTURE OF SPECIAL WORK

It is rather interesting to note that within the city limits of Philadelphia there are 1100 street railway crossings with other street railway lines and over 400 street railway crossings with steam railroads at grade. In all there are 1800 locations of special work comprising about 3100 individual pieces of special work. About 33 per cent of these are right angle crossings, the rest being connecting curves, cross-overs, steam railroad crossings, etc. In view of the necessity for maintaining this great amount of special work, the company has found it advantageous to undertake the manufacture in its own shops of most of the crossings and other pieces of special work required on the system. For this purpose extensive shops have been built and are described in the course of this article.

The special work for the most part is of the hardened center type, but these centers are made larger than in most cities. A novel method of holding the center in the bed is employed. In addition to the usual spelter filling, the pocket and hardened steel center have diagonal recesses so that when the steel plate is dropped into the pocket these opposite and complementary recesses form four diagonal grooves converging downward toward the center. In these diagonal grooves are fitted four very thin brass tubes, and the tubes together with the under part of plate and pocket are filled with zinc spelter. The object of the brass tubing and the downwardly converging grooves is as follows: When in the course of time the hardened steel center plate is to be renewed the spelter that fills the tubes in the four grooves can be driven out with the use of a round die and sledge hammer, thus releasing the plate without disturbing the surrounding paving. The new plate can then be set into the old pocket in the same manner as when the crossing was first built. The brass tubing serves to form a separation between the body of the zinc that fills the pocket and the bolts of zinc that are to be driven out.

The distinguishing feature in the form of switch now followed as standard is the extra broad and heavy tongue. When the switch is located at the entrance to a curve the design permits of continuing the switch point in a line almost true to the theoretical outline of the curve. It will be understood that if the tongue were built to the true theoretical curve it would taper down to a very thin section, and at the point would be subject to constant wear and breakage. In the Philadelphia Rapid Transit standard switch the tongue follows the curve nearly to the tangent point,



STANDARD PLATES FOR FROG CENTERS

but is reinforced with a shallow shelf or ledge at the side, the clearance from the top of this shelf to top of tongue being sufficient to clear the flanges of the wheels. While strengthening this part of the tongue this shelf or ledge acts as a path for wagon wheels and carries them over the recess in the switch block, thus preventing the wheels from becoming jammed or wedged in the switch.

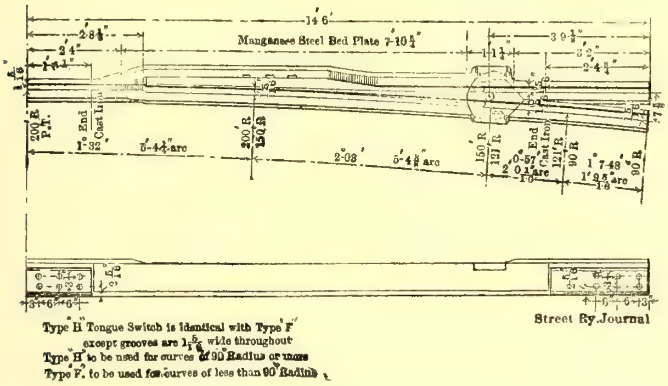
OUTFIT FOR RENEWING SPECIAL WORK

In one of the engravings, Plate XV., will be seen a repair wagon designed for use in connection with renewing hardened steel centers in special work. The wagon is equipped with air compressor and fuel oil tank, a melting pot for melting zinc spelter, two reservoirs for compressed air storage, pockets for carrying hose, two hydro-carbon blow pipes with hose attached, a tool chest for small tools and a tool chest under the rear part of the wagon for carrying long tools, such as bars, etc. The fuel oil tank is connected with the oil reservoir through reducing valves, so that the oil is under about 5 lbs. pressure, or just sufficient to force the oil to flow to the burners. The two hand blow pipes are connected to the oil tank and also to the oil reservoir and receive air at about 25 lbs. pressure. The melter consists of a cast-iron pot, about 8 ins. in diameter, surrounded by a double sheet-iron jacket which is packed with mineral wool. An oil burner under the melter supplies heat for melting, and is so arranged that the flame enters the melter longitudinally and after circulating through the space between the cast-iron pot and outside jacket is allowed to escape through an opening at the top. This opening is provided with a stand in which is kept the carbon crucible for carrying spelter from the wagon to the special work in the tracks. By this arrangement the escaping heat keeps the crucible at high temperature and prevents the spelter from chilling while it is being carried to the work. The melting pot is mounted on trunnions to

prevent the contents from splashing as well as to provide for tipping when the small crucible is being filled.

ROADWAY SHOPS

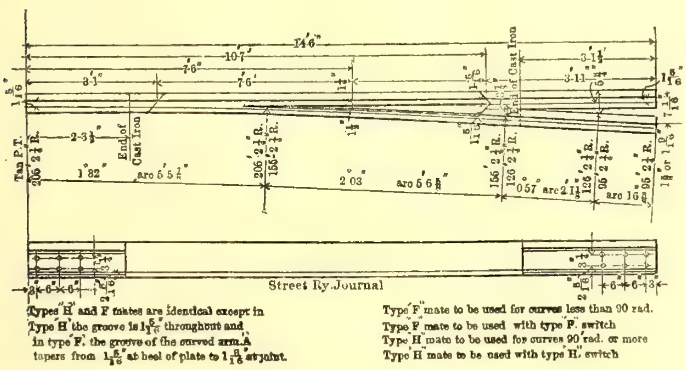
The roadway shops, where the company is building most of the special work for its entire system, including hardened steel renewable center crossings and frogs, all castings, track drains, manholes, tools, etc., are probably among the most complete of the kind in the country. The principal feature of these shops, besides their completeness, is the maximum economical utilization of mechanical power and appliances for the handling, working and finishing of the materials. The shops are located on the eastern and western side of Schuylkill Avenue, above Catharine Street,



PHILADELPHIA RAPID TRANSIT STANDARD SWITCH, TYPE H AND F

the eastern part of the buildings having been rebuilt from the first car house and power house that formed part of the Philadelphia Traction Company's first electric line. The shops occupy a plot of ground approximately 500 ft. x 194 ft. They comprise a rail yard, a layingout yard, a machine shop, a woodworking shop, a foundry, a blacksmith shop, general storeroom for the roadway department, storerooms for the shops and the offices of the shops.

The rail yard, in which stock rails are kept, is located alongside the Baltimore & Ohio main line, and consists of a structure 194 ft. x 70 ft. It is of steel skeleton construction, having brick



PHILADELPHIA RAPID TRANSIT STANDARD MATE TYPE H AND F

walls on three sides, the fourth wall, which communicates with the layingout yard, being left open, so that the rail yard is separated from the latter by the columns of both structures. Throughout the entire length of this yard runs a trackway supported on columns on which a 5-ton electric crane is operated. The capacity of the yard is 5000 tons of rail. As will be noticed from the diagram on page 498, the rails are piled very snugly, with the view of economizing space.

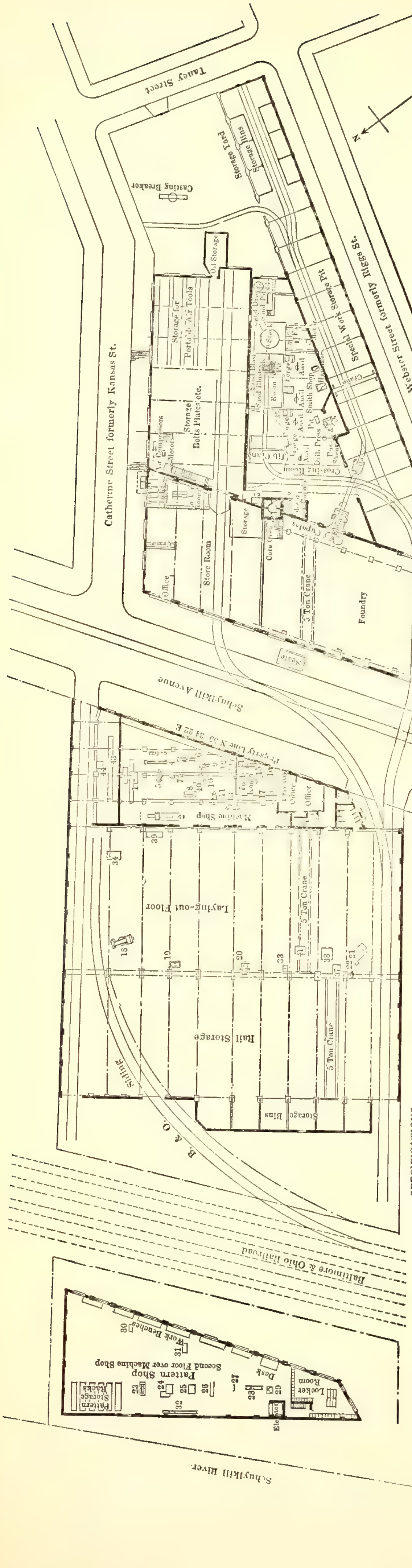
The layingout yard, which is adjacent to the rail yard and abuts the machine shop, is a structure similar to the first and occupies a space 194 ft. x 82 ft. Here also a 5-ton electric crane runs from end to end. The roofs of both these structures have large skylights and ventilators, which give good light and air. The floor in the layingout yard is built of wooden blocks cut from ties and placed on end on a bed of concrete, the joints being filled in with pitch. This gives an indestructible floor and at the same time it is very accommodating to stakes and bars that may be used in setting up work. In this yard are machines for bending rails, punches, shears, circular saws, drill presses, grinders and other machinery for building special work. Each of these machines is run direct by independent motors. The location of all machines is shown on the plan.

The machine shop occupies the ground floor of the irregular shaped plot of ground fronting the west side of Schuylkill Avenue. Here are located the smaller machinery as well as the heavy planers. A part of this is also occupied by the tool room. The heavy machines here are run by independent motors. There are two lines of shafting running from end to end. One shaft is driven by a 20-hp motor located in the tool room, and drives by belts all the light machinery, while the other line of shaft, which is driven by a 30-hp Crocker-Wheeler motor located on the floor above, operates the machinery in the woodworking shop on the second floor above the machine shop. In the woodworking shop, the patterns, flasks, templets, etc., are made, and here is also stored the lumber and patterns. The latter are distributed on pattern racks built of angle skeletons on which wire screenings are used for shelving. This gives for the patterns a good circulation of air on all sides and the shelves of wire screening prevent any accumulation of dust. A hydraulic hoist runs to this floor.

Next to the machine shop is located the office of the superintendent of the shop, as well as that of the clerks. Further south is located the men's lavatory; the space above the offices and lavatory is occupied by the men's dressing room, which has lockers of wire screening as well as washtrays.

The foundry was rebuilt from the old boiler house and is 100 ft. x 67 ft. It has two Whiting cupolas, one 48-in. and one 36-in. dia., which are supplied with blast by a positive blower. A 5-ton electric crane supported on independent I-shaped columns is operated here. The most novel features of this foundry are the universal clamps for crossings and frogs, illustrations and description of which are given herewith, and also the core oven. The interior of the core ovens is built of cast-iron plates, so that the flame and smoke which generally enter the usual core ovens is carried between the plates and the brick walls, so that while the oven is perfectly clear and clean inside, the maximum amount of heat is utilized. There are ventilating communications from the interior of the oven to the stack to carry off the moisture. The material for the cupola is served by a hydraulic hoist, located as shown on the plan. A pneumatic moulding machine is used for standard castings.

The blacksmith shop has four Sturtevant down-draft 48-in. x 60-in. style J-2 forges, and one Sturtevant circular 60-in. dia. forge, style N-3. The air to the forges is supplied by a Sturtevant size "0" monogram blower, and the gas and smoke are carried away by a 90-in. Sturtevant exhaust. The blower and exhaust are run by one 10-hp Crocker-Wheeler motor; the latter, together with the blower and exhaust, being placed on an elevated platform. The exhaust carries the gases directly into the old power house stack. Besides exhausting the fumes from the forges, the blower also carries away the dust from the sand-blast room. This sand-blast room, which is 30 ft. x 19 ft., and is used for finishing off castings, has a large square pit covered with cast-iron gratings. In this pit, several inches above the bottom, lies a terra cotta pipe connected to the 15-in. terra cotta exhaust pipe which runs under the row of forges and connects up by means of an iron galvanized pipe to the exhaust. In finishing up the castings or sand blasting, the rough castings are placed on top of the gratings and the dust is carried away by the fan, while the sand drops down to the bottom of the pit and can be used over again. In the blacksmith shop are also located the melting pots



SPECIFICATIONS

No. 1- 42" Planer - Fitchburg Mach. Co.
2- 36" Planer - Powell - Worcester Mass.
3- Small Lathe
4 Lathe - E. P. Bullard
5- Cincinnati Shaper
6- Lathe - Shipley Mach. Co.
7- Verticle Drill - W. E Shipley
8- Radial Drill - Bickford - W. E. Shipley
9- Small Lathe - Carvin Mach. Co.
10- Emery Wheels
11- 24" Planer - Amer. Tool Wks.
12- Shaper - Gould & Eberhardt
13- Screw Cutting
14- Lathe - Lodge & Shipley
15- Grinding Mach., Greenfield Mach. Co.
16- Tool Grinder
17- Motor
18- Rail Bending Machine
19- Cold Saw Cutting off Machine
20- Punching Machine
21- Cold Saw Cutting off Machine Newton
22- Saw Sharpener
23- Grindstone
24- Planer
25- Circular Saw
26- Jointer
27 Band Saw
28- Wood Lathe
29- Motor
30- Trimmer
31- Large Trimmer
32- Swing Saw
33- Drill Press
34- Punch
35- Zinc Melters for Crossing Work
36- Blacksmiths Bench
37- Saw Grinding Machine
38- Large Higley Saw on Turntable
39- Tongue Pin Grinding Machine
40- Tool Grinder
41- Saw for Bevel Cutting Guards
43- Wood Planer
44- Circular Rip Saw

PLAN OF ROADWAY SHOPS

for the spelter, which is used for setting hardened steel centers. Here are also located heavy shears, power hammers, drill press and grinders. Back of the blacksmith shop is the sand-drying room, which has a large pit for the dried sand; and further back is the yard, where a pneumatic drop for breaking up scrap is located. Old special work is broken up here and assorted, the cast iron and spelter being used over again, while the rail is sold.

Alongside of the blacksmith shop and yard the old car house pits have been utilized for storing special work. This is also served by a 2-ton electric crane which runs the entire length. The general roadway storerooms, men's lavatories and lockers and one shower bath is located in the north part of the building. There are also several hoists for handling material.

The shops are heated by a boiler plant located alongside the west side of the layingout yard, and the heating is done by Sturtevant steam hot-blast system. The pipes through which the hot blast is forced run throughout all buildings. The same fans and pipes are utilized in the summer time for cooling the shops by sending volumes of air through the pipes. In one corner of the storage room are located two Fairbanks-Morse air compressors with their air reservoirs, one for low pressure up to 25 lbs., and one for high pressure of 125 lbs. A system of pipes, which end in nozzles, run from the air reservoirs to different locations in the various shops where sand blasting or various pneumatic tools and hoists are easily attached and used.

From the track layout and the hoisting machinery described in the foregoing it will be understood how economically the work is handled. When the material arrives on the rail siding, which enters the rail yard and the layingout yard, it is unloaded from the cars by the cranes. If it is rail, it is piled up as shown in the diagram, or if it is other kind of material, it is placed on a small electric service car and carried where desired. The rail proper, when it is being worked into special work, is served by the cranes from saw, bender and punch, and is placed on the ground for fitting up. When no foundry work is necessary to do on it, it is then hoisted on the construction cars, with which all the divisions are supplied, and taken to the location intended in the streets. In case the rail has to go to the foundry or blacksmith shop, the service car takes it over there and the foundry crane places it in the flasks from the foundry; again it is taken in the service car to the finishing or blacksmith shops, and then either stored away or taken to the street location. It will thus be noticed that from the time the raw material arrives and until the finished article is ready to put in the ground, all handling and hauling is done by machinery.

OTHER APPLIANCES FOR THE ROADWAY DEPARTMENT

On the accompanying plates are shown a number of track tools and appliances that have been developed for the use of the roadway department.

The portable drop hammer was designed for breaking castwelded joints and concrete beams when renewing old track construction. The drop hammer, as shown, is collapsible and is mounted on a flat car which is drawn by a motor car from point to point as its services are required. The winch is operated by a GE 800 railway motor. The drop hammer weighs 1500 lbs. and has a fall of 16 ft.

The portable rail punch is used for punching holes in joint plates and rails in the street. The punch is carried on the arm of a hand-wheel which is counterbalanced at the end to assist in raising the punch.

For drilling, reaming and grinding in track work the company has a number of portable electric plants, consisting of a motor mounted on a small truck with gearing, flexible shaft and attachments. The plants were furnished complete by the Gem Manufacturing Company.

One of the engravings illustrates a hand truck used for carrying short pieces of rail and parts of special work from one point to another. The rail is slipped through a chain loop hung from the

yoke of a truck and is balanced by a brace which is set a short distance out on the handle of the truck.

The night-light stands are utilized for giving illumination while doing work at night. Each stand carries a bank of 10 lamps, which receive current from the trolley wire through a fish-pole connection. The ground terminal is connected to the rails. When a car passes, the poles are raised from the trolley wire without disturbing the position of the stands.

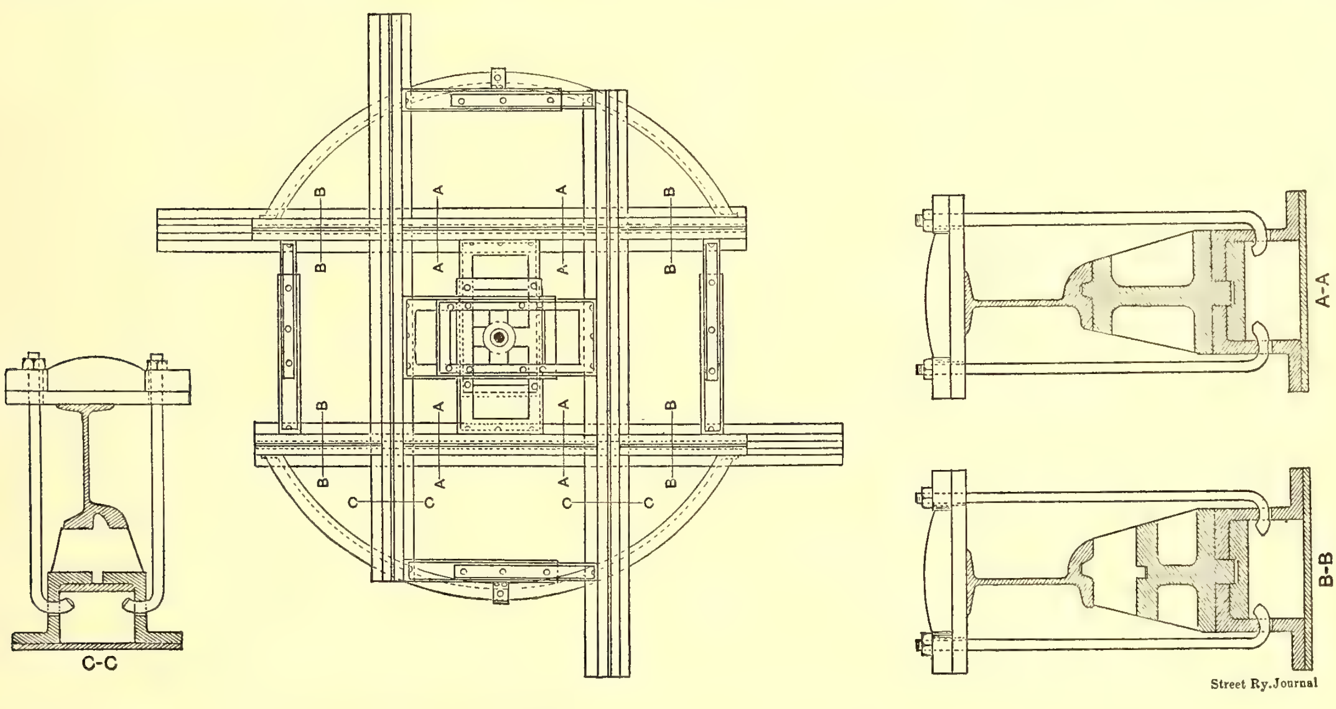
The large amount of curves and special work require the attention of a considerable force of track greasers. In order to enable these men to get around the system without loss of time, small wagons, known as "greasers chariots," as shown in the engraving, have been devised. These wagons are large enough to hold two pails of grease, sand, salt, a switch iron and a broom, and the men go rapidly from one curve to another. All the curves on the system are greased at least once a day, and some curves three or four times a day.

RAIL CAR

For carrying long rails through the city, an ingenious car has been built as shown. With this device, 62-ft. rails can be handled around 33-ft. radius curves in 26-ft. streets without trouble.

hose, and are carried in an iron pipe along the bottom of the skeleton frame, so that the car may easily take either sharp curves or grades. This connecting frame consists of three parts. The two end parts comprise two square frames, 7 ft. on a side, built of I-beams and braced together with channels; in the center are castings fitted into two parallel channels and pivoted directly over the king bolt to the car proper. The middle part of the connecting frame is also built of I-beams and braced with channels, and is connected to the two end portions by means of extending plates and heavy pins, thus permitting this portion to swivel vertically, and allowing the two ends of the cars to stand at different elevations, as when going over a grade. By removing the pins, the two end cars may be disconnected and used separately as construction cars.

Across the king pins of each square end of the frame are attached bolsters, on which the load of rail rests, so that the entire load rests on these two supports without touching any other part of the car, and in going over grades the load swings up or down on these bolsters. Side posts are also placed on each end of the bolsters to prevent the load from slipping off. The car is provided with four skids, two on each side. These skids are chained



DETAILS OF FORM FOR ASSEMBLING SPECIAL WORK

The arrangement consists practically of two specially built double-truck cars connected together with a hinged and swiveling skeleton frame. The double-truck cars have side members consisting of I-beams, over which the adjustable cranes can be moved so as to set them for any length of rails that it may be desired to haul. It will be noticed that the small wheels on which the cranes move roll along the bottom flange of the I-beam when there is no weight to be carried, but when the weight is hoisted the wheels that are farther away from the weights press against the upper flange of the I-beam. On top of each crane is carried a trolley pole, which has a special socket so that it can be easily removed if desired.

On the channel track, on top of the cranes, is a carriage, in which, on a universal hanger, the air hoists can be moved across the entire length of the car. These air hoists are connected with a long, flexible rubber hose to an iron pipe, and through the latter to the engineer's valve. Both hoists, as well as all brakes on each end of the car, are connected, so that the engineer's valves on either end of the car can be used to work both hoists simultaneously, and one man can operate the loading or unloading of the rails. The air connections for the hoists, as well as for the brakes, between the two ends of the car, are also made of rubber

to the sides in such a way that when the car is moving they rest inside of the side I-beams, but when the rails are being unloaded and strung out along the streets, the skids are swung out toward the gutters, and when the necessary number of rails is unloaded and the car moves along a rail length for the next discharge of rails, the skids, by the forward movement of the car, swing themselves in toward the sides of the car, and it is only necessary to swing them out again in order to drop down the next load. The car can be operated by three men, one motorman and two laborers. The capacity of the car is from 20 tons to 25 tons. By means of this car the cost of transporting rails has been reduced from $1.50 or $1 per ton to about 20 cents per ton. The car has been in use for about three years, and has required practically no repairs. During this period over 22,000 tons of rail have been handled on the car.

PORTABLE RAIL SAW

The principal features of the portable-circular rail saw are the quick adjustment to the work, the possibility of using it without the slightest interruption of traffic, the instantaneous adjustment of the saw to the cut after the cars pass by, and the economy in time

necessary to make a cut. The work can be done at the rate of three cuts per hour, and a single cut has been made in the short time of 12 minutes. The saw consists of three parts. The clamping part, which holds the mechanism to the rails; the saw frame, on which the saw proper and gearing, as well as the feed mechanism, is attached, and the motor part. The clamp is made of two halves, connected together by a swivel, and is attached to the rail by means of a screw, which draws the clamps together and holds the saw to the rail. This screw is tightened by means of a removable hand-wheel. From the half of the clamp that fits on the outside of the rail there projects obliquely upward a frame which reaches slightly above the rail and ends in a bearing block that in cross section is diamond shape. This bearing block is split, the upper half being arranged to be locked down by a swing bolt or cam. Into this bearing the shaft of the saw frame is placed and adjusted to the cut. The saw on its shaft swings also on this bearing when it is being fed or when it is necessary to permit the cars to pass. The diamond-shaped bearing insures perfect fit and alignment regardless of wear or the presence of dirt.

The saw frame consists of a Z-shaped steel casting, to which is attached the gear and the feed mechanism. The saw gearing is of the standard Higgly construction. The feed is arranged through a friction clutch, so that in feeding, the hand-wheel is turned at a regular rate of speed, but in case the saw strikes some particularly hard portion, the hand-wheel turns without moving the feed screw. The obliquely-projecting frame has on the side nearest the web of the rail a small T-shaped slide, which in its normal position locks the frame in a position to cut, but when this T is moved toward one side it permits the entire saw frame to swing out to allow the cars to pass. From this it will be noticed that after the cars have passed the saw is instantaneously brought back to the exact position where the cutting was stopped, and ready to be continued without any adjustment. This is the most valuable feature of the saw.

The truck on which the saw is transported can be either attached to the rear of a wagon for long-distance transportation or be pulled by a man for short distances. On this truck is mounted a 4-D Christensen compressor and a small air reservoir. The saw is driven by means of a slow air motor, which is connected to the reservoir with a long rubber hose. This motor ends in a square shank, which is placed on the gear shaft when in use.

The method of operating the saw is as follows: When the truck is brought approximately near the work, the clamp is first attached to the foot of the rail, within a few inches of the spot where the cut is to be made. The saw frame shaft is then placed into the bearing and adjusted latterly so that the saw comes exactly opposite the line of cut. The motor is then attached to the shaft of the gear, and the motor started. When a car comes along the T-lock is moved out, and the entire frame and feed is swung outward and brought back again when the car passes. The rubber hose which connects the motor with the reservoir permits of the truck being a considerable distance away from the point of work, thus providing for any obstruction or wagon traffic that may be on the street.

SWITCH TONGUE PIN GRINDER

To insure the perfect working of a tongue switch it is of the utmost importance to have the pin in the tongue perpendicular to its bottom surface, and the pin itself must be to a true cylinder. If the first condition is neglected the tongue will have a tendency to jump and the rear wheels of a car passing over it may be derailed. If the contour of the pin is inaccurate, the pin cannot be made to set tight in the switch bushing. As all of the tongues made for the company are of manganese or chrome steel, a metal so hard that it cannot be machined with ordinary tools, some of the switches have been supplied with tongues having a separate pin riveted in to get a perfectly true fit. In order to avoid this, and to permit of the casting of a solid hardened steel tongue and pin in one piece, the company has designed the special pin grinder shown on Plate XVI., and which is installed at the roadway shops.

The movement of the principal drive in this machine is believed to embody an entirely new mechanical construction.

The machine consists of a bed on which is mounted the tongue rest or stand, which is arranged to move along the bed by means of a worm screw in conjunction with the support of the swiveling grinder-drive, which is fast on the bed, and the rear drive of the grinder, which is also fast on the bed. The tongue stand has a V-shaped jaw on which the pin rests and it is adjustable to bring the center of the rough pin in line of center of the grinder. After the pin is so adjusted the tongue is then gripped by means of two clamps against the outside surface of the tongue stand, thus insuring that the pin after it is ground will be perpendicular to that surface.

The principal drive of the grinder consists of a saddle fast on the bed and having on the top a perpendicular conical-shaped pin on which a fork-shaped bracket has a horizontal movement. The upper two arms of this fork end in a bearing in which is fitted a yoke having a vertical movement. This yoke carries the grinder shaft, the driving mechanism and the feed screw, and ends with a ball and socket joint fitting into the face plate of the rear drive. In the long axis of the yoke are two bearings that carry a tubular shaft in which an inner shaft carrying the grinder is loosely keyed. The tubular shaft is driven at the rate of 1000 r. p. m. by means of a pair of beveled pinions and a small pulley which is belted to the pulley of the motor above. The inner or grinder shaft, being loosely keyed in the tube and projecting from both ends of the tube, may be moved along its axis by means of the feed screw, as will be seen in the engraving. The face plate moves at the rate of 10 r. p. m., and through the ball and socket joints imparts to the grinder shaft a sweeping movement which describes the contour of two cones, which meet at the intersection of the axis of the conical pin of the saddle and the center line of the two bearings of the fork.

The point of intersection of the three movements has zero movement, as each plane of a cone parallel to its base is a circle. The grinding edge of the emery wheel which is mounted on the other end of the inner shaft describes a circle, the diameter of which may be varied by moving the emery wheel nearer to or farther from the zero point by means of the feed screw. From this it will be seen that as the pin is ground down or the emery wheel wears away, by moving the inner shaft toward the face plate, the cutting edge of the emery wheel is made to describe smaller and smaller circles. The action is equivalent to the movement of the cutting tool on an ordinary lathe towards the axis of the work.

Of course, as the emery wheel is drawn away from the tongue-rest by this feeding, the tongue-rest is also moved nearer, either by hand or by the automatic feed through the worm screw. The center of the pin, the zero point, and the center of the face plate lie in the same straight line.

PAVING

As stated elsewhere in this issue, the Philadelphia Rapid Transit Company is required by the terms of its various franchises to maintain and renew the entire paving from curb to curb on all streets in which it has tracks. As a result of these conditions the company is now maintaining 6,685,000 sq. yds. of paving, of which 64.5 per cent, or 4,316,000 sq. yds., is Belgian block; 22.4 per cent, or 1,500,000 sq. yds., is asphalt; 5.1 per cent, or 342,000 sq yds., is brick; 7.5 per cent, or 499,000 sq. yds., is macadam; 0.5 per cent, or 27,699 sq. yds., is cobble.

In streets paved with asphalt it is now the standard practice to pave between the rails with Belgian blocks, and two longitudinal rows of blocks are laid along the outside of each rail. Where the entire street is paved with Belgian blocks, the paving is laid crosswise over the surface of the street from curb to curb.

DEPARTMENT OF LINES AND CABLES

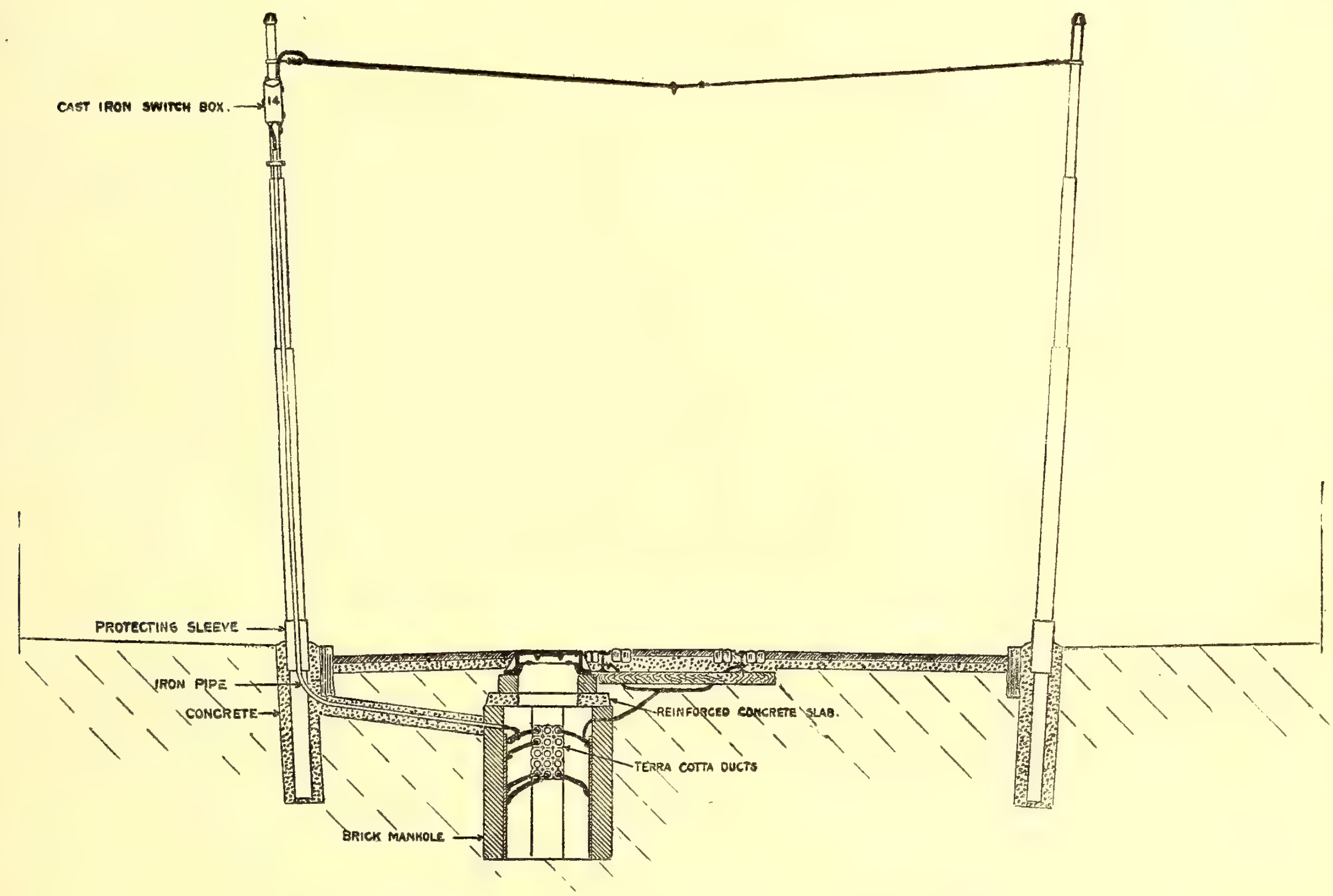
On the Philadelphia system the distribution of power is accomplished almost entirely through underground cables. These cables are installed in the company's conduits, which are used exclusively for its own power, telephone and return cables. Over 1000 miles of underground cable are in use for the distribution of power. There is one stretch of 5 miles of overhead a. c. transmission lines on the new Willow Grove route, and there are short sections of overhead d. c. feeders, but for the most part the distribution system is underground. As outlined in the maps included in this issue, the distribution centers consist of ten d. c. generating stations, two a. c. generating stations (one of which is now under construction), four chloride accumulator battery stations and six rotary converter sub-stations.

For cable conduits terra cotta ducts have been adopted as standard. These ducts are laid in single-duct formation, and are surrounded by 3 ins. of cement concrete. On straightaway stretches elliptical manholes are placed at frequent intervals, the manholes being for the most part 9 ft. long, and varying in depth and width according to the size and location of the conduits. Square manholes are placed at the junction points. The manholes are connected with the sewers by terra cotta drain pipe, and each hole is thoroughly cleansed every two months.

The d. c. cables differ in size, but the standard sizes are 1,000,000 circ. mil, 1,500,000 circ. mil and 2,000,000 circ. mil. Rubber, jute and paper insulations for cables are in use, but the standard cable is covered with 5-32-in. saturated paper insulation, with a 5-32-in. wall of lead. The size of the cables is figured on a basis of a maximum loss of 10 per cent voltage. The sections to be fed were first made short, so that in case one cable became disabled the next section would be able to carry the load, but, inasmuch as very little trouble has been experienced with the underground cables, the sections have been increased in length and in size.

Most of the trouble in the underground cables is due to mechanical injury of one form or another. Mechanical injury in manholes is now being avoided by assigning each cable a certain hanger in the manhole, and the cable is thoroughly secured in the position allotted to it.

Feeder taps are taken off at intervals of from 500 to 1000 ft. in the feeder sections. The feeder sections vary in length from 2000 ft. to 5000 ft. The taps are brought up the feeder poles through $2\frac{1}{2}$-in. iron pipe. The tap cables are insulated with 6-32-in. rubber compound covered with $\frac{1}{8}$-in. lead and protected outside the lead with a weather-proof braid. A cast-iron switch-box containing a 250-amp. switch is placed near the top of each feeder pole, and the tap cable is brought through this switch before connecting to the feed span. The feed switch has been found the most satisfactory method of connecting the taps to the feed spans. Connection is made from the top of this switch-box to the span, which is permanently connected to the trolley wire by a solid metallic hanger at the feed ear. Where the feeder connection rises from the top of the switch-box, the lead covering is continued up a short distance, to insure absolute waterproofing. The lead is then stripped off and the rubber-covered cable is continued to the tap connection. On the other side of the pole from the feeder switch is a lightning-arrester box, the lightning-arrester lead being a rubber-covered wire wrapped in circular loom, the lead passing from the under side of the switch-box to the lightning arrester. The ground from the arrester box passes down through an iron pipe to the underground return cable.



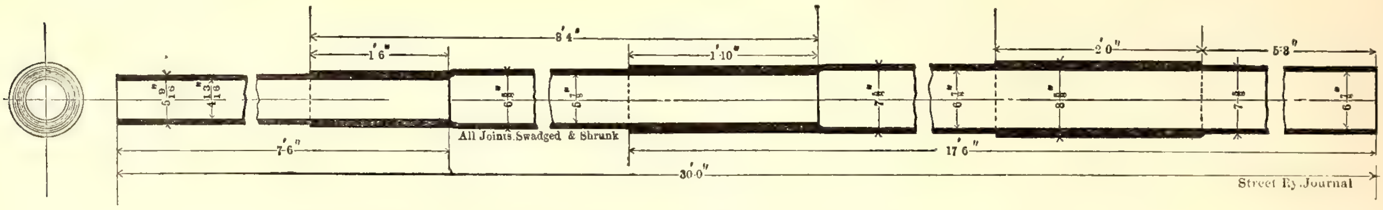
SECTION OF FEEDER POLE, SHOWING STANDARD CONSTRUCTION

Trouble from electrolysis on the lead sheaths of the underground cables has been practically obviated by the use of special

insulated return cables extending for a radius of about 1000 ft. from each power house, connected to the negative bus-bars and bonded to the lead coverings.

Ample capacity in return cables has been provided, the negative cables varying in cross section from 1,000,000 circ. mil to 3,250,000 circ. mil, and being connected to the rail at each manhole through a No. 0000 bond. The standard return feeder is a 7 x 7 strand bare copper cable.

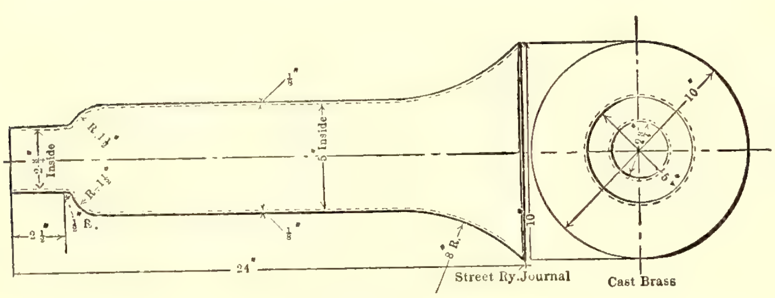
In addition to the feeder cables, numerous tie-line cables are in use between the d. c. distributing centers. The d. c. tie-line layout is shown on Plate XXX. in this issue. The tie cables, as will be readily understood, are very serviceable in equalizing the load betwen power stations and sub-stations, and are also of great service in case of breakdowns.



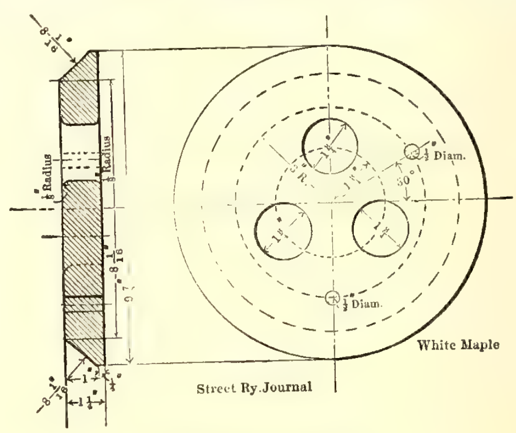
STANDARD 30-FT. STEEL POLE WITH REINFORCING SLEEVE AT SIDEWALK LINE

A. C. CABLES

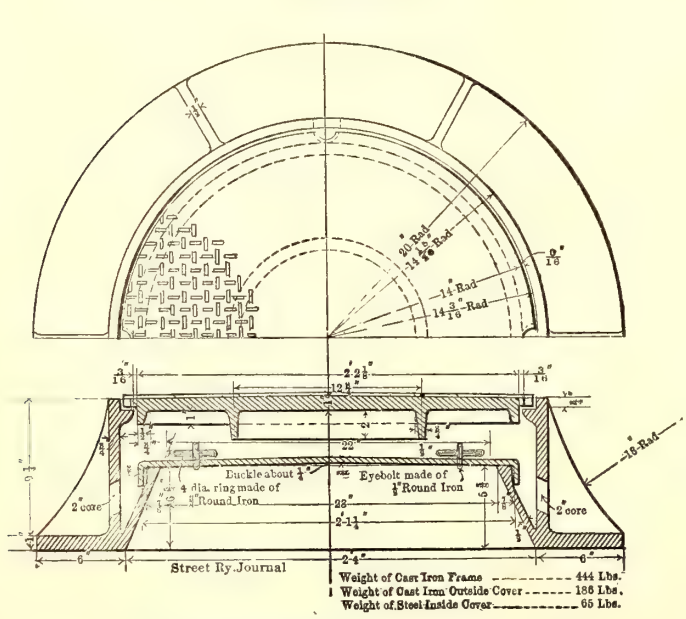
Each rotary converter sub-station is connected to the generating plant by at least two high-tension underground cables varying in size from No. 0 three-conductor to No. 0000 three-conductor. The insulation on high-tension cables consists of a 6-32-in. saturated paper wall around each conductor and a 6-32-in. belt around the three conductors after they have been twisted together. The lead covering is 5-32 ins. thick. The working voltage is 13,200 three-phase,, and each cable is subjected to a breakdown test of 26,000 volts between all conductors before the cable is placed in service. As one cable is sufficient to operate a sub-station, the other cable is kept idle. Each cable is put into service every other day, and is out of service the alternate days. This arrangement protects one cable to each sub-station from any excessive voltage surges which may occur on the system. The a. c. cables terminate in cast-bronze bells, which are supported in the power station and sub-stations immediately under the oil switches. This bell is illustrated herewith. Connection is made to the oil switch by means of three single conductor cables insulated with 14-32 in. of rubber compound, and protected by a double waterproof braid. These cables are spliced to the three conductors of the lead-covered cable in the terminal bell. The a. c. tie lines are shown on Plate XXIX.



CABLE BELL



TOP FOR CABLE BELL



CAST-IRON MANHOLE FRAME AND COVER

OVERHEAD CONSTRUCTION

The standard overhead construction is span wire with steel poles in three sections. All bracket and center-pole construction has been abolished. Each pole has a patent reinforcing sleeve 2 ft. long swedged around the pole above and below the sidewalk level for the purpose of preventing the excessive corrosion that takes place at this point. On old poles, where this sleeve was not used in the first place, the sleeves are now being added by a patented method, which is described later in this article.

The standard trolley wire is No. 00 hard-drawn copper of circular section, suspended on soldered ears from round-top bells. No cap and cone overhead material is used in new work. Owing to the number of crossings and track intersections (there being over 1100 such crossings) it is the practice to insulate the trolley wires at all intersections so as to maintain the proper feeder sections and avoid mingling of current from different power houses. A satisfactory type of insulated crossing has been designed by the company's engineers in order to give a straight under-running. The crossings are made with removable ends, so that the end portions, which are subjected to the heaviest pounding from the trolley wheel, can be readily replaced as they become worn. All feeder sections are separated at the curves by means of a short circuit-breaker, which is placed 18 ins. from the switch on the leaving end, thus doing away with the necessity for insulated switches, which have never been very satisfactory. On curves malleable iron double and single pull-off castings with 2½-in. globe strain insulators are used. Around each curve a safety wire is run parallel to the trolley wire and attached to each pull-off on the curve, so that in case of a trolley break the pull-off cannot drop

to the ground and strike cars or pedestrians. All guy wires on curves are made up into a $2\frac{1}{2}$-in. galvanized steel strand cable ring, so that only one pull-off wire crosses the intersecting trolley wire.

To avoid burning out section insulators or causing trouble at the power house when a car passes from one section to another, the poles on which breakers are located are painted with a broad white band, and motormen have instructions to shut off power when passing one of these poles.

To expedite the work of the emergency crews and for general convenience in referring to cables, every cable on the system is numbered, and this number is stamped on the joint in each manhole. The cables are numbered according to the station from which they feed. For instance, all cables fed from station No. 1 are numbered between 1 and 199; cables from station No. 2 are numbered from 200 to 299, etc. For reference purposes, the feeder lay-out is divided into sections, and blue-print maps are made of each section showing each cable, feeder tap, insulator, etc. A portion of one of these maps is shown on page 507 to illustrate the system.

For drawing cables through the conduits there has been designed an electric winch, shown on one of the accompanying plates. The winch is equipped with a 10-hp motor of the Christensen air-brake compressor type. The motor drives a shaft through gear and pinion, and the shaft is geared to the winch by beveled gear and pinion.

EMERGENCY CREWS AND HURRY-UP REPAIR SERVICE

There are held in readiness at all times for immediate service six emergency wagons and two tower repair wagons, the latter being engaged in doing heavy repair and construction work on overhead lines. The emergency wagons respond to all calls in case of trouble, such as breaks in the overhead system, broken wagons, fires,etc. The emergency calls are received at the emergency desk, and the despatcher on duty immediately transmits the call to the nearest wagon available for the purpose, and then notifies all operating depots concerned that there is liable to be a blockade, and the routeing of cars is changed in accordance with the necessities of the case.

The emergency despatcher keeps a record of the movements and locations of all the emergency crews and wagons at all times, and uses for the purpose a large sheet with the column headings shown in Form 144. The time a wagon goes out is noted, and when the crews report they have finished the work they were assigned to do, proper notation is made on the sheet. This sheet also gives the location of the trouble and the nature of the trouble. The emergency crews turn in a report of every call to which they respond, using for the purpose Form 33. Summaries of these reports are made on Form 211 and Form 275, the former giving the emergency calls per wagon, and the latter giving the number of calls classified according to the causes of the trouble.

Each emergency wagon carries what is known as the "Linemen's Book of Cables," which shows all the line sections in the city. The book is made up of blue-print sheets bound on the loose-leaf system, and the prints show on what streets the cables run, also the location of the feeder taps and connecting cables. The emergency crews are required to know by memory the location of all the cables, taps, etc., and are examined twice a year upon this subject. Any man receiving 100 per cent on this examination receives a reward of $10; linemen receiving over 90 per cent get $5; helpers receiving over 80 per cent get $5, and drivers receiving over 70 per cent get $5. The linemen are all employees who have served as helpers, and are advanced in accordance with their proficiency.

The general instructions to emergency crews read as follows:

The lineman's book of cables must be kept on the wagon at all times. The lineman in charge of the watch will be held responsible for its condition.

When you cut out or in a cable be sure and see that the current is on the line before leaving. This test can be made by using the cluster of lamps, with which each wagon is provided.

In cutting out cables when the tap comes out of a feeder-head, always break the tap at the head instead of simply pulling the tap at the trolley wire.

When you are called to a wreck do your utmost to get the cars moving. If the injured car is in such shape that it cannot move, pull it off the track. When the wrecking car arrives on the ground you are to work under the direction of the foreman of the wrecking car.

Report in writing when you come in how long the cars were blocked, and the cause.

When you are going to and from a call always keep a sharp watch for anything that may be wrong on any of the company's property. If trouble is found on the track or in paving, report the same as soon as you reach the house to "Emergency."

PHILADELPHIA RAPID TRANSIT COMPANY.

EMERGENCY REPORT. Date, 190

Wagon No.	Time Leaving	Time Return	Reported by	Location of Trouble	Nature of Trouble	Remarks	Foreman

FORM 144.—DAILY REPORT OF EMERGENCY WAGON CALLS

Philadelphia Rapid Transit Company.

Emergency Calls and Causes.

Ending 190

CAUSES	WAGON No.	TOTAL
Break in Trolley Wire,		
" Guard "		
" Span "		
" Pull off,—Guy Wire,		
Charged Pole,		
Trouble at Feeder Pole,		
Feed Taps and Spans,		
Painting,		
Globe Strains leaking and broken,		
Line or Cable Grounded,		
Foreign Wires,		
Ears Off and Broken,		
Bells Off " "		
Hangers Loose and Broken,		
Repairing Bridles,		
Section Insulators,		
Crossings and Crossovers,		
Frogs,		
Brooklyns Leaking and Broken,		
Odd Jobs,		
Repairs,		
Cutting in and out Cables,		
Lining up Special Work,		
Broken Studs,		
Wrecks and Car Troubles,		
Fires,		
False Reports,		
Curve Work,		
Guard "		
Pole "		
Trough Repairs,		
Lights,		
Lightning Arresters,		
Testing and Inspecting,		
Renewing Wire,		
Trimming Trees,		
Total Jobs,		
" Calls,		

Remarks:

FORM 275.—SHEET FOR CLASSIFYING EMERGENCY CALLS ACCORDING TO CAUSES

The lineman is in charge of the wagon and is responsible for the conduct of the other employees.

If permission to "lay off" is desired, the application must be made to the division foreman, and the request will be granted if possible.

When you receive instructions to answer a fire alarm always see that the hose tripods are put on the wagon. When you arrive at the fire the lineman can look the ground over and see if the cars are liable to be blocked, and if so, where to put the wagon so as to open the line. If you require help go to the nearest public or private telephone and notify "Emergency."

The driver and helper must stay on the wagon at all times, unless their services are required to move hose and assist in opening the line.

The emergency wagons are of the Trenton tower type, with the lower section of the tower built of structural iron. The upper section of the tower on which the platform is mounted is wood. The design is well adapted to making line repairs, and also to general wrecking work of all kinds. The towers carry a complete complement of wrecking and repair tools, such as jacks, switch blocks, motor hoists for raising a crippled motor, fire-hose tripods, etc. The emergency stations are fitted out on the pattern of fire department stations, with quick-hitching harness, etc., and in cases of hurry calls, the men and horses respond in accordance with fire department drills.

The number of emergency calls averages about 1000 per month, or 35 calls per day.

RECLAIMING IRON TROLLEY POLES

As many of the trolley poles in use in Philadelphia have been in the ground eight and ten years, the Philadelphia Rapid Transit

Philadelphia Rapid Transit Company.

Emergency Calls per Wagon.

Ending 190

DATE	WAGON No.	TOTAL
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		
HIGH.		
LOW.		
AVERAGE.		
TOTAL.		

Remarks:

FORM 211.—SHEET FOR RECORDING EMERGENCY WAGON CALLS BY DATES

Company has recently been confronted with the necessity of renewing the poles along many of its important lines. In these poles, the point of weakness has been found to be just at the surface of the ground, where the extreme variations in dryness and moisture cause excessive corrosion of the metal. In some cases the poles have been found so badly pitted at the ground line that the shell of the pole could be punched through with an ordinary blow. The poles, with the exception of the corrosion at this point, are in excellent condition, and show no other evidence of weakness.

The company's engineers have succeeded in practically tripling

Form 33. [illegible] 5-15-05.

Lineman's Report.

Wagon No. .... *Date,* *190*

Time: *Leaving,* ....
Return, ...

Time out, ...

Cable No. ....

Trouble, ...

....

....

....

....

Material used, ...

....

....

....

....

....

....

....

Cars detained, ...

.... *Lineman.*

FORM 33.—LINEMAN'S REPORT OF EMERGENCY WAGON CALL

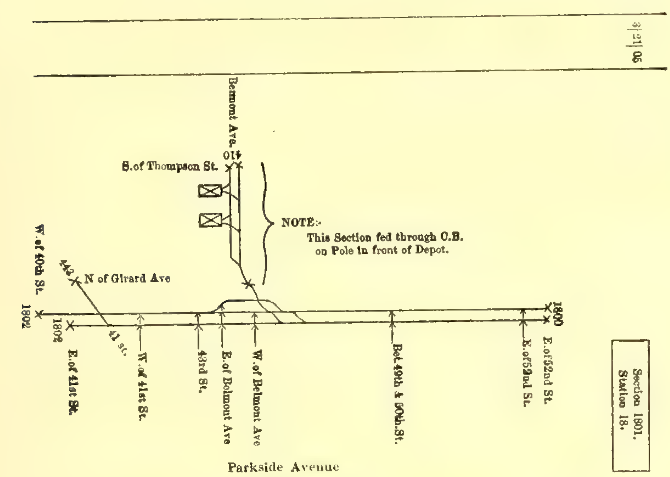
the life of these old poles by the simple method of slipping an iron sleeve over the top of the pole, and bringing it down over the corroded portion at the ground level. This sleeve is 24 ins. long, and has a shell 1/4-in. thick. The space between the sleeve and the pole is filled with molten sulphur, and concrete is poured in around the outside of the sleeve.

In carrying out this work, a hole 24 ins. square is first dug out around the base of each pole to the depth of 10 ins. The poles were formerly set in concrete, and all old concrete is broken out. The band at the top of the pole, holding the span wire, is then removed by the aid of a tower wagon, and the pole is stripped of any breaker boxes, junction boxes or other projections or obstructions. The sleeve is then slipped over the top of the pole and is allowed to slide down so that it rests with about 10 ins. of its length below the ground level and 14 ins. above the ground. Before the sleeve is in place, the base of the pole is, of course, thoroughly cleaned, a wire brush being used for this purpose. The interior diameter of the sleeve is 3/8 in. larger than the outside diameter of the pole, thus leaving a clear space of 3-16 in. all around between the pole and sleeve. Into this space is then poured hot sulphur, the composition being crude sulphur approximating 95 per cent pure. To assist in pouring the sulphur into the opening, a heavy leather strap is placed around the top of the sleeve, and the sulphur is poured from a coffee pot into the space between the strap and the pole, so that it has a chance to flow down slowly and thoroughly fill the space. The sulphur is brought up to 1/4 in. above the sleeve, and is then sloped off from the pole to the edge of the sleeve, in order to turn off water that may run down the pole.

After the sulphur has set, new concrete is rammed into the hole at the base of the pole, the concrete being brought up to the level

of the sidewalk, where it is finished off with a cement block, which is brought 1/4 in. higher than the pavement at the pole, and is sloped off to the pavement so as to drain water away from the pole. The pole is then painted with a dark green graphite paint for a distance of 6 ft. above the pavement.

It has been found that poles reinforced in this way are stronger than they were originally, and it is believed they will last twice as long as the length of time they have already been in place. The sulphur becomes almost as hard as iron and absolutely prevents moisture from getting at the pole proper, so that any corrosion that may take place in the future will be on the outside of the reinforced sleeve, and not on the pole.

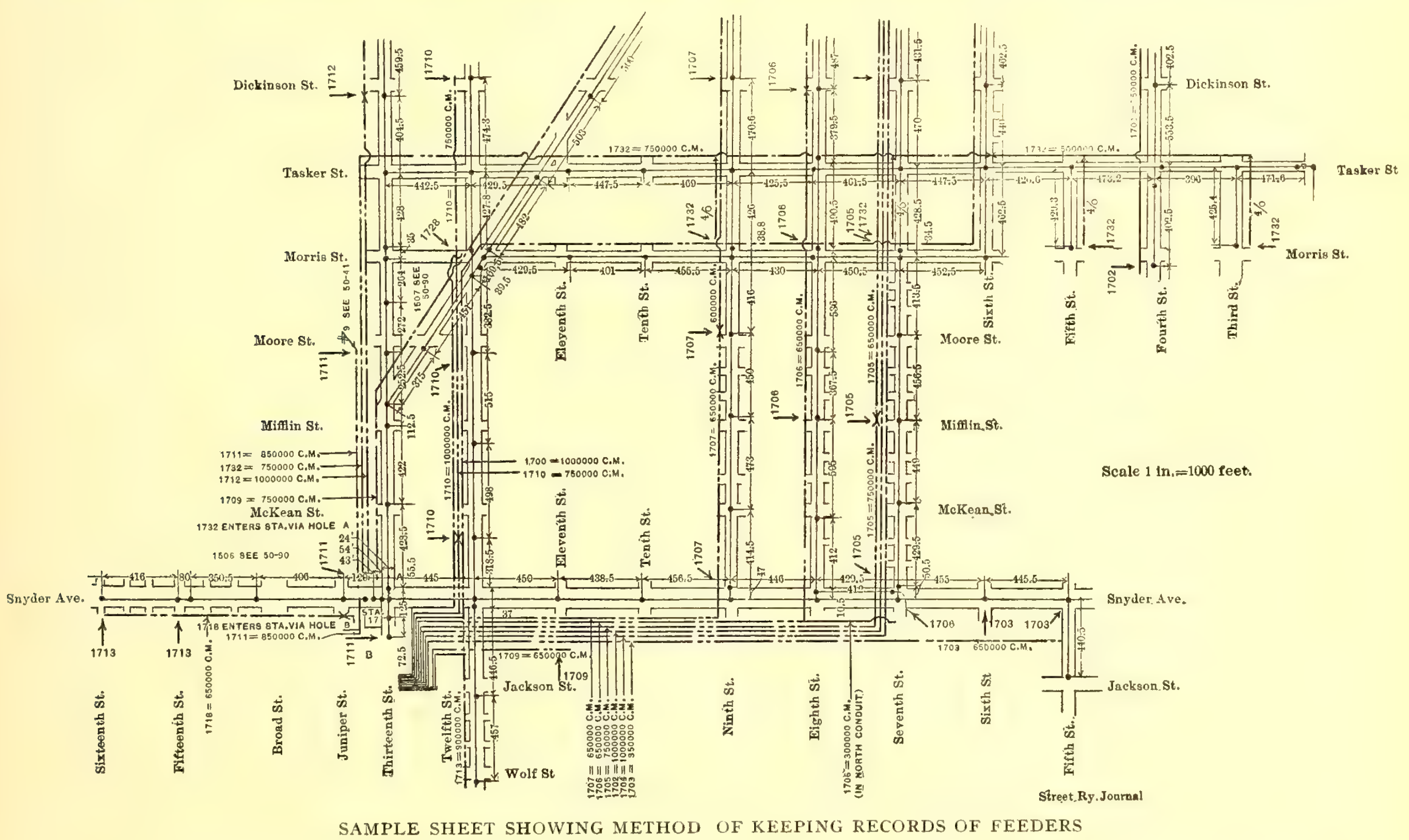


SAMPLE SHEET FROM LINEMAN'S BOOK

A gang for doing this work has been organized, and approximately 10,000 poles have been reinforced in this way during the past year. To expedite the work, a wagon has been rigged up for mixing the concrete cement used around the base of the poles. The wagon has a platform 4 ft. wide, 10 ft. long and 8 ins. deep, with flaring sides. The sulphur is melted in a large cast-iron pot, which is carried on a wagon. For doing the work expeditiously, a gang of twenty-eight men is required, and this gang is now going over the older lines reinforcing all of the poles as they go. From the work already carried out, it is found that the cost for putting the sleeve in place, including all materials and the labor necessary for digging out the holes, pouring the sulphur and reconcreting the hole, is from $5 to $6 per pole. All new poles ordered by the company have a sleeve swedged around the pole above and below the ground line, in order to do away with the trouble which has been experienced with the old poles corroding at this point. The process of reclaiming the poles, as outlined in the foregoing, has been covered by letters patent granted to the company's engineers.

TELEPHONE SYSTEM

The company operates and maintains its own private telephone system, but rents the telephone switchboard and all the instruments from the Keystone Telephone Company. Its private exchange comprises a two-section switchboard, with which is connected about 300 private instruments, covering the entire system, including all departments, car houses, power houses, storerooms, shops, outlying offices, parks, and about 100 street pole boxes distributed at various points. The company's central board has ten trunk lines to the central exchange of the Keystone Telephone Company, and there are ten independent trunk lines for emergency use. There is a separate telephone board known as the "emergency despatcher's desk," to which all emergency calls are transmitted. There are about 60 miles of underground telephone cables, which are carried in the company's own underground ducts. The street pole telephone sets are enclosed in cast-iron boxes fastened to the poles at important street intersections. Street superintendents are provided with keys for these boxes, and keep in touch with the emergency despatches as to the location of any trouble which may be occurring.



SAMPLE SHEET SHOWING METHOD OF KEEPING RECORDS OF FEEDERS

GENERATION AND DISTRIBUTION OF POWER ON THE PHILADELPHIA RAPID TRANSIT SYSTEM

In 1895 the company had plenty of power, but beginning with 1898 the introduction of longer cars and the increased traffic brought about a constantly increasing demand for additional power. This demand was met at first by adding new direct-current generating facilities at different points on the system, and later by installing storage-battery plants at points of heaviest load.

In the beginning of 1903 the engineers of the company recommended the adoption of alternating-current work to the Philadelphia situation, and a temporary plant was erected at Second Street and Wyoming Avenue with 2000-kw capacity in alternating-current generating apparatus. In this connection three rotary and transformer sub-stations were installed, one of 2000-kw capacity at Thirteenth Street and Snyder Avenue, one of 1000-kw capacity at Frankford, and one of 1000-kw capacity at Germantown. In 1904 the station at Second Street and Wyoming Avenue was increased by the installation of four 1500-kw Parsons turbine alternating-current units. During the time these additions were going on three additional sub-stations were built, one of 3000-kw capacity at Fifty-Second Street and Lancaster Avenue, one of 2000-kw capacity at Glenside, and one of 1000-kw capacity at Willow Grove, and the Snyder Avenue sub-station was increased to 3000-kw capacity and the Germantown sub-station was increased to 3000-kw capacity.

It was then decided to make the alternating-current generating station at Second Street and Wyoming Avenue a permanent plant instead of temporary, and there are now being installed at that station two 1500-kw additional Parsons turbine units.

The next step in the comprehensive power scheme that is in process of evolution will be the erection of a central alternating-current generating station at Delaware and Laurel Avenues, on the Delaware River, having an ultimate capacity of 50,000 kw, for which the immediate plans provide for the installation of three 6000-kw units. In connection with this plant there is now being installed a large sub-station in the center of the city at Ninth Street and Sansom Avenue, which will have an ultimate capacity of 12,000 kw, and which will take current from the new Delaware Avenue station. The new alternating-current generating station and the old alternating-current plant at Second Street and Wyoming Avenue will be tied together with underground alternating-current tie-lines, and the bus-bars of the two stations will be connected in multiple, so that any sub-station can be run from either of the generating stations. There are two cables to each of the sub-stations, except to Germantown, which has three. From Germantown to Glenside there are two high-tension cables, and from Glenside to Willow Grove there is an overhead transmission line, consisting of three single aluminum wires. This line is about 5 miles long, and is the only overhead high-tension transmission on the system, all the other lines being carried in underground conduits.

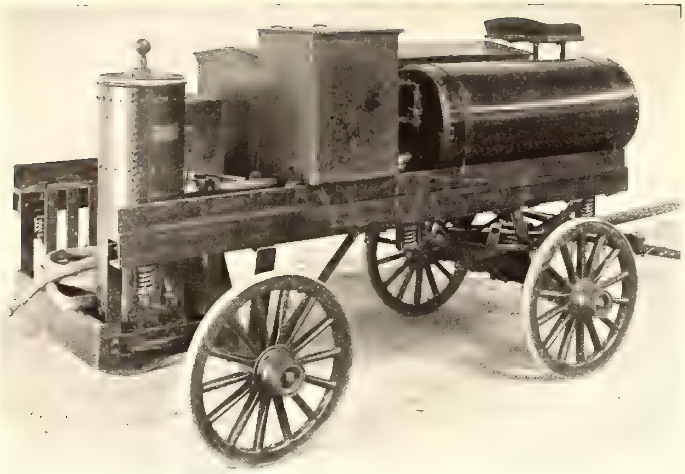
For taking care of the new elevated and subway lines, power for the city end—that is, east from City Hall—will be furnished from the Ninth Street and Sansom sub-station. The section from City Hall west to about Forty-Sixth Street will be fed from the present direct-current generating station at Thirty-Third and

TABLE XVI.—SHOWING STEAM AND ELECTRIC EQUIPMENT IN ALL THE

Station No.	Location.	Engines.	Condensing or Non-Condensing.	Generators.	Direct Connected or Belted.	Boilers.	Steam Pressure.
1	Thirteenth and Mt. Vernon Sts..	4—1,500 hp. Wetherill-Corliss........ 1—2,200 hp. Wetherill-Corliss........	Non-cond.. Non-cond..	5—1,500 kw. West..............	D.C..	19—375 hp. B. & W......... 1—400 hp. Parker..........	145 lbs.
2	Delaware Ave. and Poplar St....	4—1,000 hp. Porter-Allen............ 1— 300 hp. Porter-Allen............ 1—1,000 hp. Wetherill-Corliss........	Condensing Condensing Condensing	4— 800 kw. Gen. Elec.......... 1— 600 kw. West.............. 1— 250 kw. Gen. Elec..........	D.C.. D.C.. D.C..	14—250 hp. B. & W.........	145
3	Beach and Green Sts...........	3—2,000 hp. Allis-Corliss............ 1— 750 hp. Allis-Corliss............ 1— 350 hp. Allis-Corliss............ 1— 350 hp. Fischer...............	Condensing Condensing Non-cond.. Non-cond.. Non-cond.,	3—1,500 kw. Gen. Elec.......... 1— 500 kw. Gen. Elec.......... 1— 300 kw. Gen. Elec.......... 1— 150 kw. Gen. Elec.......... 1— 125 kw. Crocker-Wheeler Motor-Driven Booster.........	D.C.. D.C.. D.C.. D.C.. D.C..	14—250 hp. B. & W.........	150
4	Thirty-Third and Market Sts....	2—2,000 hp. Penna.-Corliss.......... 2—1,500 hp. Wetherill-Corliss........ 2—1,000 hp. Penna.-Corliss..........	Condensing Non-cond.. Condensing	4—1,500 kw. West.............. 2— 800 kw. West..............	D.C.. D.C..	16—375 hp. B. & W......... 1—500 hp. B. & W......... 2—375 hp. Parker..........	150
5	Thirty-Third and Dauphin Sts., See also Table XVII........	3—1,000 hp. Wetherill-Corliss........	Condensing	2— 800 kw. Bullock............ 1— 600 kw. West.............. 1— 125 kw. Crocker-Wheeler Motor-Driven Booster.........	D.C.. D.C.. D.C..	8—250 hp. Berry...........	145
6	Twenty-Seventh and South Sts .	3— 600 hp. McIntosh & Seymour.... 2— 350 hp. Porter-Allen............	Condensing Non-cond..	3— 400 kw. Gen. Elec.......... 2— 250 kw. Gen. Elec..........	D.C.. D.C..	6—250 hp. B. & W.........	160
7	Ogontz......................	3—1,200 hp. Allis-Corliss............	Condensing	3— 850 kw. Siemens-Halske..... 2— 125 kw. West. Boosters......	D.C.. D.C..	9—250 hp. Berry...........	150
8	Willow Grove................	2— 400 hp. McIntosh & Seymour.... 3— 250 hp. Wetherill-Corliss........ 1— 500 hp. West.-Kodak...........	Non-cond.. Non-cond.. Non-cond..	2— 250 kw. Gen. Elec.......... 3— 150 kw. West.............. 1— 400 kw. West..............	D.C.. Belted. D.C..	5—125 hp. Weth. Ret. Tub.. 6—150 hp. Weth. Ret. Tub..	115
9	Wheel Pump.................	1—1,000 hp. Wetherill-Corliss........	Condensing	1— 600 kw. West..............	D.C..	5—125 hp. Weth. Ret. Tub..	115 to 120
10	Second St. and Wyoming Ave...	2—1,500 hp. Wetherill-Corliss........ 6—2,250 hp. West.-Parsons Turbines.. 2— 500 hp. West. Cross Compound.	Condensing Condensing Non-cond..	2—1,000 kw. Gen. Elec. A. C.... 6—1,500 kw. West. A. C......... 2— 400 kw. West. D. C.........	D.C.. D.C.. D C..	8—700 hp. Parker double-ended.................. 2 —800 hp. Parker double-ended.................. 6 —600 hp. Parker double-ended..................	160
D	Neshaminy Creek and Doylestown Pike.................	2— 200 hp. Ridgway..............	Condensing	2— 150 kw. Thompson-Ryan....	D.C..	2—250 hp. Stirling.........	140
	New Delaware Ave. Station.....	3—6,000 kw. West. Turbines........	Condensing	3—6,000 kw. West. A. C........	D.C..	16—800 hp. Parker..........	175

INTERSECTION OF THIRD AND MARKET STREETS, LOOKING NORTH ON THIRD STREET.—THE VIEW SHOWS THE STREET CONGESTION ON AN ORDINARY AFTERNOON

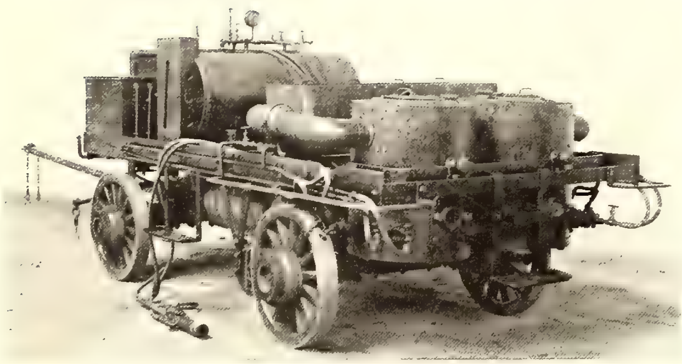
MARKET STREET, LOOKING NORTH FROM ELEVENTH STREET TOWARD CITY HALL.—THE VIEW SHOWS THE SCENE ON AN AVERAGE PLEASANT AFTERNOON



Latest Form of Sand-Blast Wagon

Sand Blasting Rail Ends and Plates

Reaming Holes

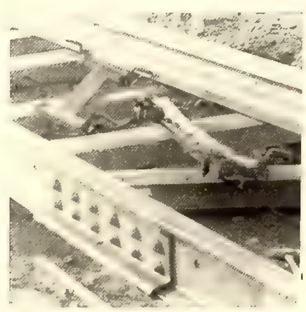


Latest Form of Melting Wagon

Pouring Joint

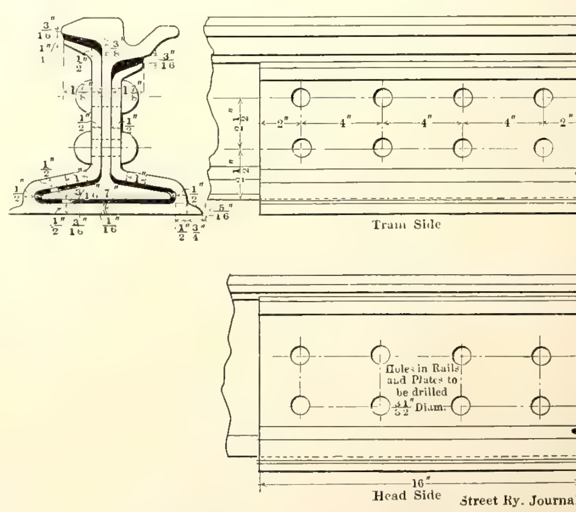
Joint After Pouring

Latest Form of Reamer Wagon



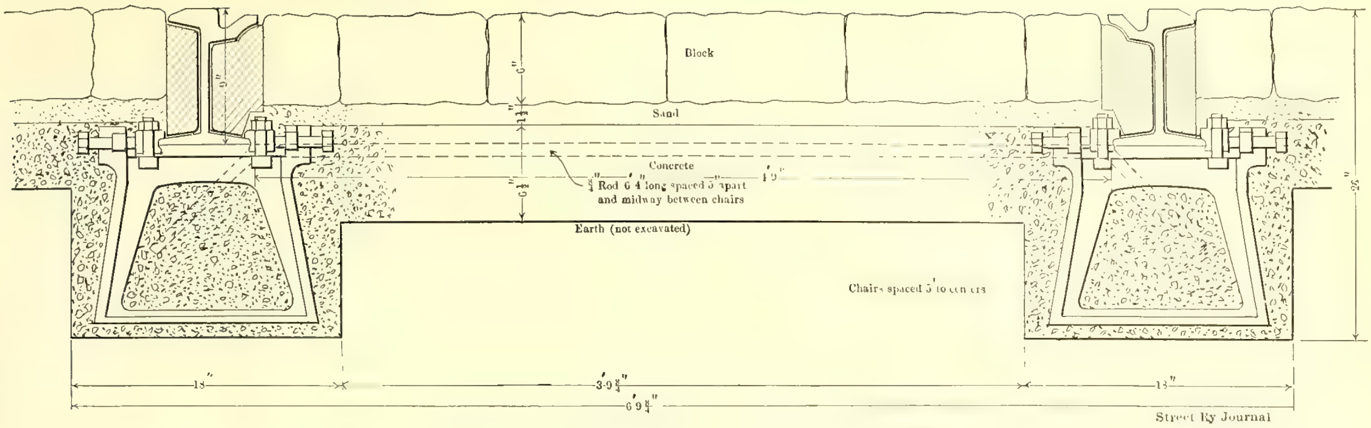
Joint with Moulds Removed

Latest Form of Riveter Wagon



Cast-Zinc Joint on 137-Lb. Rail

APPARATUS AND PROCESSES IN MAKING CAST-ZINC JOINT



DETAILS OF CONCRETE TRACK CONTRUCTION

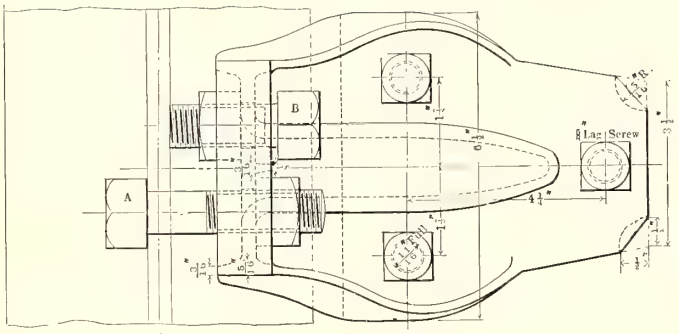
SPECIAL SLIP JOINT ON BRIDGES

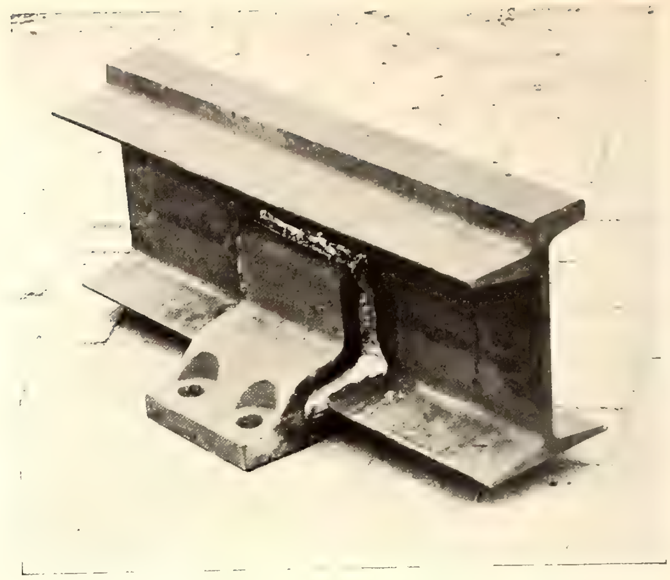
SPECIAL RAIL CHAIRS USED ON BRIDGE WORK

TRACK WITH YOKES ATTACHED PRIOR TO PLACING CONCRETE

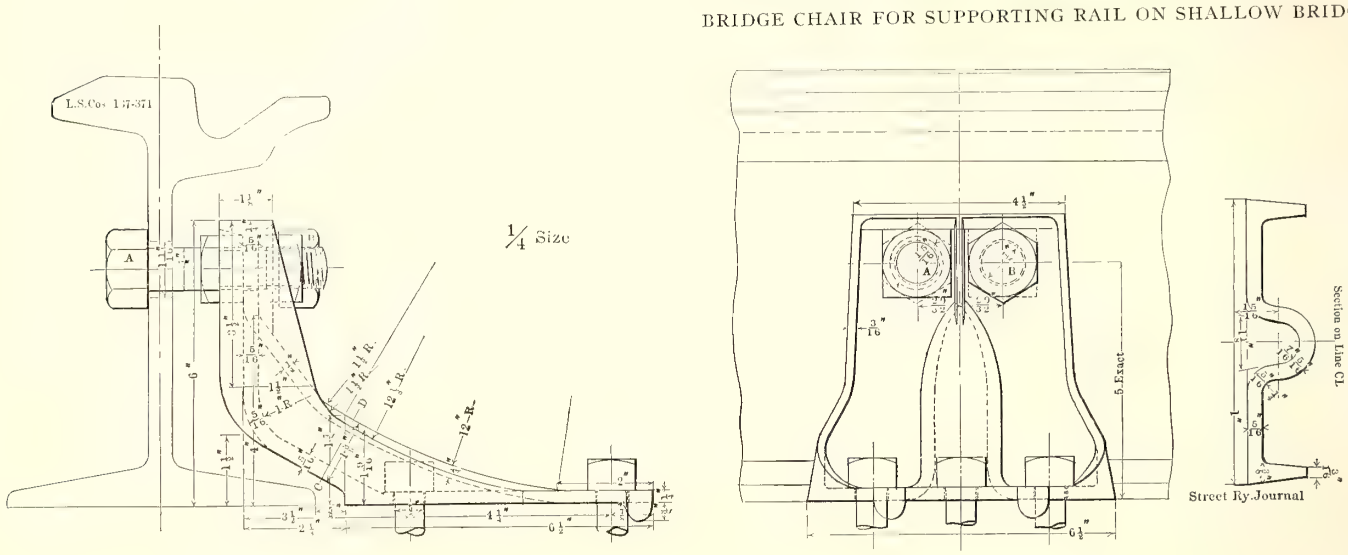
DETAILS OF SPECIAL RAIL CHAIRS ON BRIDGES

TRACK READY FOR CONCRETE

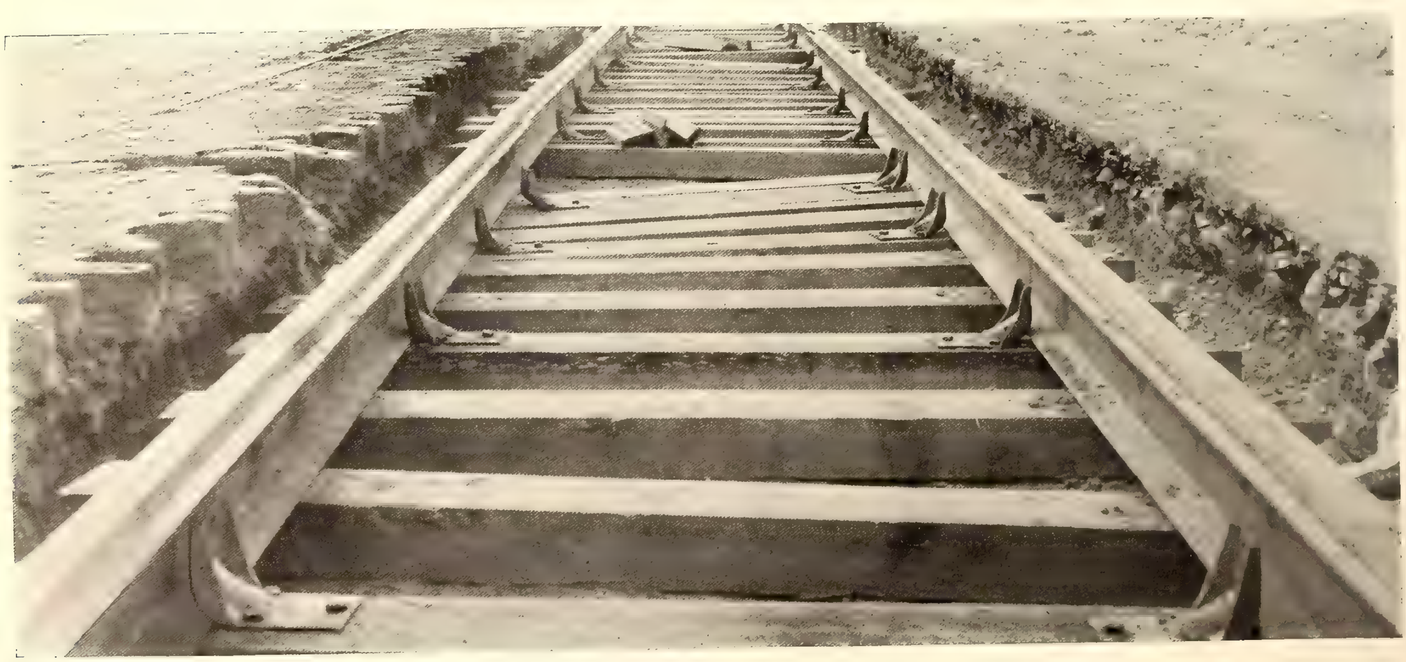




BRIDGE CHAIR FOR SUPPORTING RAIL ON SHALLOW BRIDGES



MALLEABLE IRON RAIL BRACE FOR ADJUSTING AND HOLDING RAILS TO GAGE



TRACK WITH CHAIR BRACE CONSTRUCTION

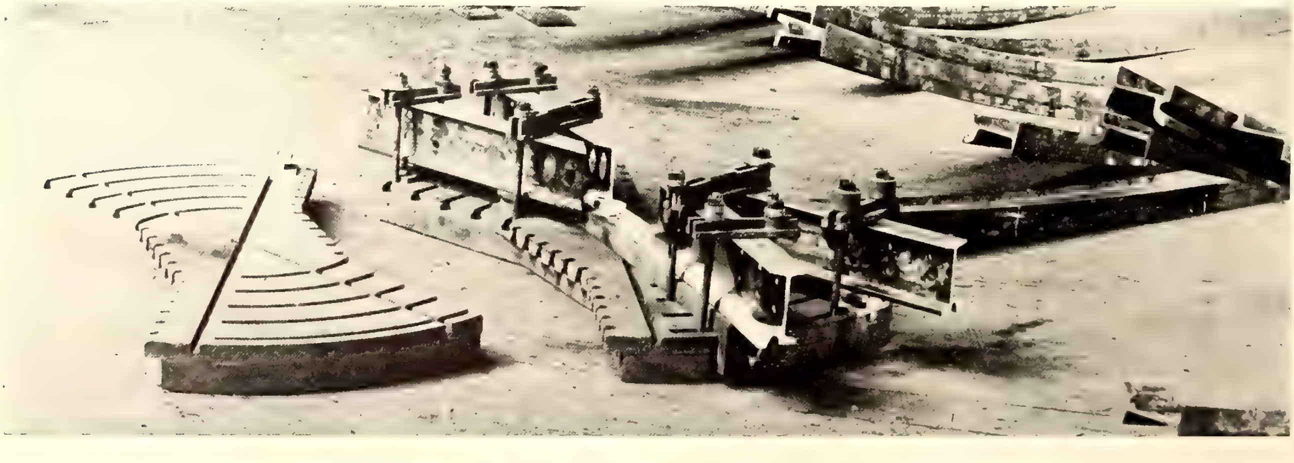
LAYOUT FLOOR FOR ASSEMBLING SPECIAL WORK IN ROADWAY SHOPS

STOREROOM FOR LIGHT MATERIAL, ROADWAY SHOPS

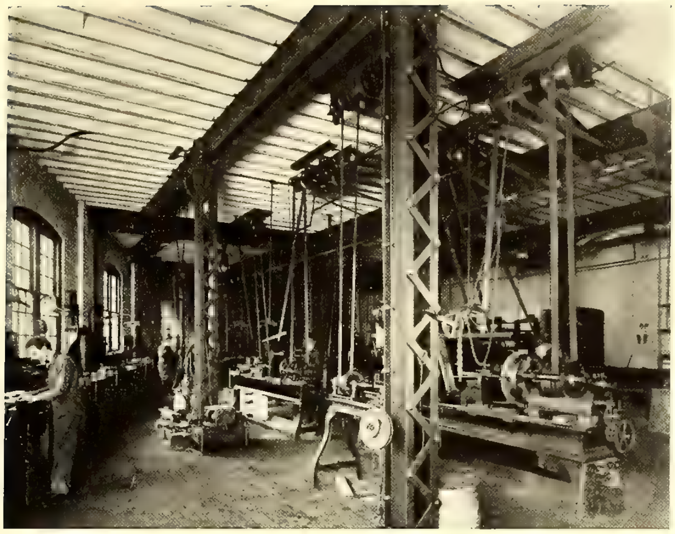
Plate XIV

UNIVERSAL CLAMP FOR ASSEMBLING CROSSINGS

FORM FOR ASSEMBLING SPECIAL WORK



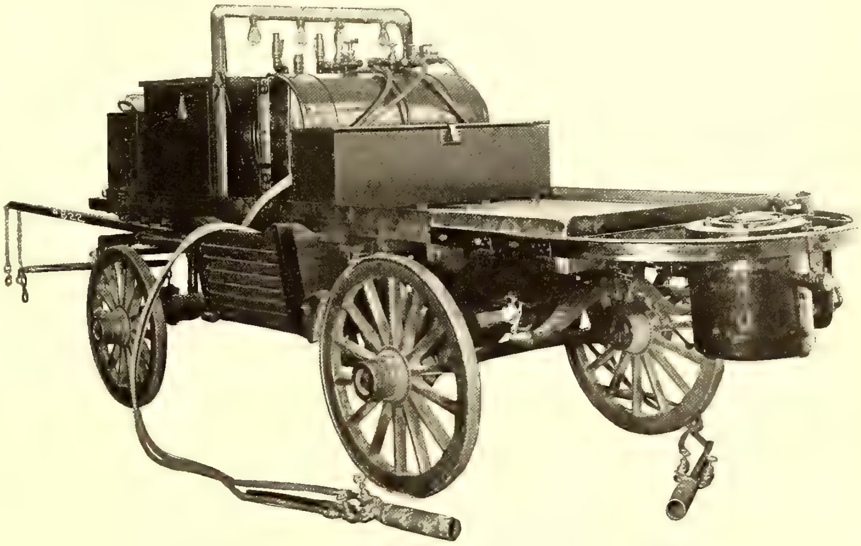
UNIVERSAL CLAMP OR MOULDS FOR ASSEMBLING FROGS



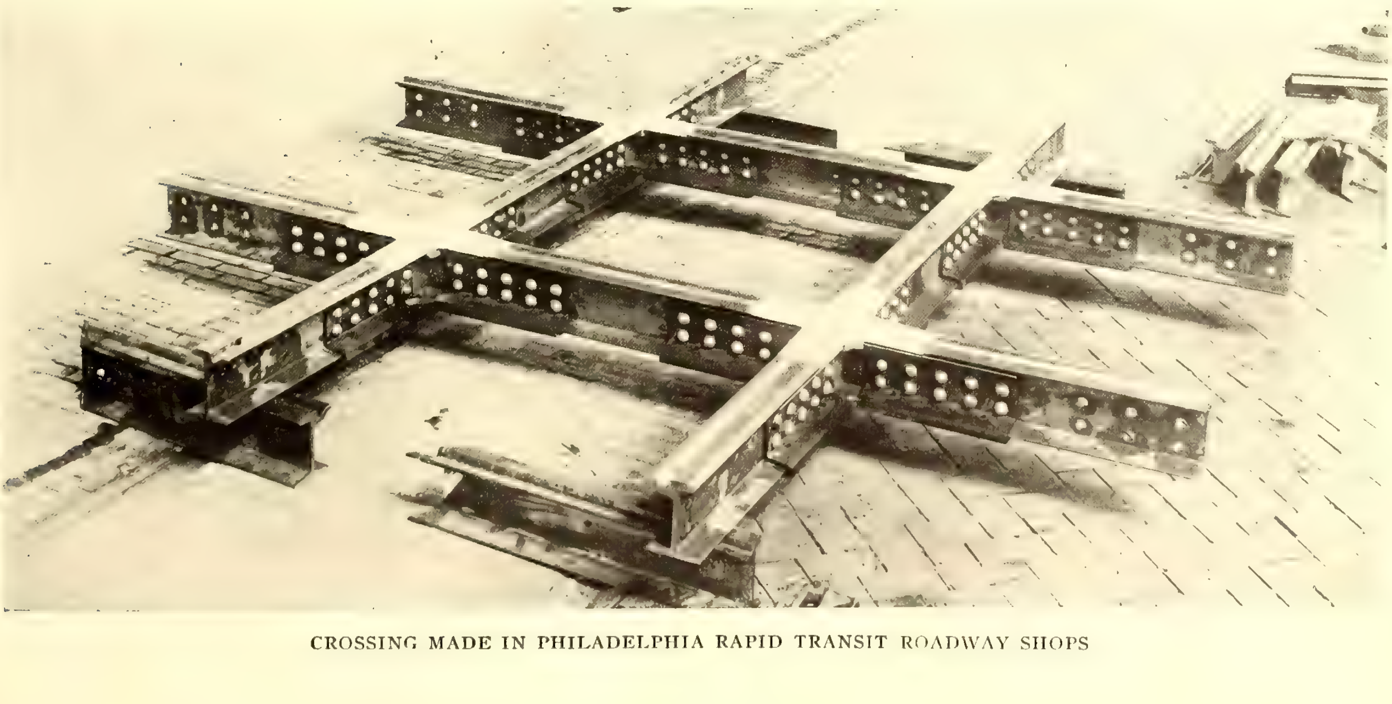
CORNER OF MACHINE SHOP, ROADWAY SHOPS

MACHINE SHOP, ROADWAY SHOPS

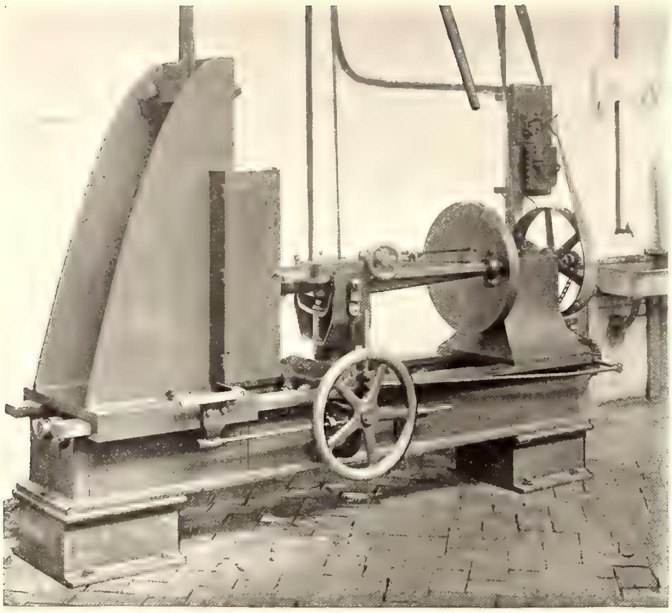
TRUCK FOR HANDLING RAIL



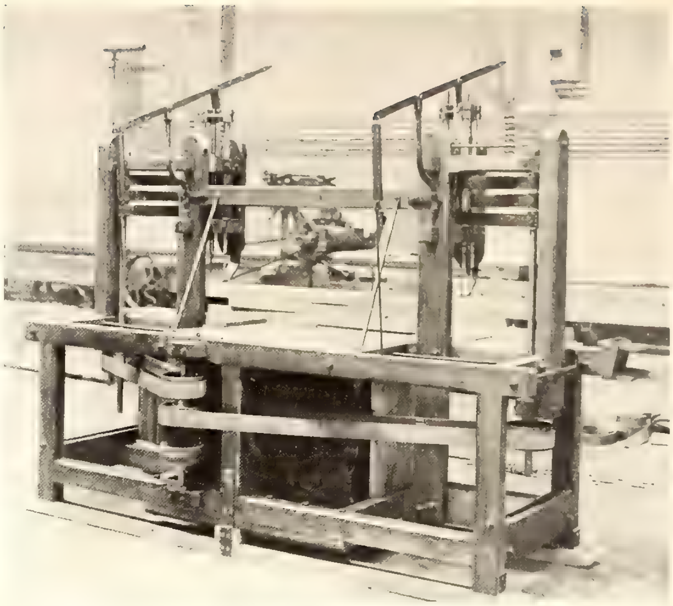
SMELTER WAGON FOR RENEWING SPECIAL WORK



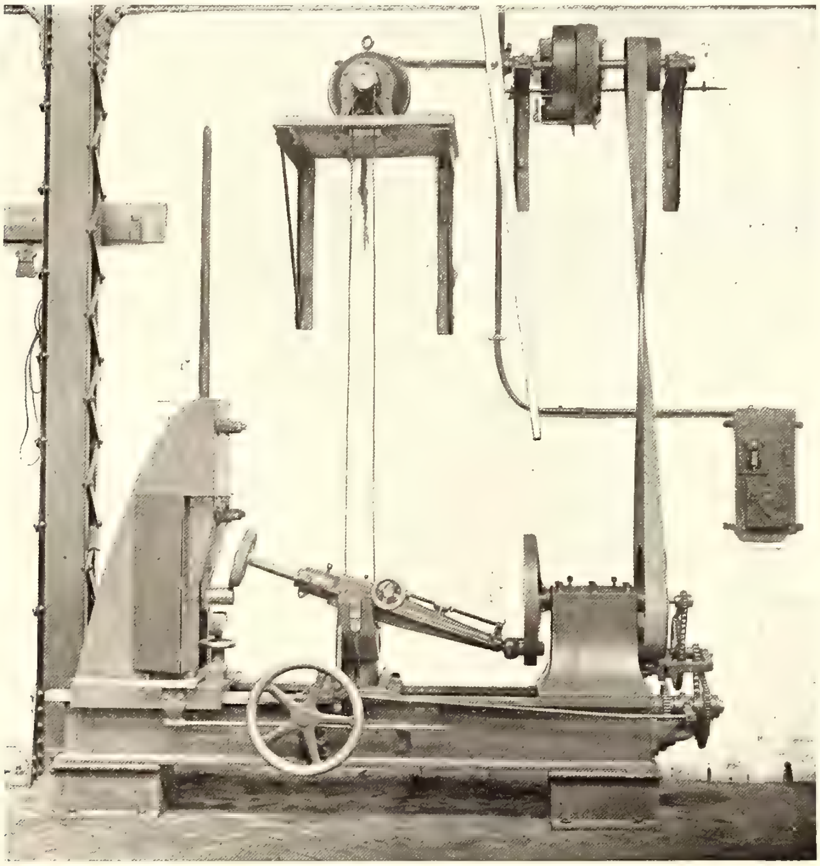
CROSSING MADE IN PHILADELPHIA RAPID TRANSIT ROADWAY SHOPS



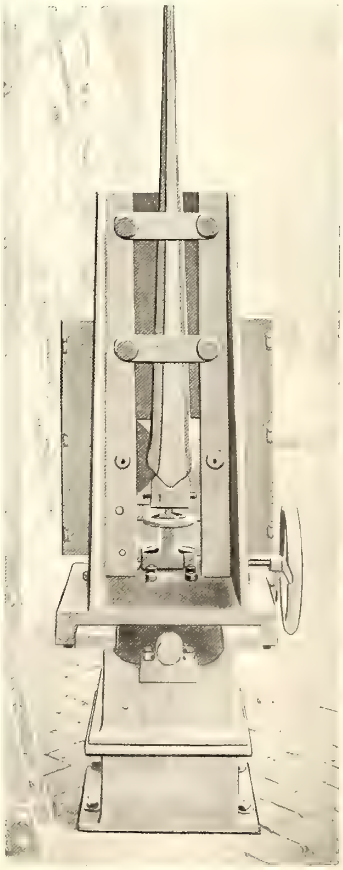
SIDE VIEW OF SWITCH-POINT PIN GRINDER



MULTIPLE DRILL FOR SIMULTANEOUSLY DRILLING SIX HOLES IN WOODEN TIES TO RECEIVE CHAIR BRACES



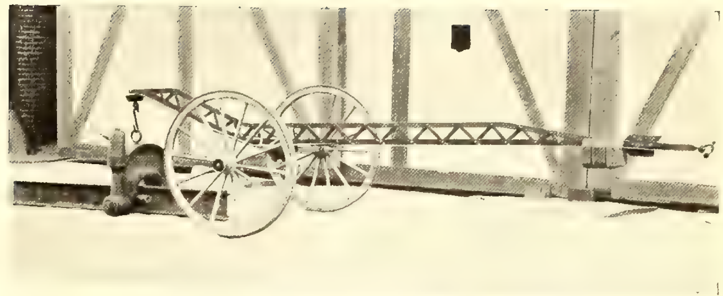
MACHINE FOR GRINDING SWITCH-POINT PINS



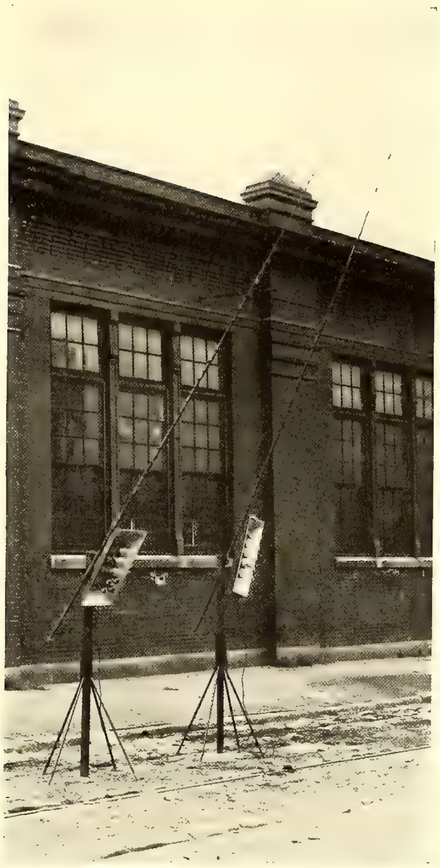
END VIEW OF GRINDER, SHOWING METHOD OF HOLDING SWITCH POINT

FOUNDRY IN ROADWAY SHOPS

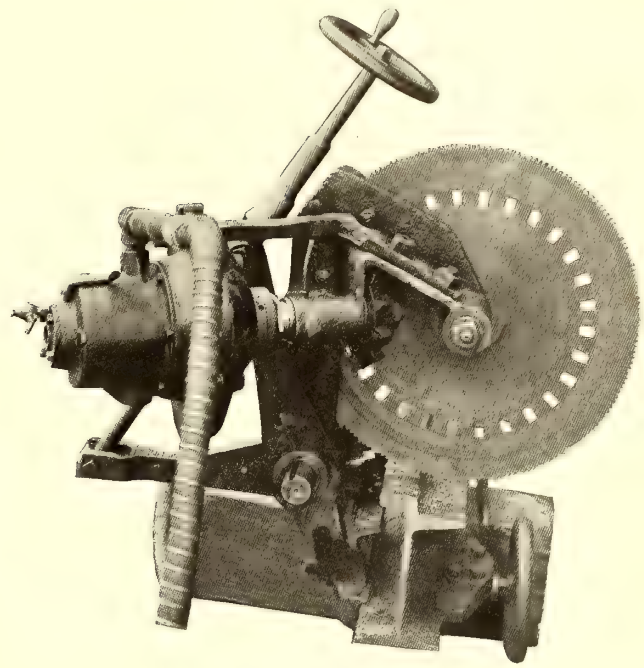
BLACKSMITH SHOP, ROADWAY SHOPS



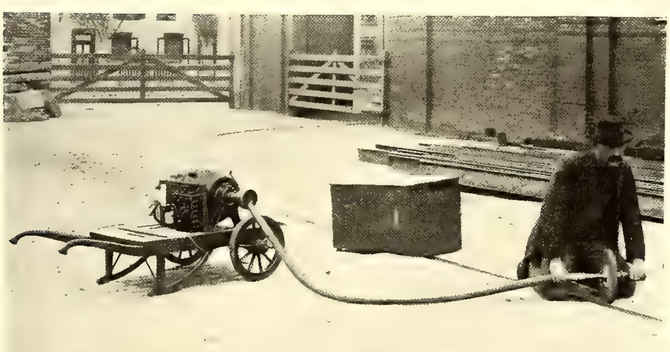
PORTABLE HYDRAULIC RAIL PUNCH



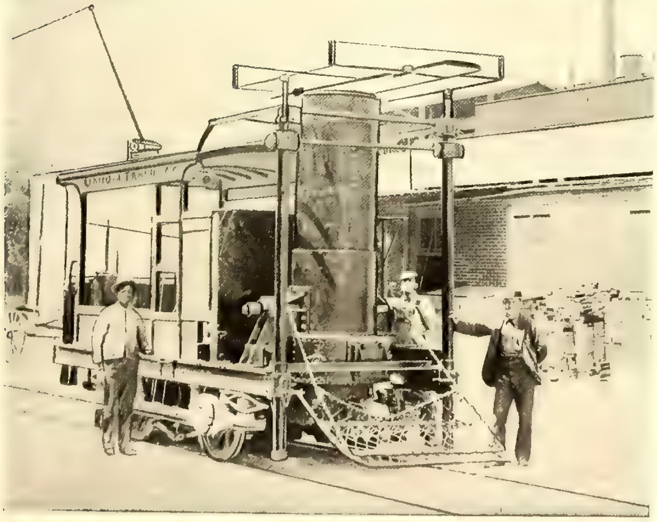
LIGHT STANDS FOR NIGHT WORK



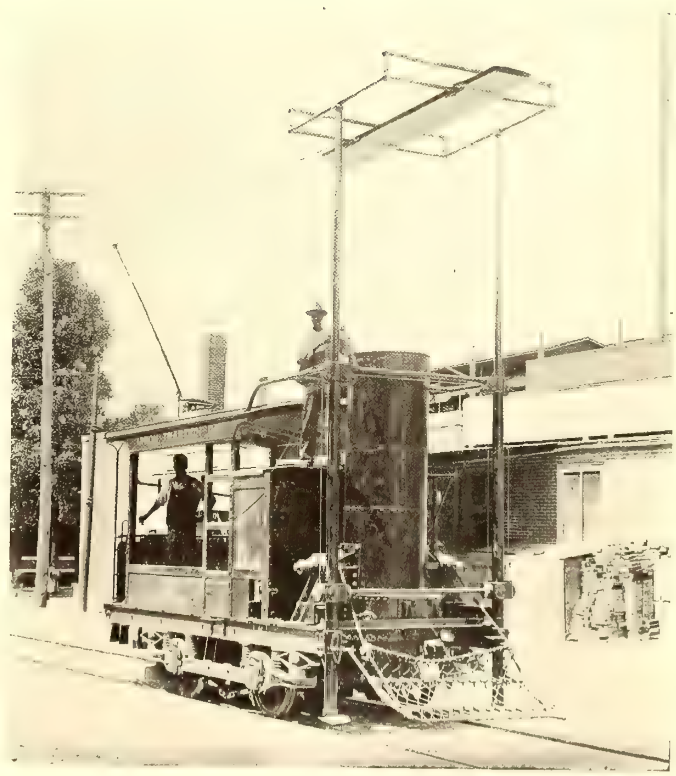
PORTABLE RAIL SAW



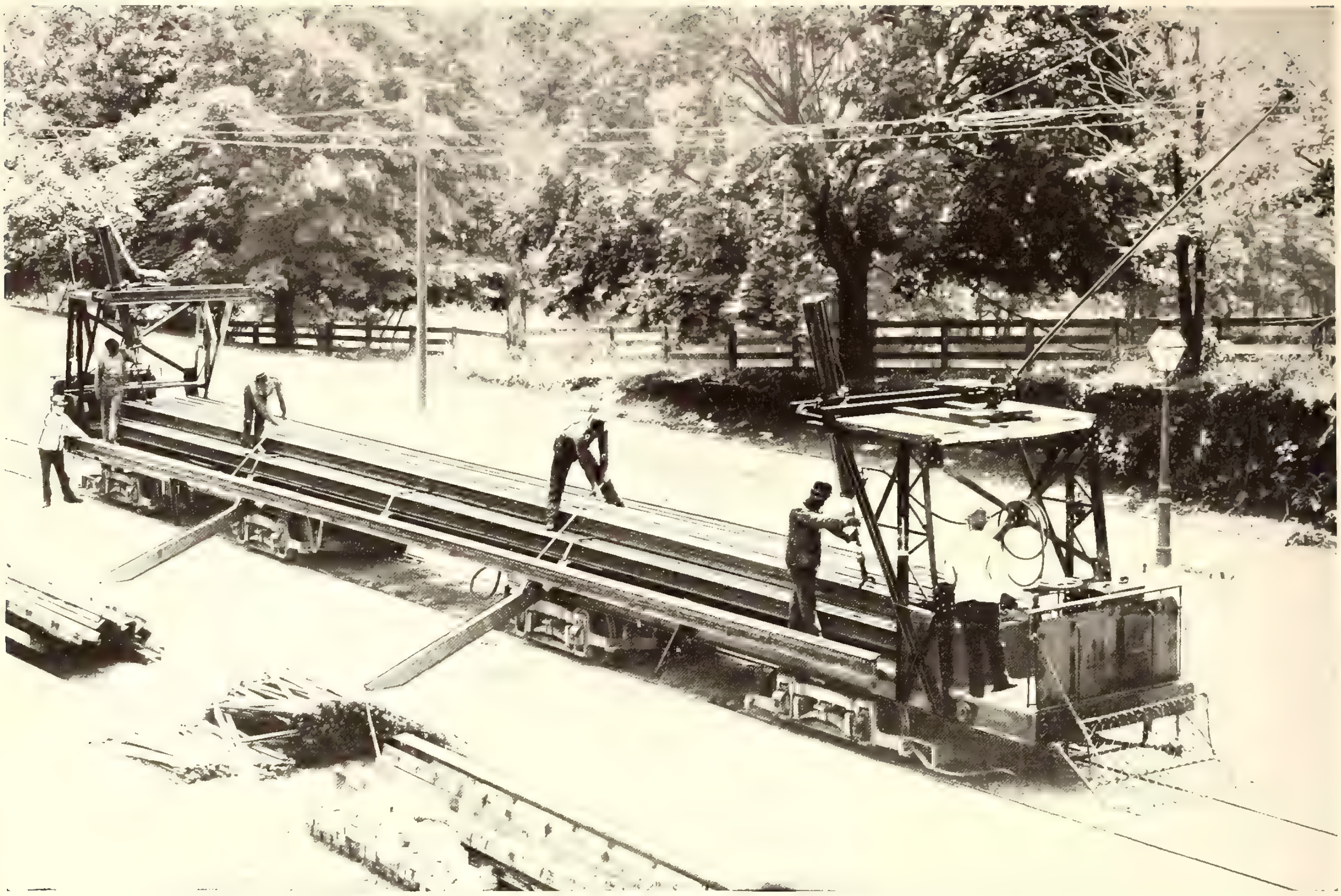
PORTABLE ELECTRIC RAIL GRINDER



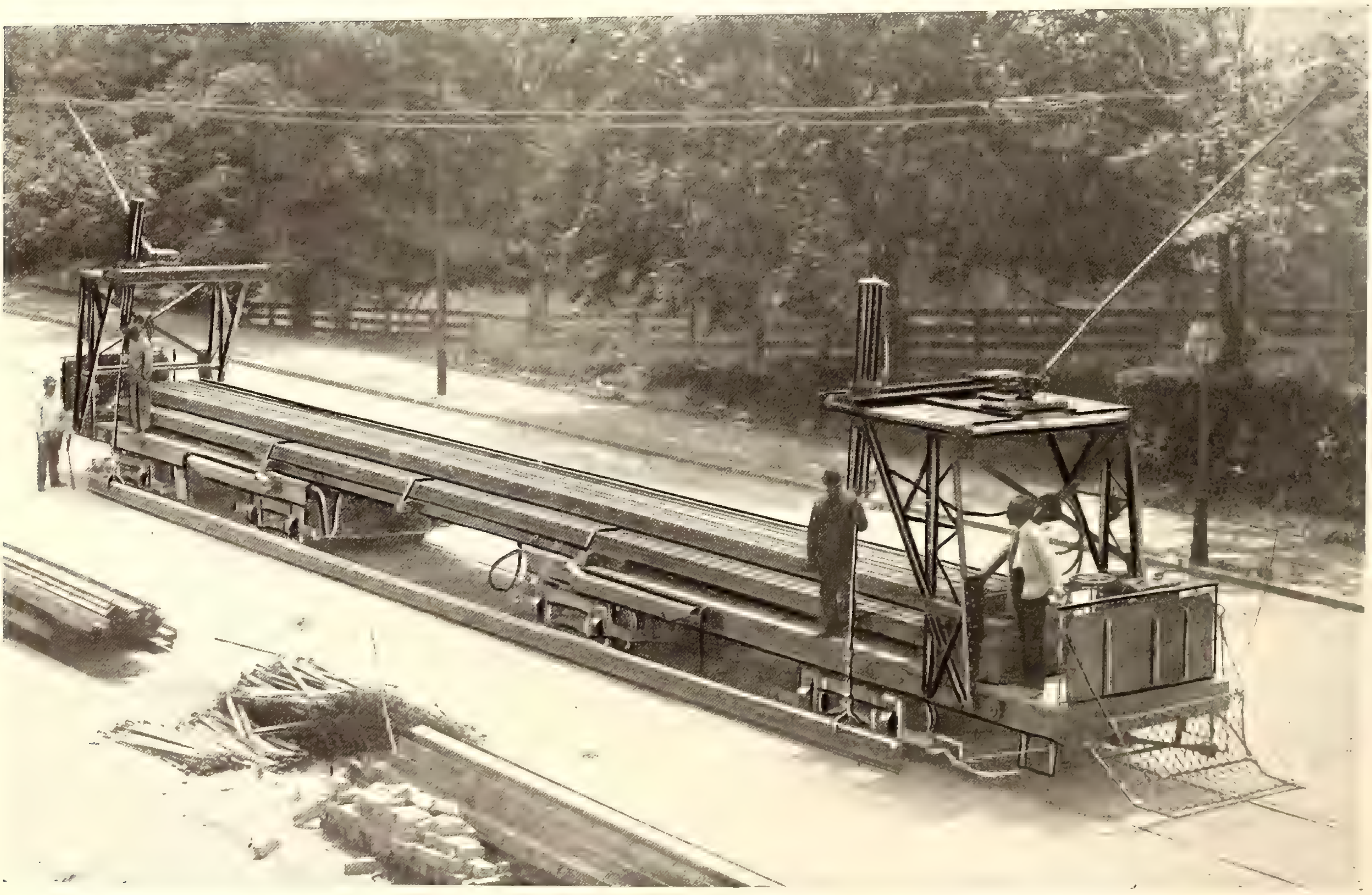
CUPOLA CAR WITH DEVICE FOR PROTECTING TROLLEY WIRE FROM SMOKE AND FUMES



CUPOLA CAR WITH PROTECTING DEVICE RAISED



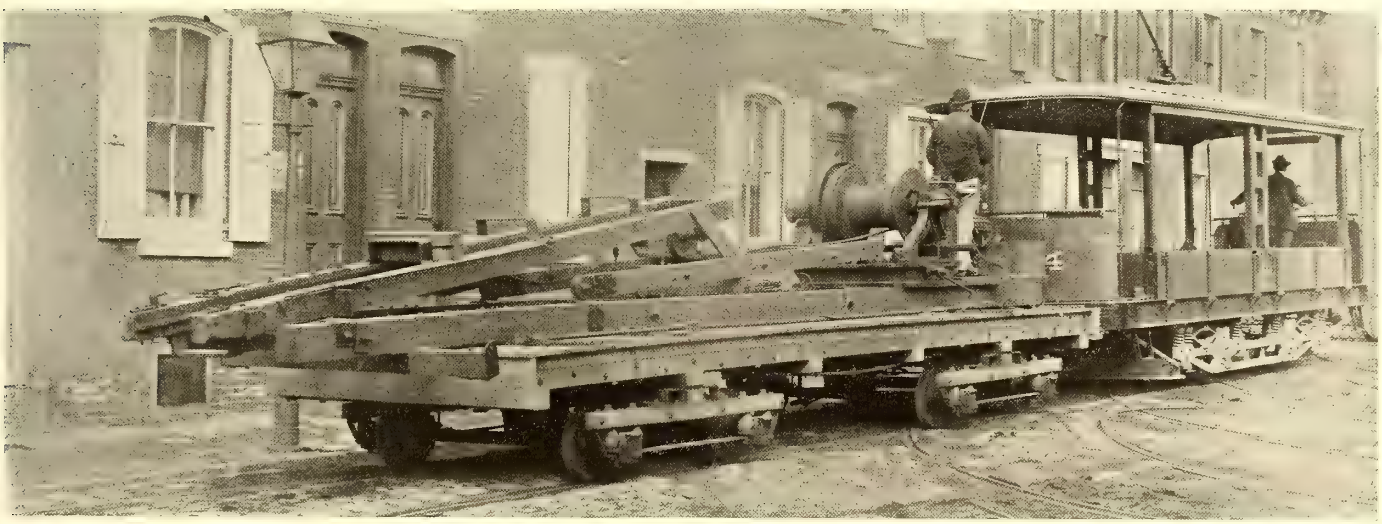
UNLOADING RAILS FROM RAIL CAR



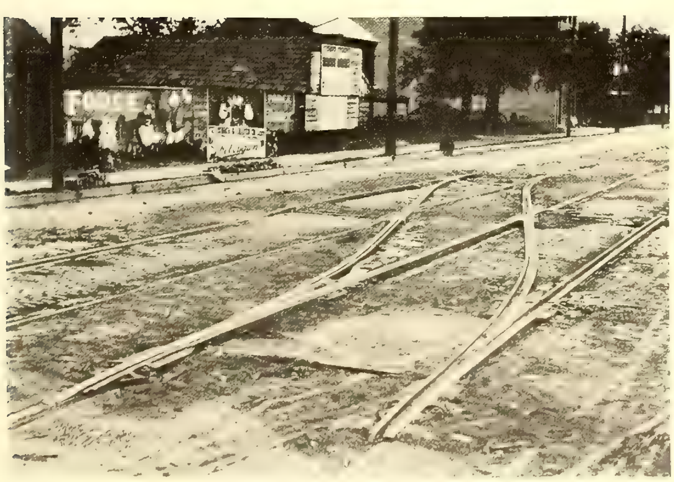
RAIL CAR FOR HAULING 60-FT. RAILS AROUND 30-FT. RADIUS CURVES IN 26-FT. STREETS

ELECTRIC DROP HAMMER READY FOR ACTION

HAULING ROAD ROLLER BY MOTOR CAR

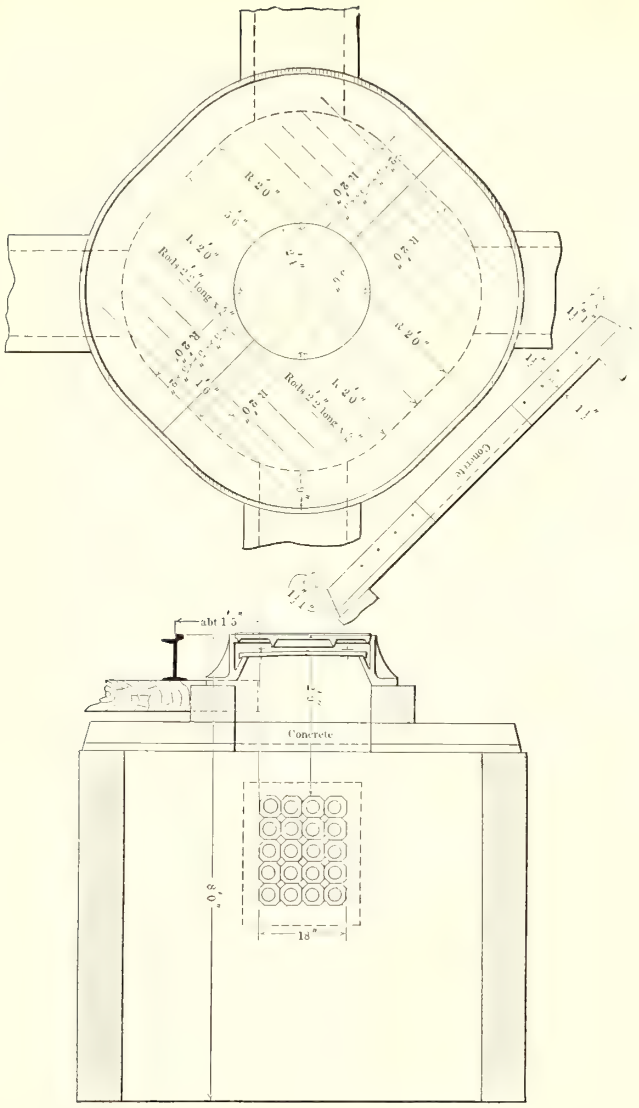


ELECTRIC DROP HAMMER IN COLLAPSED POSITION

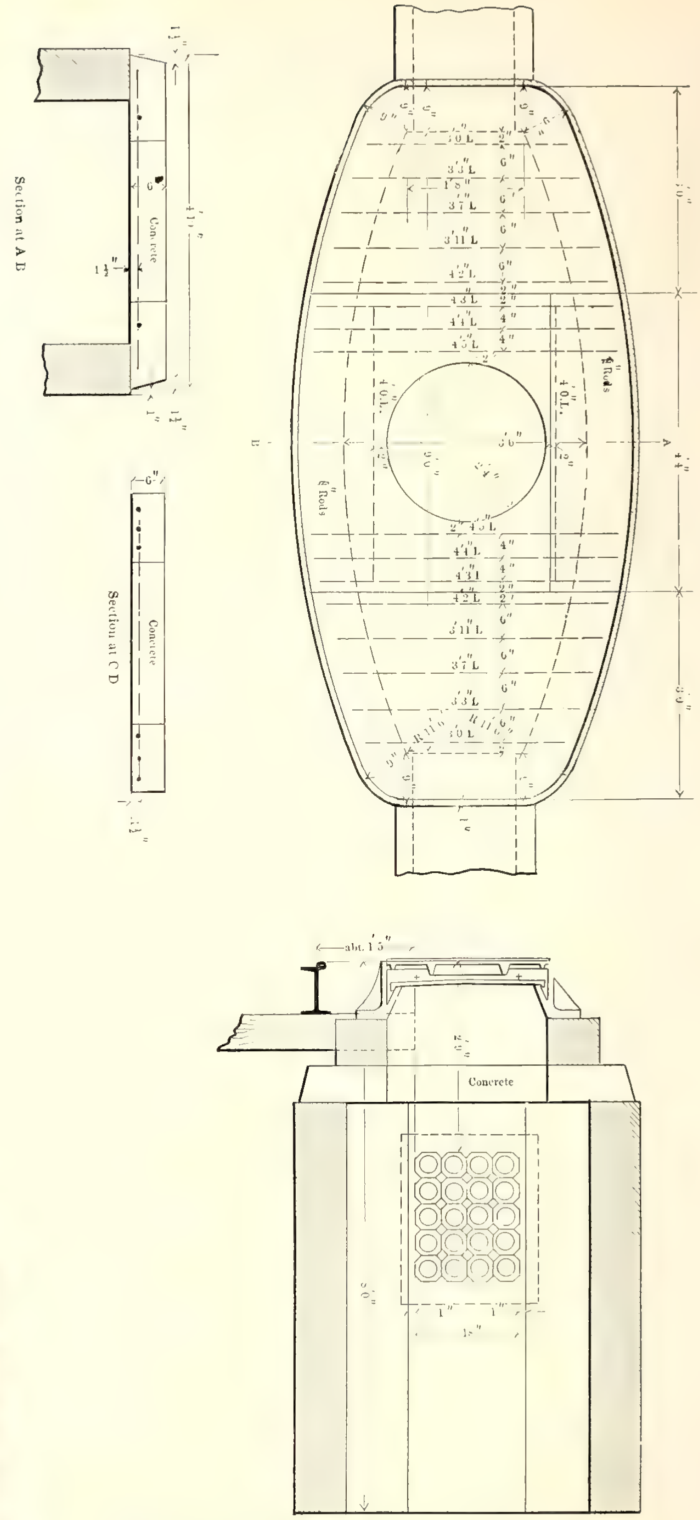


PORTABLE CROSS-OVER FOR EMERGENCY USE

GREASER'S CHARIOT

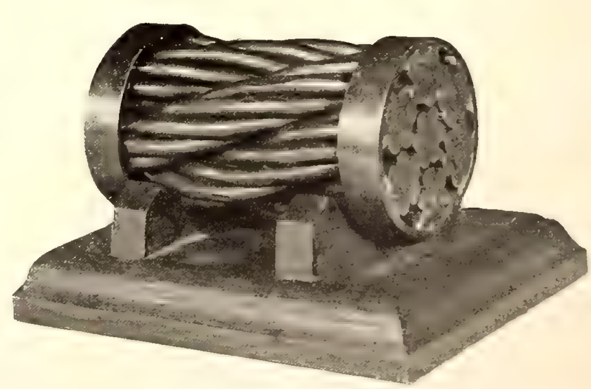


DETAIL OF TYPICAL JUNCTION MANHOLE

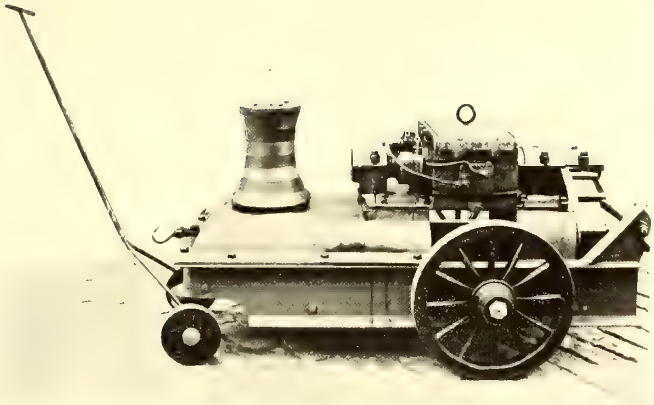


DETAIL OF TYPICAL STRAIGHT-LINE MANHOLE

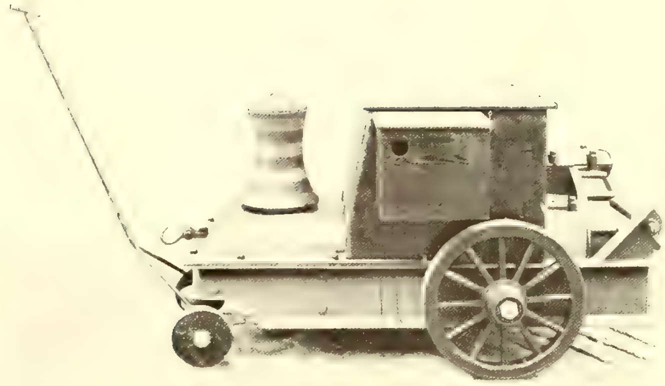
TYPICAL CABLE CONDUIT, SHOWING METHOD OF SUPPORTING CABLES IN MANHOLES



TYPICAL NEGATIVE OR RETURN CABLE

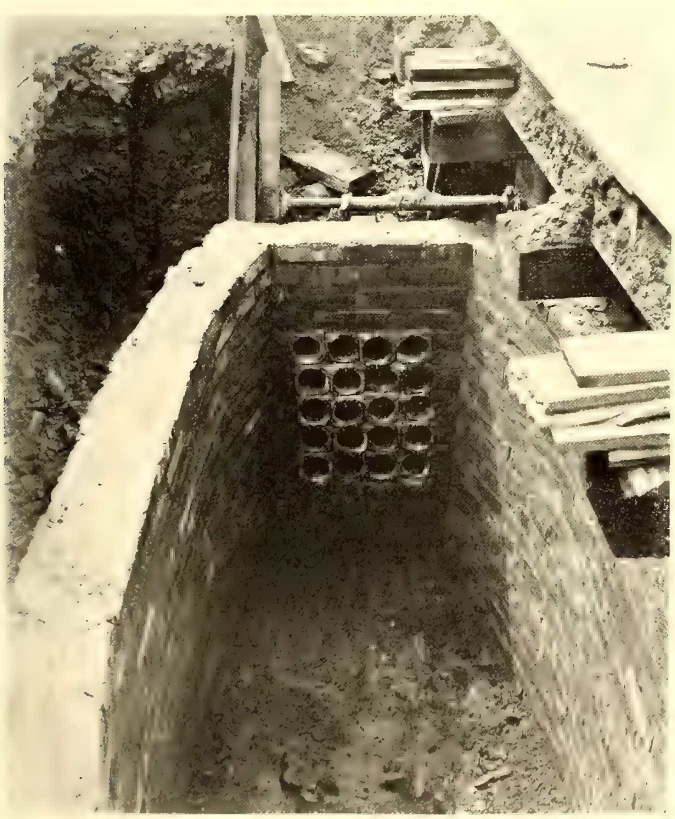


ELECTRIC WINCH FOR DRAWING CABLES THROUGH DUCTS



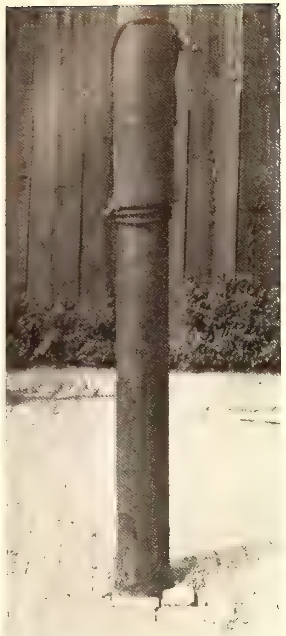
ELECTRIC WINCH WITH PROTECTING BOX IN PLACE

ELECTRIC WINCH DRAWING CABLE THROUGH DUCTS



VIEW IN CABLE MANHOLE

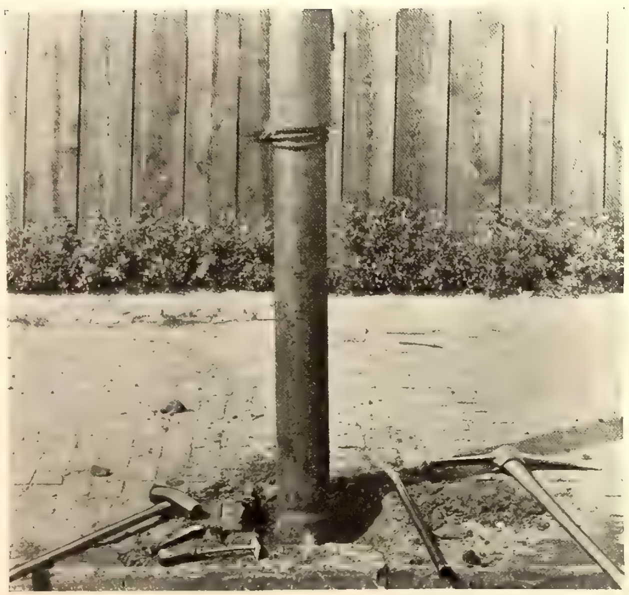
CABLES AND DUCTS IN CABLE CONDUIT



Pole Before Digging—Sleeve is Held Temporarily by Rope

Pole with Base Badly Corroded

Pouring the Sulphur—Wagon for Melting Sulphur at Right



Pole with Old Concrete Removed Prior to Slipping on Sleeve

Putting in Concrete at Base of Reclaimed Pole—Portable Concrete Mixer Shown at Right

Finished Pole, with Sleeve and Concrete in Place

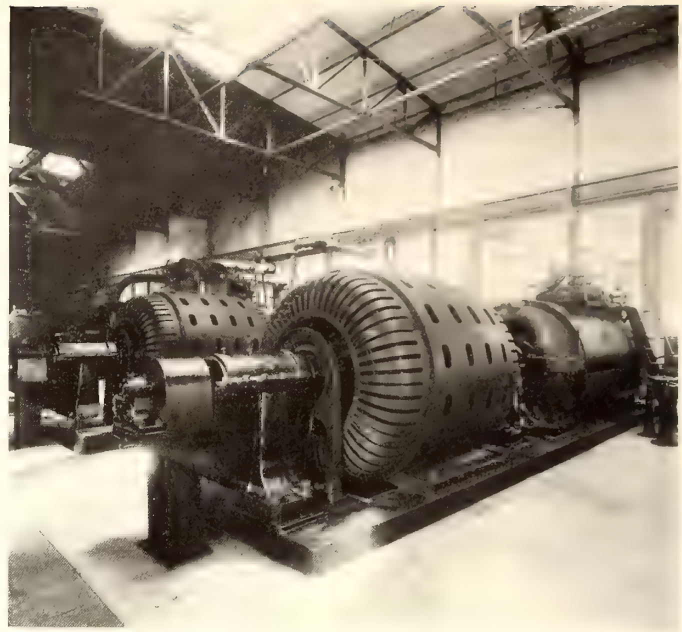
RECLAIMING IRON POLES

EMERGENCY WAGON, WITH PLATFORM TURNED AT RIGHT ANGLES

EMERGENCY WAGON AT WORK

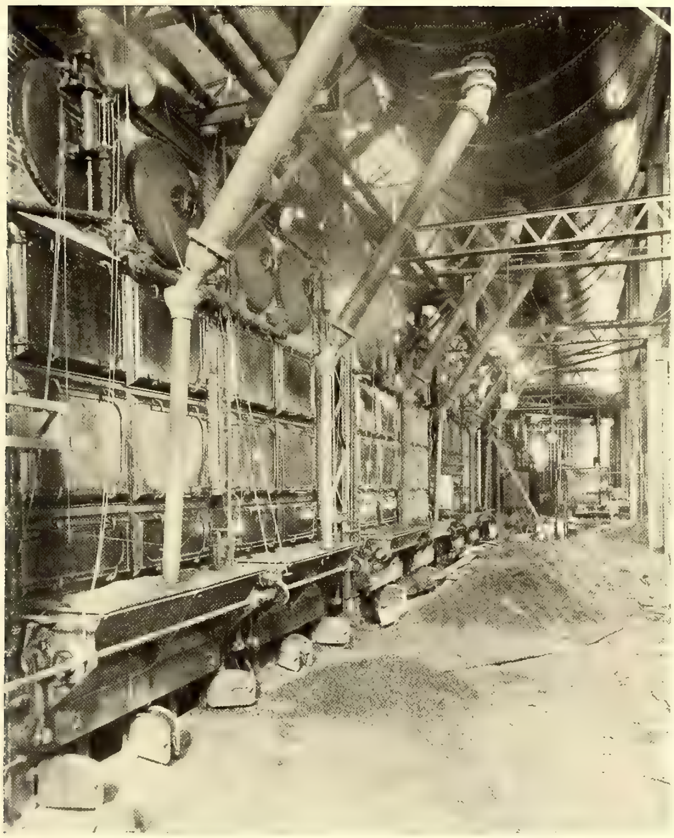
EMERGENCY WAGON STATION AT MT. VERNON STREET

INTERIOR VIEW IN TURBINE ROOM OF GENERATING STATION AT SECOND STREET AND WYOMING AVENUE

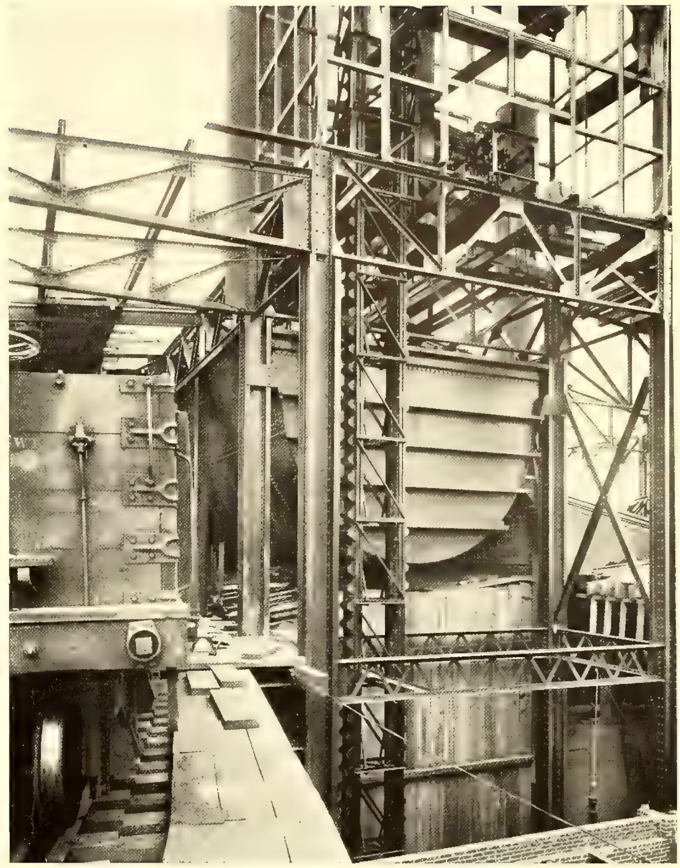


TWO OF THE 1500-KW TURBO UNITS AT SECOND STREET AND WYOMING AVENUE POWER STATION

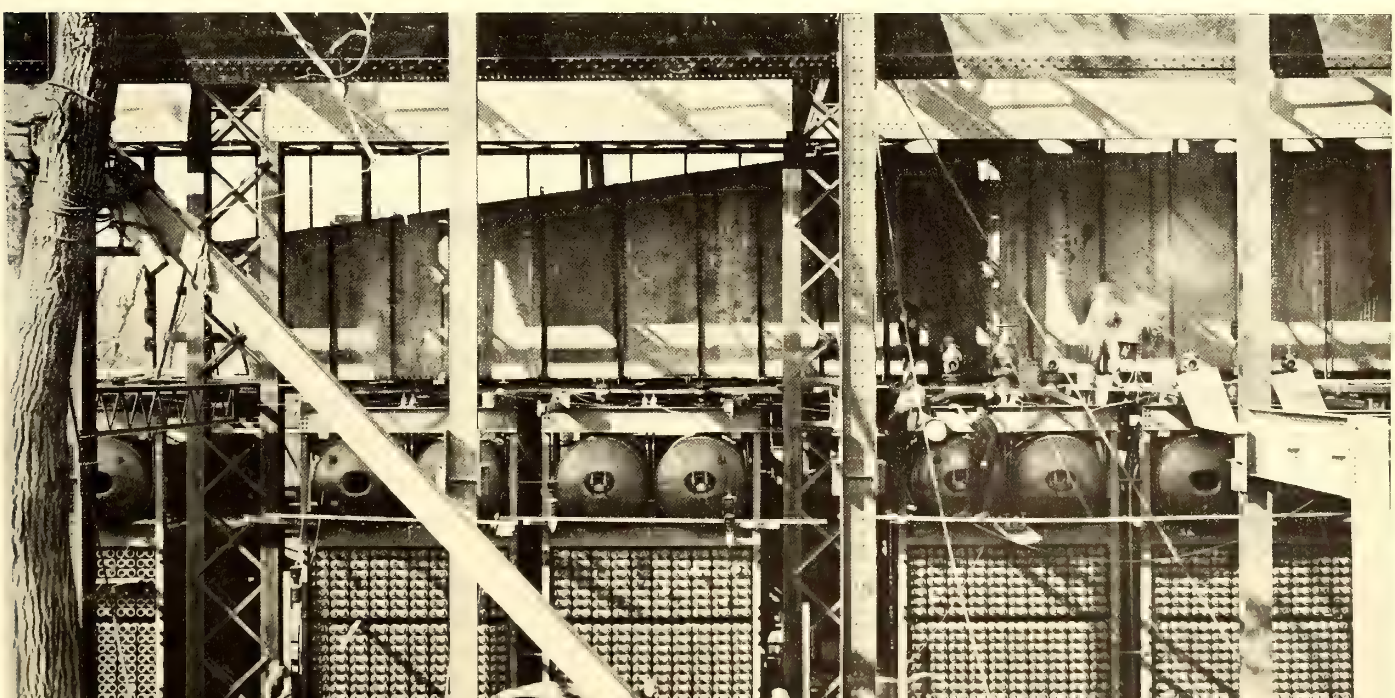
INTERIOR POWER STATION AT SECOND STREET AND WYOMING AVENUE SHOWING THE 1500-KW TURBO UNITS



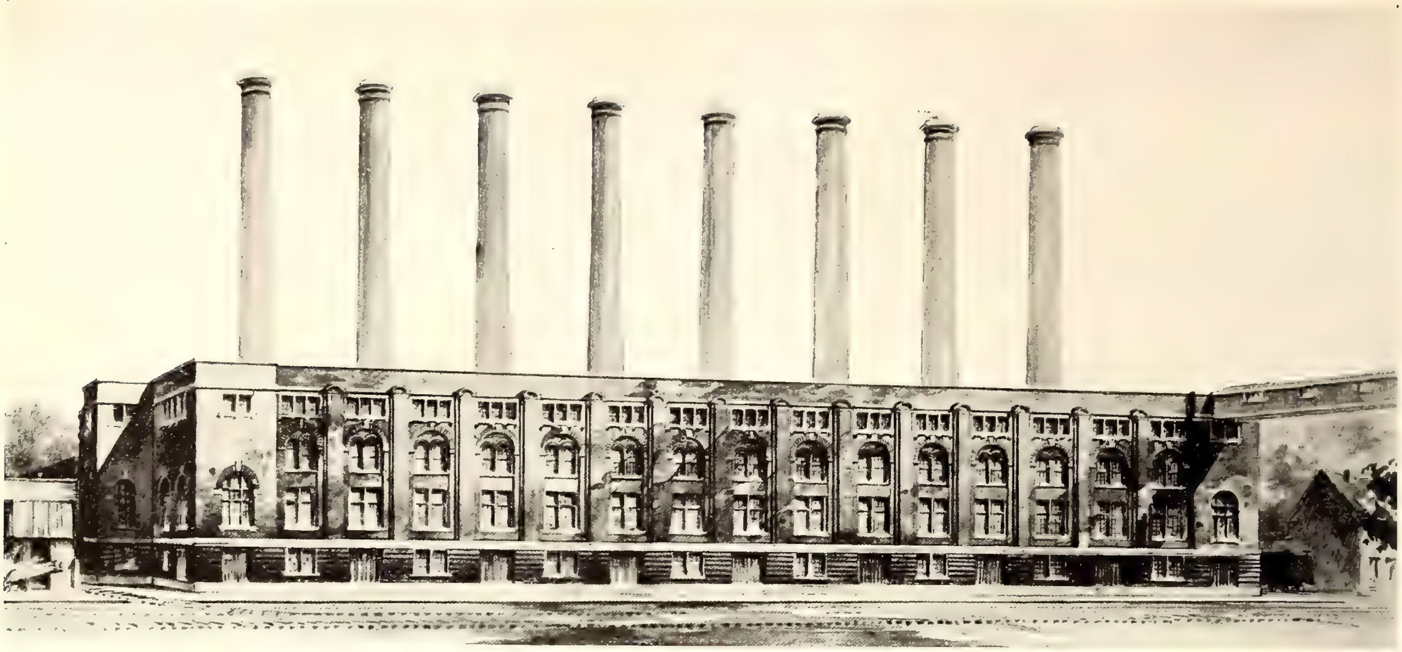
FRONT VIEW OF BOILERS IN SECOND STREET AND WYOMING AVENUE POWER HOUSE



COAL BUNKERS AND COAL HANDLING ARRANGEMENTS AT SECOND STREET AND WYOMING AVENUE POWER HOUSE

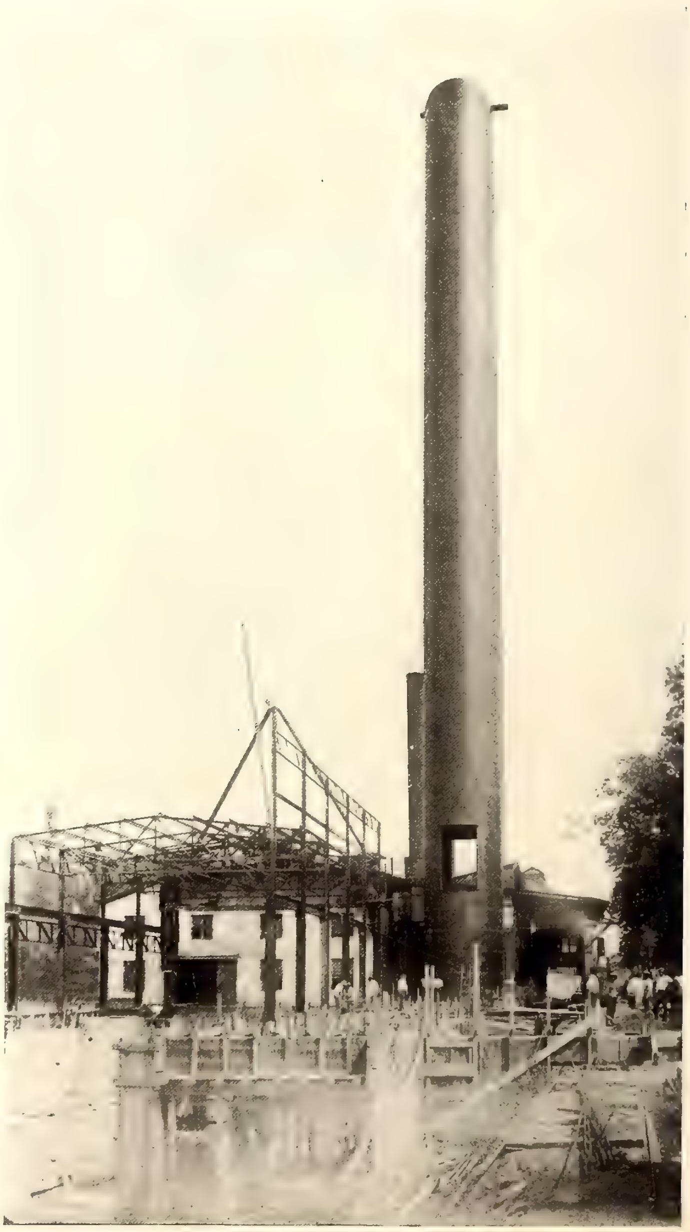


DOUBLE-END BOILERS AT SECOND STREET AND WYOMING AVENUE POWER HOUSE

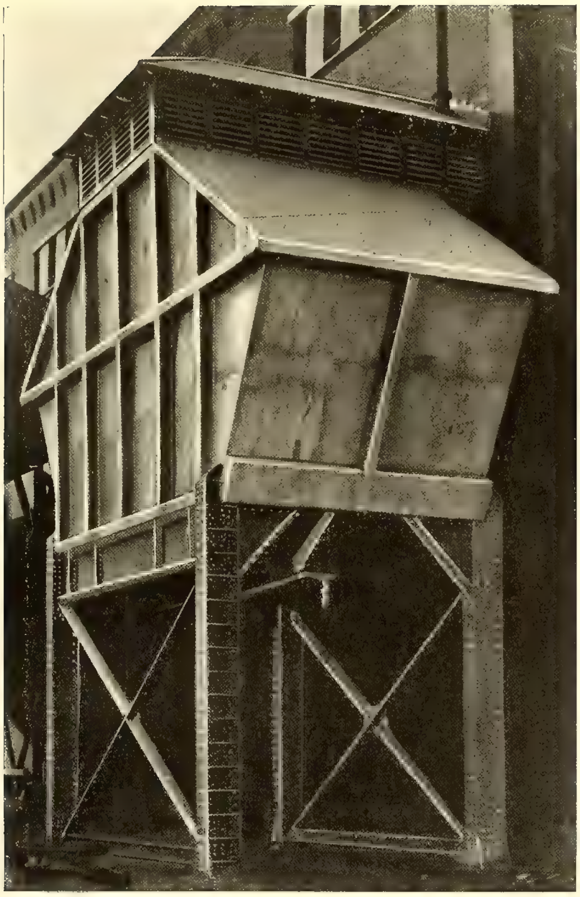


PERSPECTIVE VIEW OF NEW DELAWARE AVENUE A. C. GENERATING STATION

REAR VIEW OF DOUBLE-END BOILERS AT SECOND STREET AND WYOMING AVENUE STATION

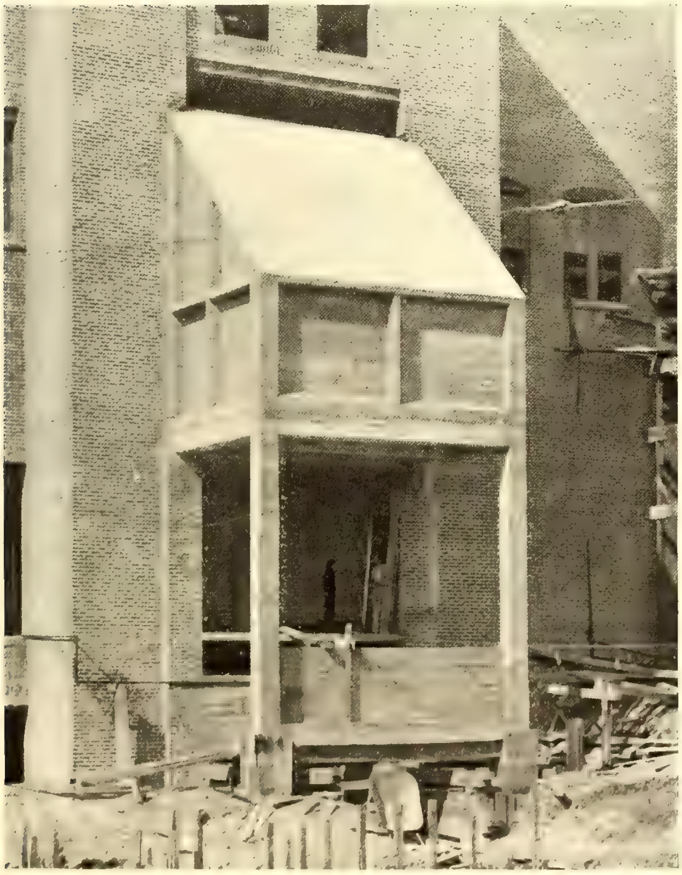


EXTERIOR GENERATING STATION AT SECOND STREET AND WYOMING AVENUE DURING CONSTRUCTION

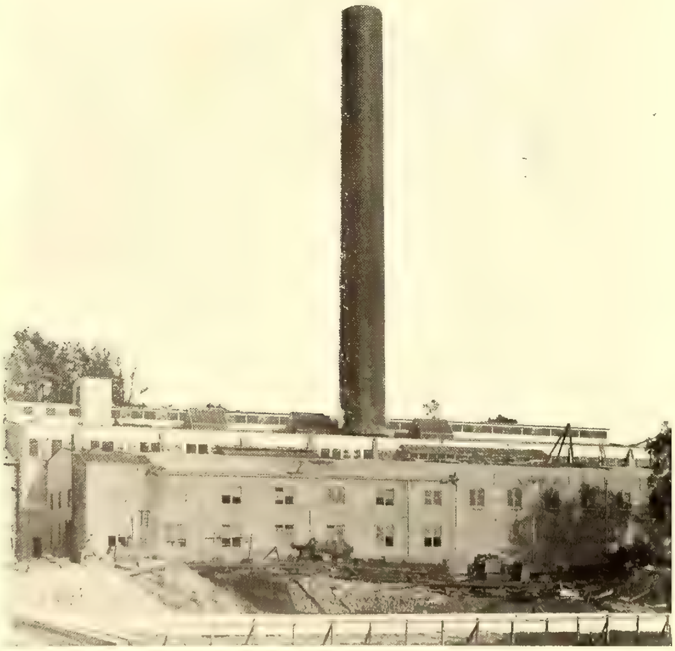


CONCRETE BIN AT POWER HOUSE FOR STORING ASH AND CINDERS

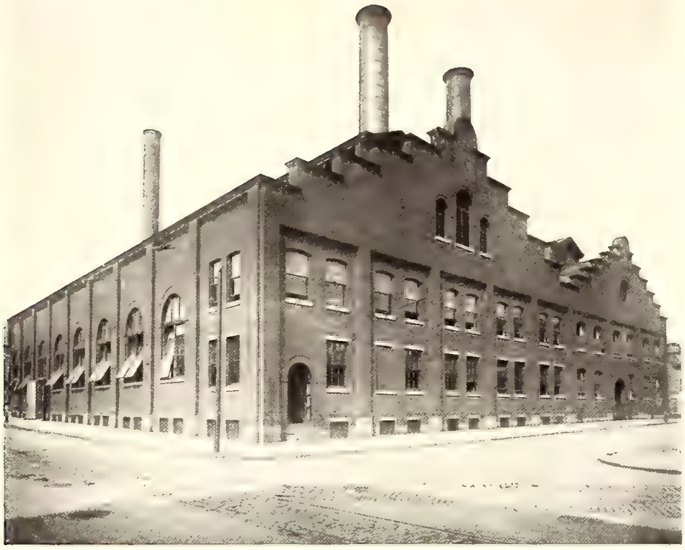
CONCRETE CINDER BIN AT THIRTEENTH AND MT. VERNON STREETS POWER HOUSE



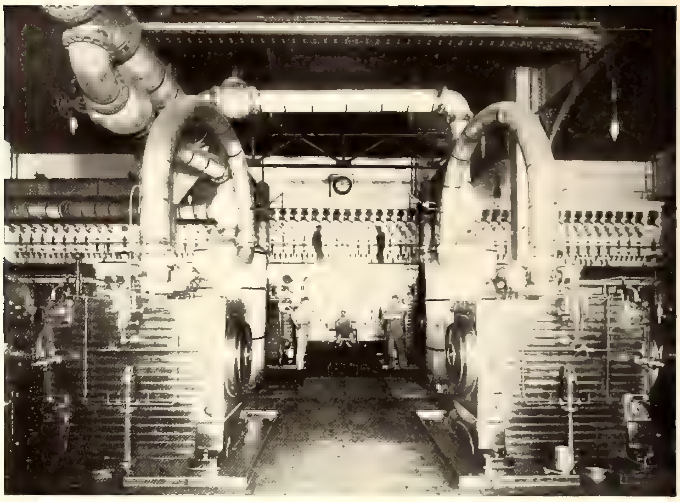
CONCRETE BIN FOR HOLDING CINDERS AND ASHES



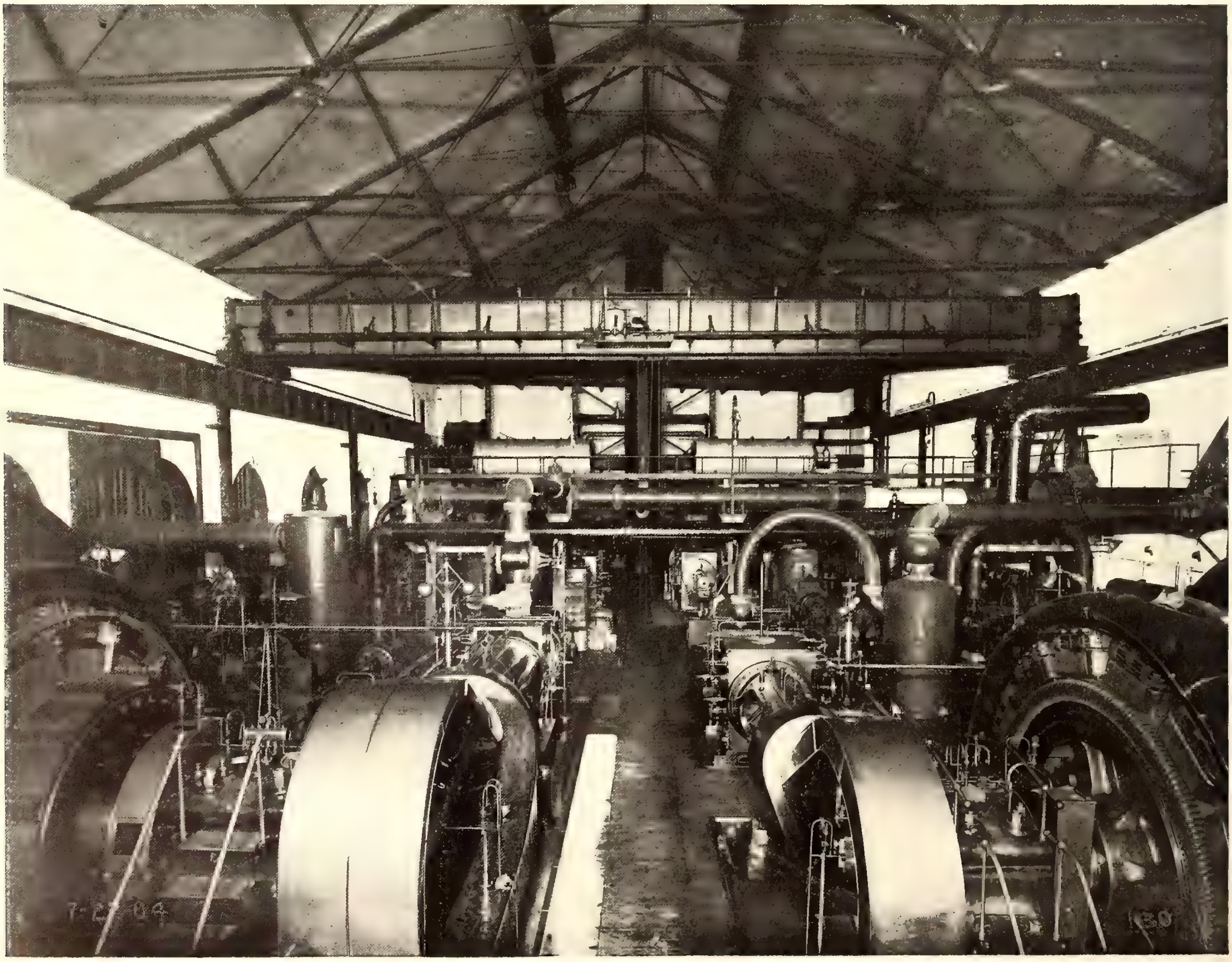
EXTERIOR OF GENERATING STATION AT SECOND STREET AND WYOMING AVENUE



EXTERIOR D. C. GENERATING STATION AT THIRTEENTH AND MT. VERNON STREETS

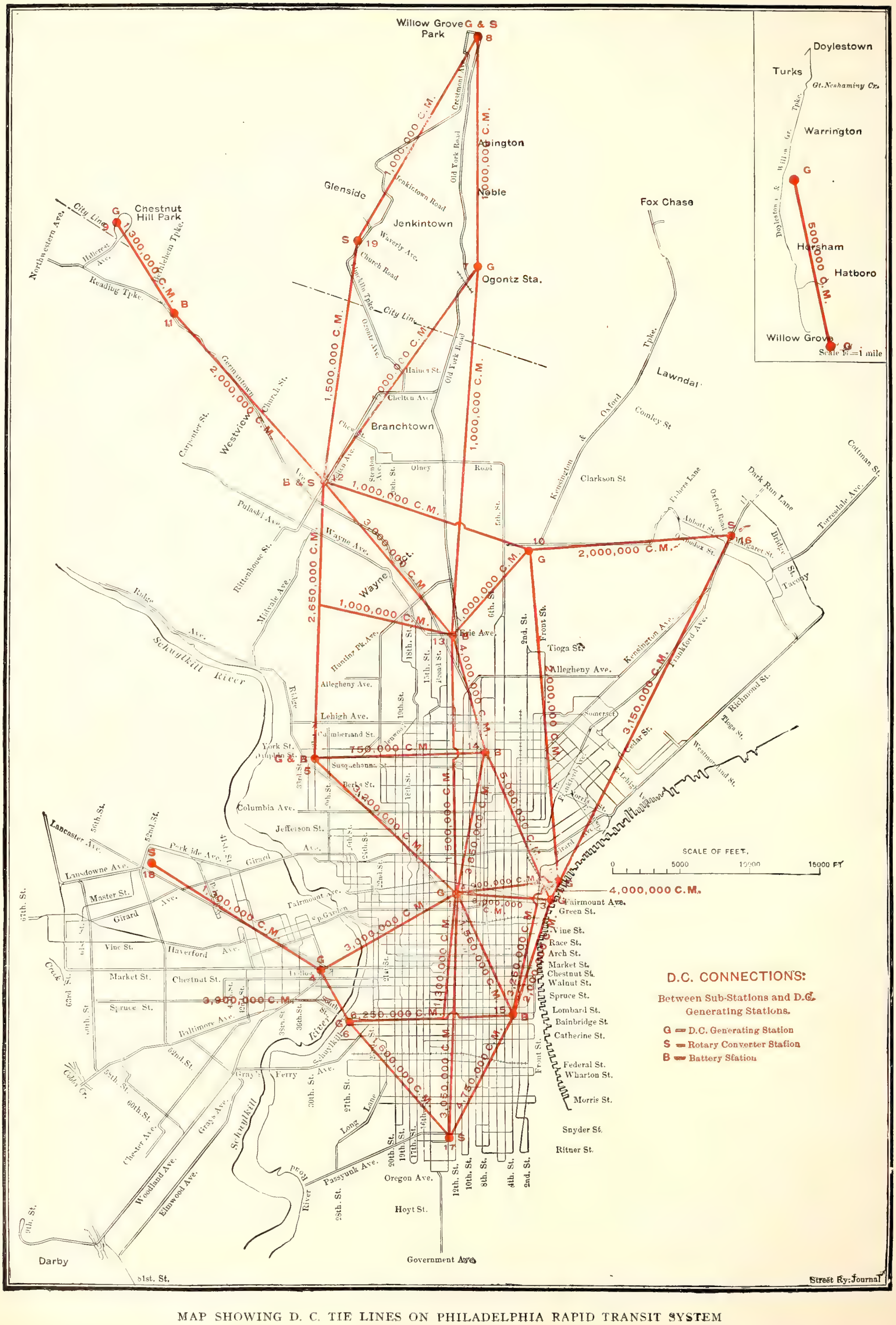


INTERIOR D. C. GENERATING STATION AT THIRTEENTH AND MT. VERNON STREETS

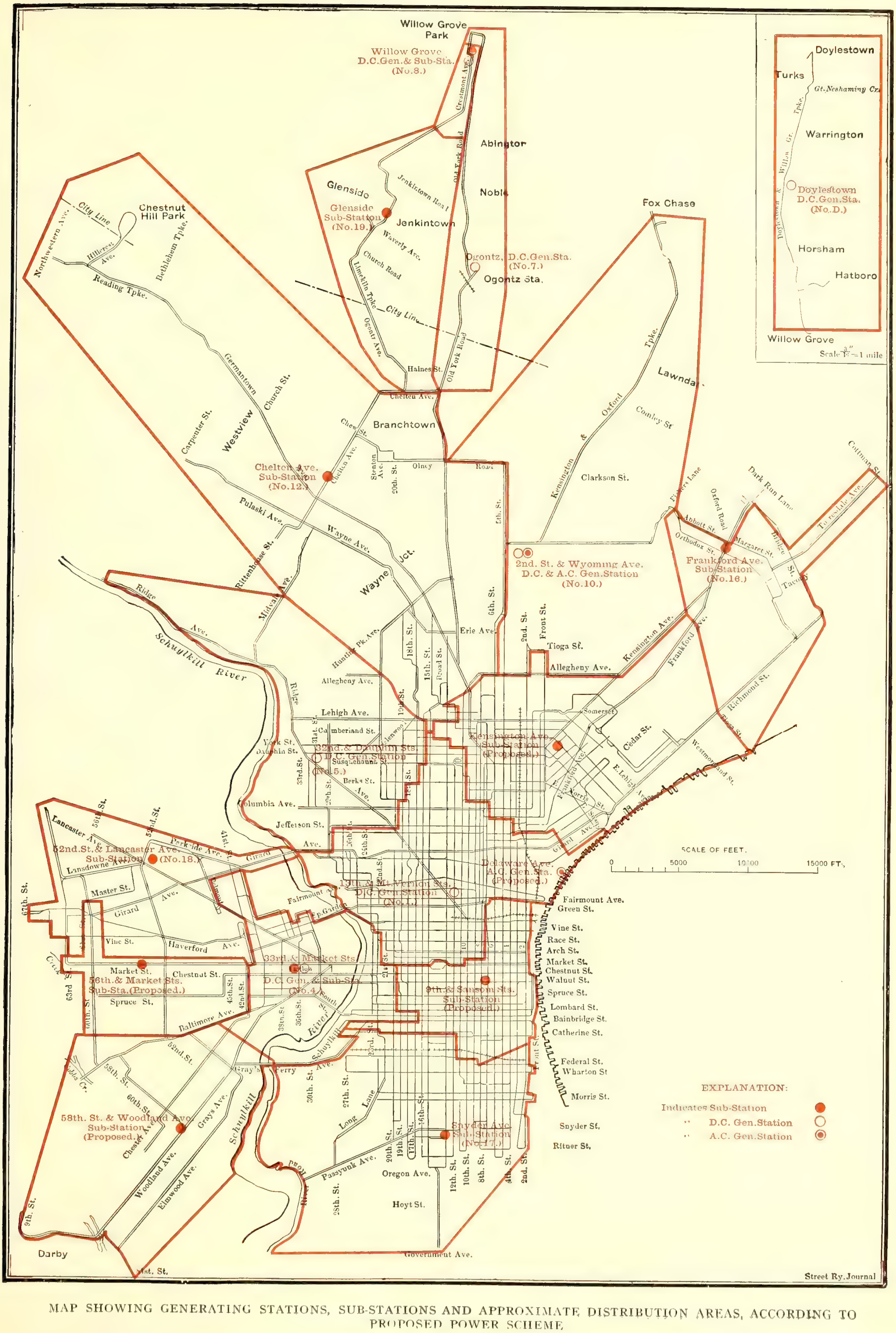


INTERIOR D. C. GENERATING STATION AT THIRTY-THIRD AND MARKET STREETS

MAP SHOWING A. C. DISTRIBUTION LINES ON PHILADELPHIA RAPID TRANSIT SYSTEM



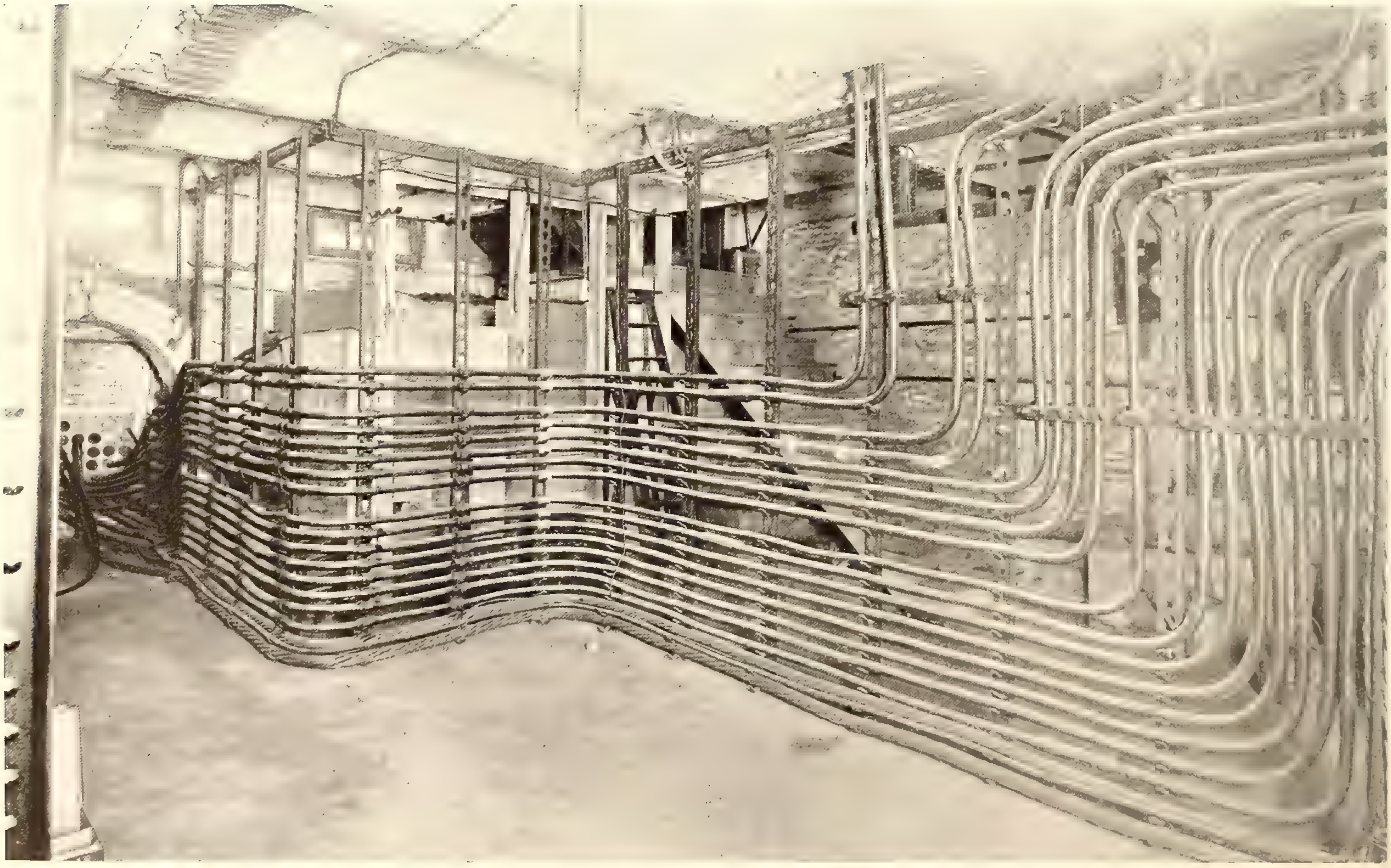
MAP SHOWING D. C. TIE LINES ON PHILADELPHIA RAPID TRANSIT SYSTEM



MAP SHOWING GENERATING STATIONS, SUB-STATIONS AND APPROXIMATE DISTRIBUTION AREAS, ACCORDING TO PROPOSED POWER SCHEME

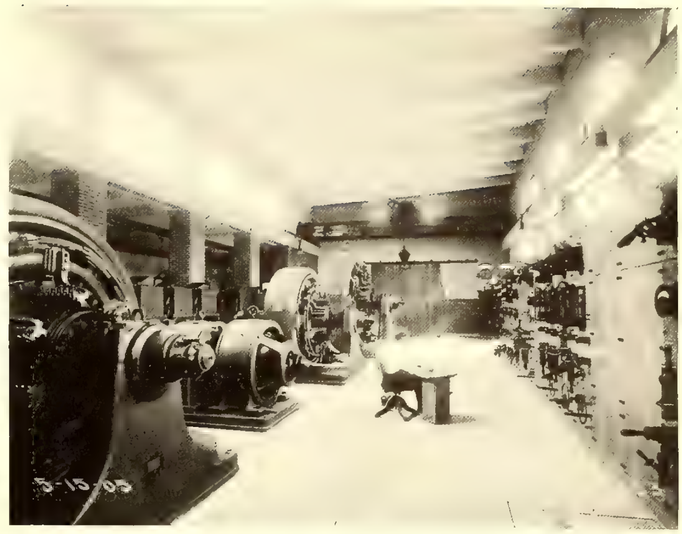
EXTERIOR OGONTZ POWER HOUSE

COOLING CONDENSING WATER BY FORCING IT THROUGH SPRAY NOZZLES



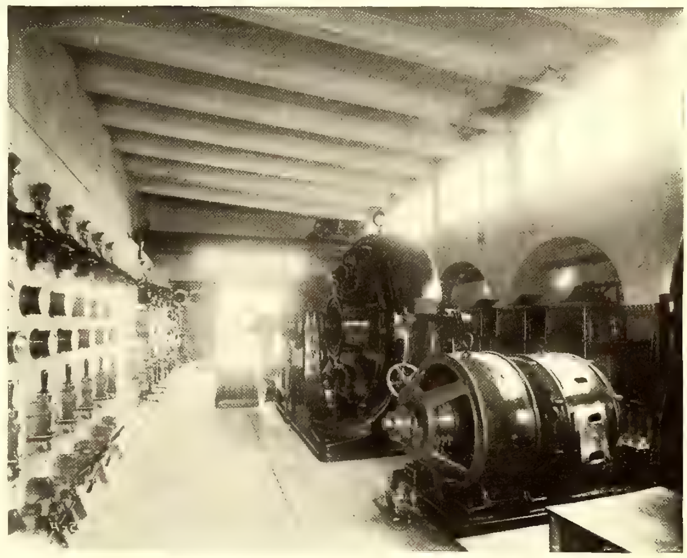
VIEW IN CABLE VAULTS UNDER GLENSIDE SUB-STATION, SHOWING METHOD OF SUPPORTING CABLES

EXTERIOR GLENSIDE SUB-STATION



INTERIOR GLENSIDE SUB-STATION

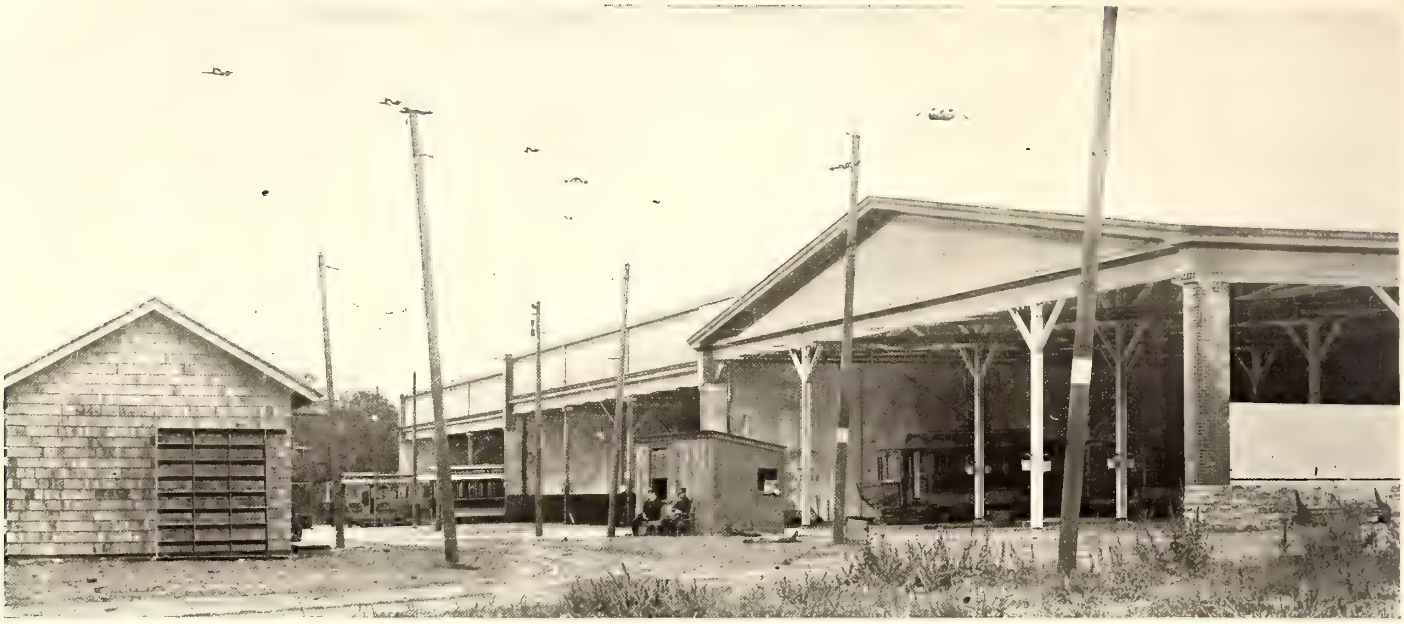
EXTERIOR SUB-STATION AT FIFTY-SECOND STREET AND LANCASTER AVENUE



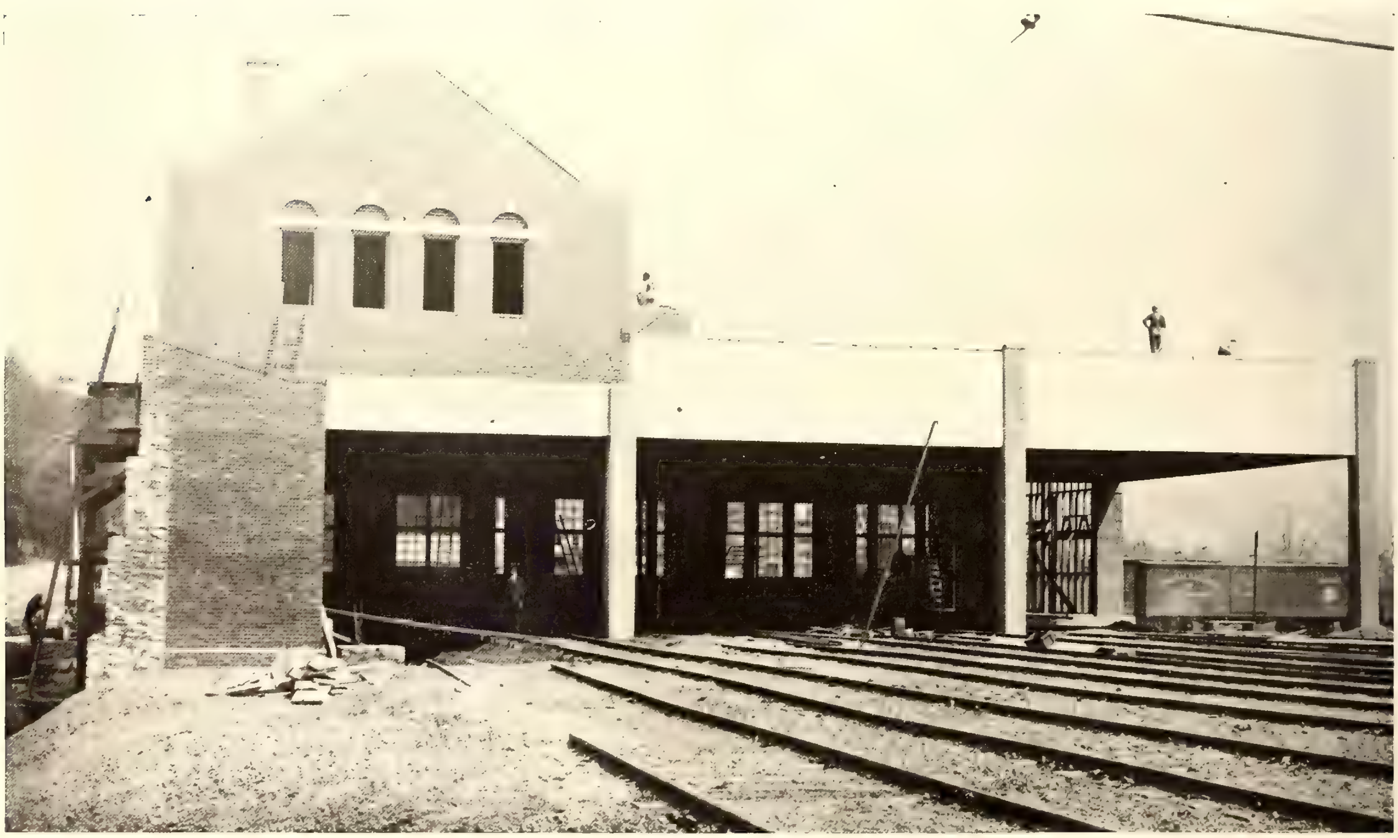
INTERIOR SUB-STATION AT FIFTY-SECOND STREET AND LANCASTER AVENUE

EXTERIOR D. C. GENERATING STATION AT WILLOW GROVE

EXTERIOR GERMANTOWN AVENUE STORAGE-BATTERY SUB-STATION

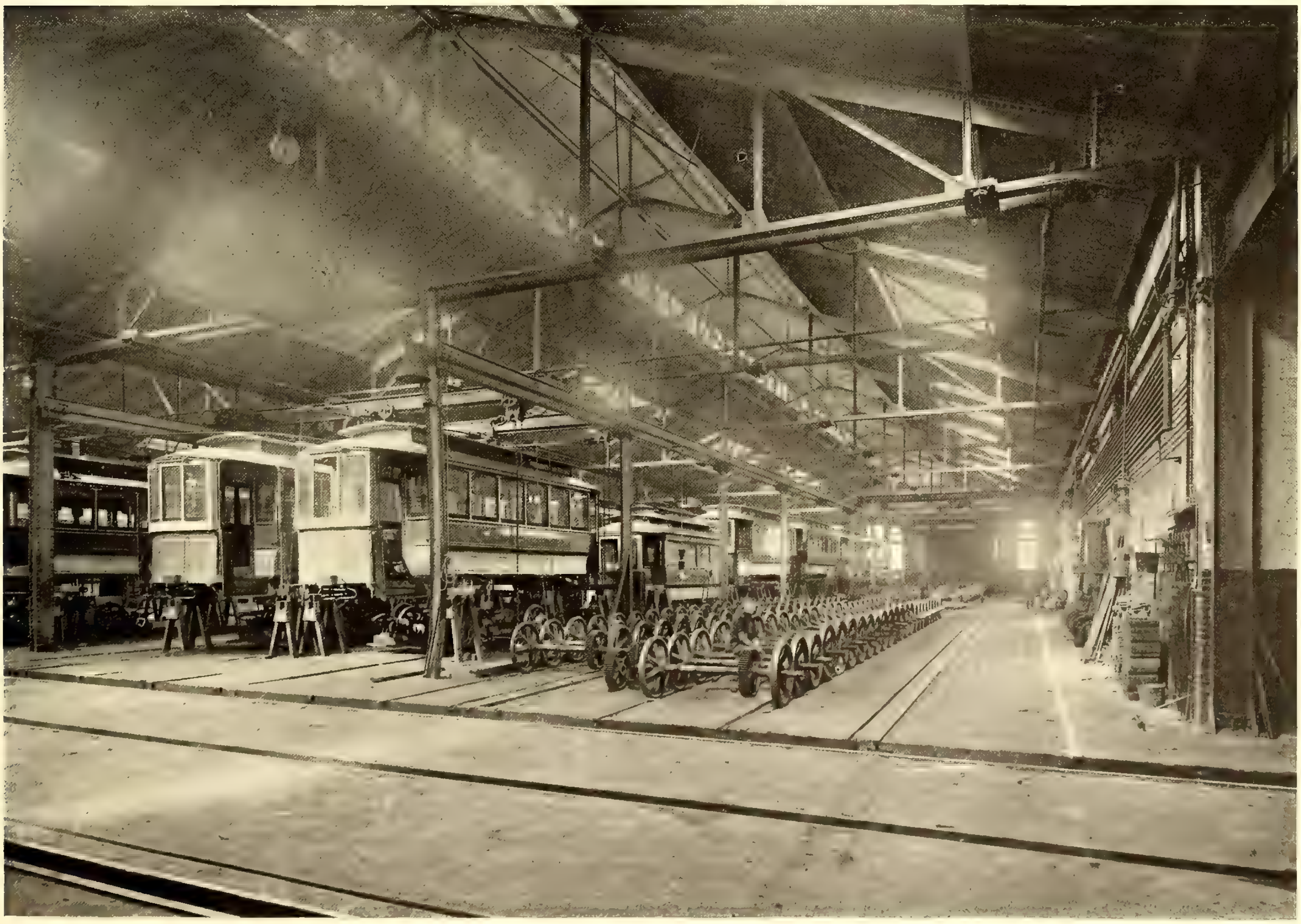


TYPICAL OPERATING CAR HOUSE

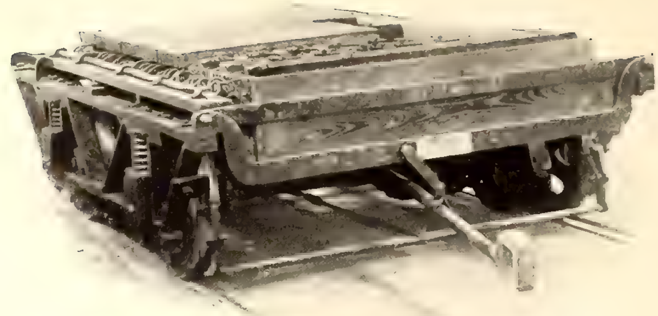


NEW OPERATING DEPOT AT WYOMING AVENUE

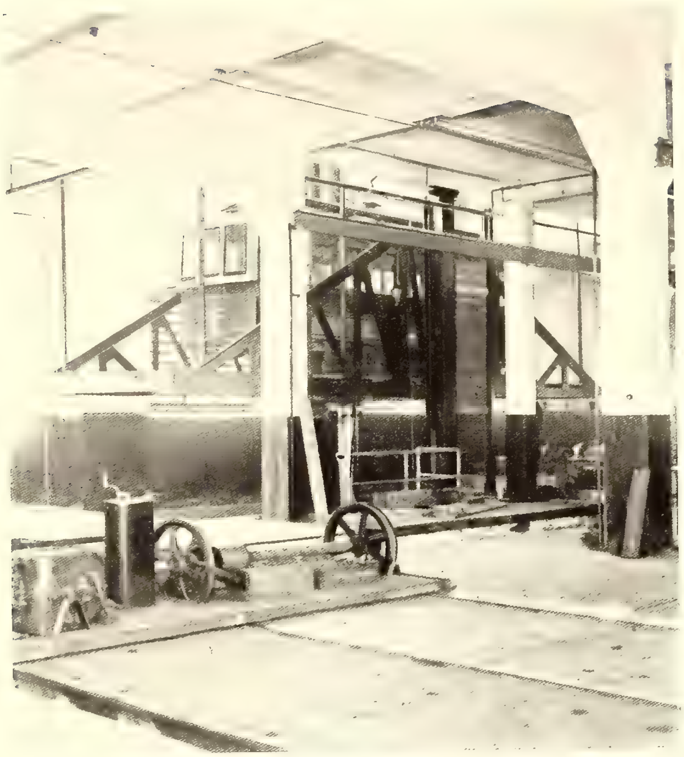
PAINT ROOM, NEW CONCRETE ADDITION TO KENSINGTON AVENUE SHOPS



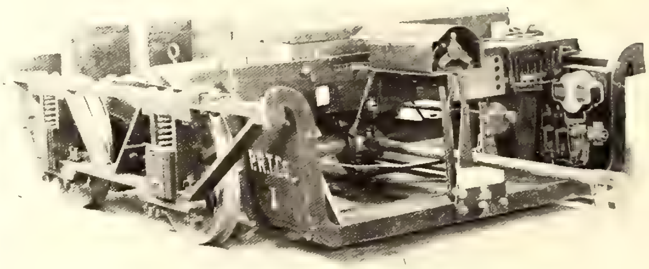
JACKING UP DEPARTMENT, KENSINGTON AVENUE SHOPS



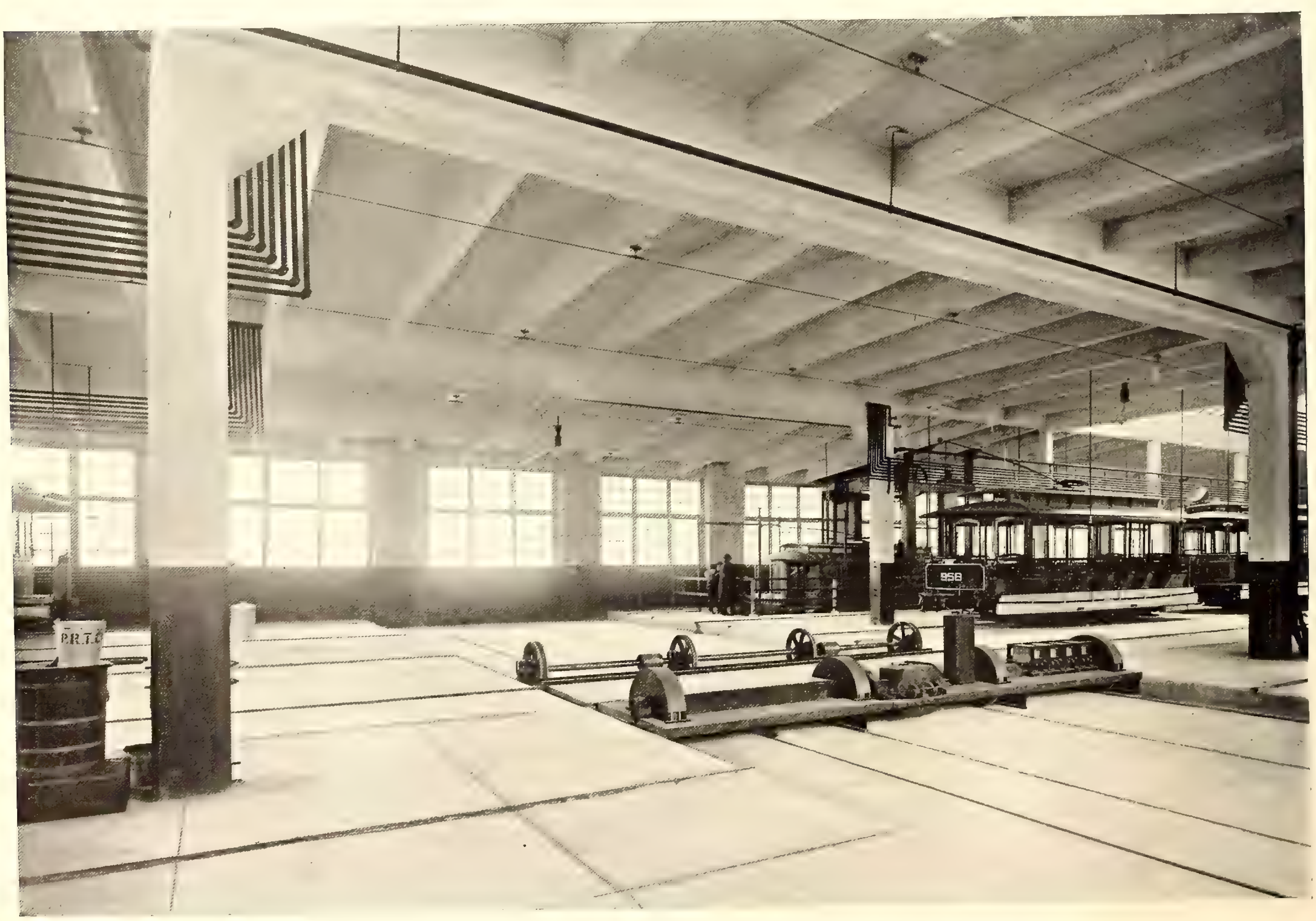
REAR VIEW OF STORAGE BATTERY LOCOMOTIVE FOR SHIFTING TRUCKS IN SHOPS



CAR ELEVATOR IN NEW ADDITION TO KENSINGTON AVENUE SHOPS



FRONT VIEW OF STORAGE BATTERY LOCOMOTIVE FOR SHIFTING TRUCKS IN SHOPS



VIEW IN NEW CONCRETE ADDITION TO KENSINGTON AVENUE SHOPS

Market Streets. From Forty-Sixth Street to the east terminal at Sixty-Ninth Street will be fed from a new 6000-kw sub-station, which will be erected at a point near Fifty-Sixth Street. together with underground tie-lines, so the entire West Philadelphia district, including the new elevated line, can be fed through any of the three sub-stations. A new 6000-kw sub-station will be built at Kensington and Cumberland Avenues to feed the Kensington district and relieve the present Delaware River direct-current generating station.

TABLE XVIII.—SHOWING NUMBER OF MEN EMPLOYED BY POWER DEPARTMENT.

Station Number.	1	2	3	4	5	6	7	8	9	10	D	11	12	13	14	15	16	17	18	19
Engineer in Charge	1	1	1	1	1	1	1	1	1	1	1	..	..	..	..	..	..	..	..	..
Assistant Engineer	2	2	2	2	2	1	2	1	1	2	1	..	..	..	..	..	..	..	..	..
First Oiler	1	1	1	1	1	1	1	1	..	1	..	..	..	..	..	..	..	..	..	..
Oilers	5	5	9	9	3	2	6	1	..	5	..	..	..	..	..	..	..	..	..	..
Switchboard Men	3	3	3	3	3	3	3	2	2	4	..	1	1	1	1	1	1	1	1	1
Generator Men	3	3	3	3	..	..	..	1	..	3	..	1	4	2	2	2	2	3	2	2
Pumpmen	1	3	..	..	..	1	..	..	..	2	..	..	..	..	..	..	..	..	..	..
Water Tender	3	3	3	3	3	3	3	..	..	3	..	..	..	..	..	..	..	..	..	.
Firemen	14	6	6	14	3	2	3	4	2	6	2	..	..	..	..	..	..	..	..	..
Firemen's Helpers	..	..	5	..	2	2	2	3	1	6	..	..	..	..	..	..	..	..	..	..
Boilermen	1	1	1	1	1	..	1	..	..	1	..	..	..	..	..	..	..	..	..	..
Coalmen	1	1	3	1	..	1	..	1	..	1	..	..	..	..	..	..	..	..	..	..
Ashmen	2	3	..	2	..	..	..	..	..	7	..	..	..	..	..	..	..	..	..	..
Boiler Cleaners	3	2	3	3	1	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..
Janitors	1	1	1	1	1	1	1	1	1	1	..	..	..	..	..	..	..	..	..	..
Engine Room Laborers	..	1	1	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..
Boiler Room Laborers	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Screen Men	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..
Laundry Men	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	41	37	43	44	21	18	25	16	8	46	4	2	5	3	2	3	3	4	3	3

Note.—Nos. 8 and 9, operated in summer only. No. 10, new A. C. Station. No. D, small country station. No. 8, generating station and sub-station combined. Nos. 11, 13, 14 and 15, battery sub-stations. No. 12, rotary and battery sub-station. Nos. 16, 17, 18 and 19, rotary sub-stations without batteries.

Summary of Table XVIII.

Operating Men:		Boiler Maker and Helpers	4
Generator Stations	303	Rigger and Helpers	2
Sub-Stations	28	Pipe Coverer and Helpers	2
		Conductors and Motormen (Ashes and Freight)	10
	331	Storekeeper, Watchmen, etc	11
		Laborers	12
Repair Men (All Stations):		Electricians and Helpers	20
Steam Fitters and Helpers	20		
Machinists and Helpers	6		100
Brick Layers and Helpers	10		
Carpenters and Helpers	3	Total	431

A new sub-station will be built at Fifty-Eighth Street and Woodland Avenue with 6000-kw capacity to feed the Darby district. The three outlying sub-stations in this section will be tied

POWER STATIONS OF THE PHILADELPHIA RAPID TRANSIT COMPANY.

Feed Pumps.	Feed Water Heaters.	Condensers.	Economizers.	Mechanical Stokers.	Mechanical or Forced Draught.	Coal and Ash Conveyors.	Capacity of Coal Bunker in Tons.
2—Duplex Buffalo, 16x9x24"	3—5'6"x19', Hoppes open	None	None	None	Steam blowers, Eynon-Evans	2 Ash elevators 1 Coal elevator 1 Coal conveyor Link belt machinery.	1,500
2—Worthington duplex, 10x16x 8½x10"	1—Kensington, 3'x13" 1—Goubert, 3'x16', closed	1—Blake, 16x32x21 2—Blake, 12x25x18 All jet condensers.	4—Broomell-Schmidt & Stacey	None	Mechanical and steam blowers	1 Coal elevator 3 Coal conveyors. Link belt machinery.	100
2—Barr duplex, 16"x9"x24"	3—Hoppes, open	1—Allis-Corliss, 14"x30", with duplex plunger pump. Jet condensers	None	Box stokers	Steam blowers, McClave	...	30
2—Scranton duplex, 16"x9½"x 24"	2—Hoppes, 5'x19', open	2—4,000 hp Surf. Wheeler 2—110 hp. DeLaval Tur. Pumps 2—Edws. air pumps trip 1—2,000 hp. Surf Wheeler 1—Cent. Pump 1—Box Dup air pump, 22" runner	None	None	Steam blowers, Eynon-Evans	2 Ash elevators 1 Coal elevator 1 Coal conveyor Link belt machinery.	1,600
2—Worthington duplex, 10x16x 10" 1—Barr duplex, 12"x7½"x12"	3—Goubert, closed 1—Hoppes, open	3—Schutte syphon condensers 6—Wood Cent. Pumps	None	None	Steam blowers, McClave	1 Ash elevator 1 Coal elevator 1 Coal conveyor Link belt machinery.	700
1—Scranton duplex, 12x7x8" 1—Worthington, 8x6x9"	2—Kensington, closed 1—Hoppes, open	2—Blake, 12"x25"x18", with jet condensers	None	None	Steam blowers, McClave	None	None
2—Barr duplex, 18x6x12"	4—Kensington, closed	1—Wetherill-Corliss plunger pump 14"x16", jet condensers	None	None	Steam blowers, McClave	None	None
		1—Triplex Deening pump, 12"x14", motor driven	None	None	Steam blowers, Eynon-Evans		
2—Snow duplex, 8"x6"x10"	3—Wetherill, closed	None	None	None	...		
2—Blake duplex, 7½x4½x10"	1—Goubert, closed	1—Wetherill-Corliss plunger pump, 14"x16", jet condensers	None	None		None.	
2—Heissler triple exp., 6-plung. 2—Scranton duplex, 7½x12x12"	1—Hoppes, open	1—Alberger barometric 6—Alberger cent. barometric	None	Box stokers	Forced draught, fans	1 Coal elevator 1 Coal conveyor 2 Ash elevators Link belt machinery.	2,000
2—Worthington duplex, 6x4x6"	1—Kensington	1—Worthington jet condenser, 9"x5"x12"	None	None	...	None	None
2—Duplex, 16x9x24"	...	...		None	None	2 Coal elevators 2 Coal conveyors. Link belt machinery.	3,500 First Portion 12,000 Comp. Sta.

The distance from Second Street and Wyoming Avenue to the sub-station at Fifty-Second Street and Lancaster Avenue is 47,000 ft., which is the longest alternating-current transmission. This is an underground alternating-current line.

The system selected for the new power scheme is 13,200 volts, three-phase, 25-cycle generation, transmitted at the initial voltage to the sub-stations, where it is transferred and converted in the usual way.

The location of all the generating stations of the company are indicated on the maps, and the equipment of each is given in detail in Table XVI.

There are in all eleven generating stations, having a combined generating capacity installed of 33,600-kw direct current and 8000-kw alternating current, which with the 3000-kw additional alternating current now being installed will give a total of 44,600-kw in generating capacity. There are ten sub-stations, having at present a combined capacity of 14,000-kw in rotary converters. There are also six storage-battery plants, having a total capacity of 5200 amp.-hours.

With the exception of the Second Street and Wyoming Avenue station, now in operation, and the new Delaware Avenue station, now under construction, all the generating stations are equipped with direct-current generators, most of which are connected to slow-speed engines, although a few high-speed engines are still in use. The boilers are mostly of the water-tube type, made by the Babcock & Wilcox Company, Thayer & Company and the Parker Engine Company. Four of the stations were originally designed to run non-condensing and seven to run condensing. Two of the non-condensing stations have been changed to condensing by installing water-cooling devices.

TABLE XVII.—SHOWING EQUIPMENT OF ALL ROTARY AND STORAGE BATTERY SUB-STATIONS OF THE PHILADELPHIA RAPID TRANSIT CO.

Sub-Station No.	Location of Station.	Rotaries.	Transformers.	Additional Equipment.	Storage Batteries Equipment.	Amp. Hour Capacity, 8-Hour Rate.
11	Abington Ave., Gtm.	....	....	....	250 Chloride cells...	960 amp. hours
12	Chelten Ave.	2—500 kw. G. E. .... 2—100 kw. West.	2—550 kw., G. E., 3-phase...... 6—375 kw. West., single-phase,	2 fans, driven by induction motors; A. C. starting switches for G. E. rotaries; G. E. oil switches operated by 110-volt storage battery; 1 air compressor.	250 Chloride cells... Battery not run in parallel with rotaries.	1,280 amp. hours
13	Erie Ave.	....			261 Chloride cells...	1,280 amp. hours
14	Ninth and Dauphin Sts.	....	....	....	260 Chloride cells...	1,920 amp. hours
15	Fifth and Lombard Sts.	....	....	....	260 Chloride cells...	2,400 amp. hours
16	Frankford and Arrott Sts.	2—500 kw. G. E. .... 2—1,000 kw. (future)........	.... 2—550 kw., 3-phase G. E ...	2 fans, driven by induction motors; A.C. starting switches for G. E. rotaries; G. E. oil switches operated by 110-volt storage battery; 1 air compressor..	None	
17	Thirteenth St. and Snyder Ave....	3—1,000 kw. West.......... 2—500 kw. G. E.	9—375 kw. West. single-phase 2—550 kw. G. E. 3-phase....	2 fans driven by induction motors; A.C. starting switches for G. E. rotaries; G. E. oil switches operated by 110-volt storage battery; 1 air compressor;	None	
18	Fifty-Second and Lancaster Sts..	3—1,000 kw. West. rotaries... 3—1,000 kw. (future)........	9—375 kw. West. single-phase	2 fans with induction motors; G. E. oil switches operated by 110-volt battery; 1 air compressor; 1 West. motor generator for starting rotaries; motor is 3-phase, 75 hp., induction; generator is 45 kw. D. C.; 2-37½ kw. single-phase West. transformers for induction motor...........	None	
19	Glenside......................	1—1,000 kw. West.......... 2—500 kw. West. .... 3—1,000 kw. (future)........	3—375 kw. West. single-phase 6—175 kw. West. single-phase	2 fans, driven by induction motors; G. E. oil switches operated by 110-volt battery; 1 air compressor; 1 West. motor generator, motor is 3-phase, 75 hp. induction type; generator is 45 kw. D.C. for starting rotaries; 2-37½ kw. single-phase West. transformers for induction motors.......	None	
8	Willow Grove..................	2—500 kw. West. .... 1—1,000 kw. (future)........	6—175 kw. West. single-phase	2 fans, driven by induction motors; G. E. oil switches operated by 110-volt battery; 1 air compressor; each rotary has a 3-phase induction motor mounted on its shaft for starting; 3-25 kw. single-phase transformers supply the motors...............	None	
5	Thirty-Second and Dauphin Sts.	....	....	....	270 Chloride cells, operated with generators..........	3,200 amp. hours

LOW-PRESSURE TURBINES

The Philadelphia Rapid Transit Company is about to install at one of its power houses two low-pressure Curtis steam turbine units, manufactured by the General Electric Company, Schenectady, N. Y. These turbines will utilize the energy inherent in the steam between exhaust pressure (atmospheric) of the reciprocating non-condensing engines and the condenser vacuum. Briefly, these turbines consist of a specially designed Curtis steam turbine adapted to receive steam from the low-pressure side of a non-condensing reciprocating engine. Each turbo-generator will be of 800-kw capacity, and will generate direct current, the generators in effect floating on the line and automatically taking care of their part of the load. No governing mechanism will be employed, but the turbines operating in parallel with the engines will adjust themselves to the load as called upon to do so. Steam will be taken into the turbine at a pressure of 15 lbs. absolute, and exhaust into the condenser at about 1 lb. absolute, passing through the turbine in four stages. Interpolated poles on the generator will insure perfect commutation, direct current being developed at 575 volts.

Of the eleven generating stations, the more important ones are situated at Thirteenth and Mt. Vernon Streets, Beach and Green Streets, Thirty-Third and Market Streets, and Second Street and Wyoming Avenue.

POWER HOUSE AT THIRTEENTH AND MT. VERNON STREETS

This station is equipped with five 1500-kw Westinghouse

direct-current generators, directly connected to Wetherill-Corliss engines. This building is fireproof in construction. There is nothing particularly novel about the engine room, except perhaps in the arrangement of the switchboard. The station feeds a central and important part of the city, consequently has a large number of feeders running from it. The switchboard is arranged with upper and lower bus-bars. The lower bus-bar is continuous throughout the whole board, and in ordinary operation all feeders leading from this station are connected to the lower bus-bar. The upper bus-bar is divided into five sections, any of which can be connected together if desired. From four of these stations heavy tie-line cables connect to four other power houses, so that the load may be given to or taken from the other stations as occasion may require. By means of these tie-lines the company is enabled to keep its engines loaded at all times of the day.

The boiler room of this station is equipped with nineteen 375-hp B. & W. boilers and one 400-hp Parker boiler. The coal is delivered by wagons, and after passing over the scales is dumped into a hopper and carried by a Link Belt coal elevator into a suspended iron bin, from which it is delivered to the floor of the boiler room by spouts. The ashes pass beneath the boiler into ash pockets, and are drawn off into cars in runways below the boiler-room floor. These cars carry the ashes to two automatic ash elevators situated at one end of the boiler room. These elevators are new and somewhat novel, in that they require no handling except the starting on the up trip. They were made by the Morse-Williams Elevator Company. The ashes are dumped into a bucket and the elevator is started by pulling a hand rope in the ordinary manner. After starting, the elevator requires no attention. The bucket, carrying about 1000 lbs. of ashes, goes to the top of the elevator automatically, dumps the ashes into an ash bin, rights itself and returns to the starting point at the bottom of the elevator shaft. The ashes are then drawn from the ash pocket into cars made for this particular purpose, carrying 20 tons each.

POWER HOUSE AT BEACH AND GREEN STREETS

The Beach and Green Streets power house is equipped with three 1500-kw General Electric generators, direct connected to E. P. Allis twin tandem-compound engines; also one 500-kw General Electric generator, direct connected to E. P. Allis single-cylinder engine. This station is also equipped with two engine-driven boosters and one motor-driven booster for use on certain long feeders which run from this station. The boosters were supplied by the Crocker-Wheeler Company.

The boiler room is on the second floor, and is equipped with twelve B. & W. boilers and two Thayer boilers. This boiler room is the only one in the direct-current stations equipped with stokers. The station is run condensing. The condensing system consists of one E. P. Allis direct-driven pump, which draws the water through condensers for all the engines. This system has proven particularly reliable and satisfactory.

POWER HOUSE AT THIRTY-THIRD AND MARKET STREETS

The Thirty-Third and Market Streets power house was originally a non-condensing station, and has recently been changed to a condensing station by installing cooling towers on the boiler-room roof. The equipment consists of four 1500-kw Westinghouse generators, two of which are direct connected to Wetherill-Corliss engines, and two to Pennsylvania Iron Works Corliss engines. There are also two 800-kw generators connected to Pennsylvania Iron Works tandem-compound engines. These generators all deliver direct current.

The exhaust from the engines is led to three surface condensers of the Wheeler Admiralty rectangular type. Water for cooling the condensers is taken from the city mains, and after passing through the condensers, as much as is needed is taken automatically for boiler-feed purposes at an average temperature of 120 degs. F. The balance is forced to cooling towers by centrifugal pumps driven by De Laval steam turbines. These cooling towers are equipped with two fans each, driven by 40-hp motors. The average cooling in the summer time is about 16 degs. The condensing apparatus was installed by the Wheeler Condenser & Engineering Company.

Coal is delivered by wagons, and after passing the scales is dumped into the hopper and conveyed into a 1600-ton suspended coal bin, similar to the one at Thirteenth and Mt. Vernon Streets. The ashes are taken from the ash pits beneath the boilers and conveyed to ash pockets by automatic elevators in the same manner as described for the Thirteenth and Mt. Vernon Streets plant.

The switchboard in this power house is double-decked, the upper deck being for feeder panels and the lower deck for generator panels. The instruments are mounted on Tennessee marble, oil finish, and the board is equipped throughout with aluminum bus-bars.

The other direct-current stations are not of sufficient novelty to require detail descriptions.

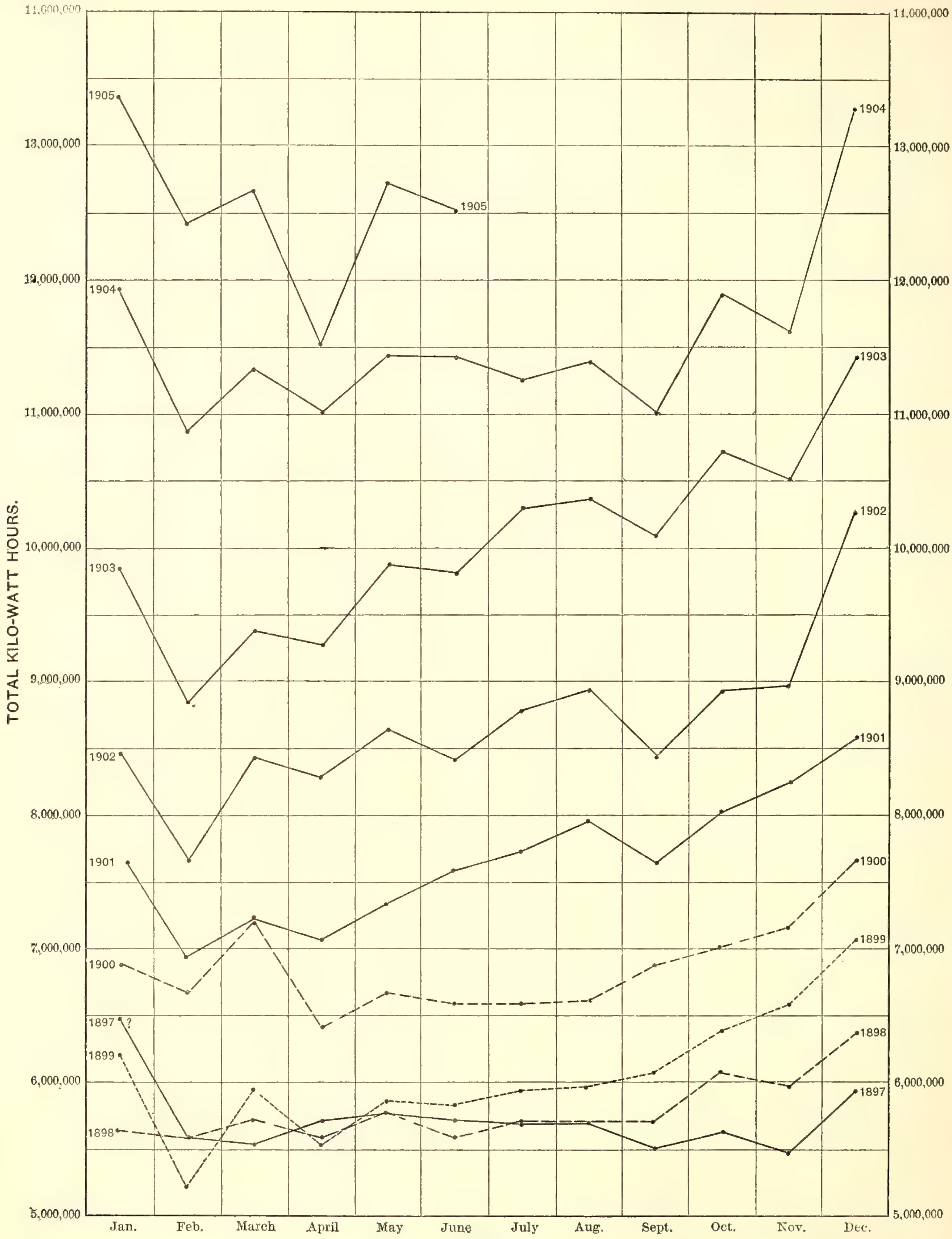
A. C. STATION AT SECOND STREET AND WYOMING AVENUE

At present, alternating current for the Philadelphia Rapid Transit system is generated

TABLE XIX.—SHOWING AREAS PER HORSE-POWER AND OTHER DETAILS OF ALL OF THE POWER STATIONS OF THE PHILADELPHIA RAPID TRANSIT COMPANY

Station No.	Location.	Size Plant in Kw.	Size Engine Room, Sq. Ft.	Size Boiler Room Sq. Ft.	Rated Hp. of Boilers, Comp. Plant.	Sq. Ft. Boiler Room, Per Hp.	Size Boiler Units Hp.	Size Grates Sq. Ft.	Hp. Per Sq. Ft. Grate.	Water HS. Grate S.	Bunker Capacity. Tons.	Size Chimneys, Ft.	Notes.
1	Thirteenth and Mt. Vernon Sts........	7,500	14,466	82½x170—14,025	7,500	1.87	375, 12 tubes high 16 tubes wide	9′8″x 7′0″— 68	5.5	55.	1,500	2—11′3″ Diam., 170′ high, steel lined..	Stacks inside B. R. Water tube boilers.
2	Delaware Ave. (old Sta. D. C.)........	3,800	12,657	83¼x200—16,650	6,000	2.77	250, 7 tubes high 16 tubes wide	7′6″x 9′0″— 67½	3.8	38.	150	....	Induced draft. Water tube boilers.
	Delaware Ave. (new sta. A. C.).......	55,500	28,080	115x340—39,500	51,200	.77	800, 18 tubes high 20 tubes wide	2′8″x10′ —160	5.	50.	12,000	8—14′ Diam., 225′ high...........	Stacks carried on steel framework of building. Water tube boilers.
3	Beach St., foot of Green St...........	5,000	10,934	78½x142—11,147	5,000	2.23	250, 9 tubes high 14 tubes wide	7′0″x 8′6″— 59½	4.2	42.	150	2— 7′x7′ 125′ high...........	Stacks inside B. R. Water tube boilers.
4	Thirty-Third and Market Sts.........	7,600	12,633	79 x147—11,613	6,500	1.78	375, 12 tubes high 16 tubes wide	9′8″x 7′0″— 68	5.5	55.	1,600	2—10′3″ Diam., 172′ high, steel lined..	Stacks outside B. R. Water tube boilers.
5	Thirty-Second and Dauphin Sts	2,200	6,287	42 x130— 5,460	2,400	2.27	300	7′0″x 7′3″— 51	6.	53.	800	1— 8′ Diam., 175′ high...........	Stacks inside B. R. "Berry boilers."
6	Twenty-Seventh and South Sts........	1,700	4,865	— 6,210	1,500	4.14	250, 7 tubes high 16 tubes wide	7′6″x 9′0″—67.5	3.7	37.	No bunkers	1— 8′ Diam., 150′ high...........	Stacks inside B. R. Water tube boilers.
7	Ogontz...........................	2,400	5,968	36 x125— 4,500	2,250	2.00	250	7′ x 6 — 42	6.5	53.5	No bunkers	1— 9′ Diam., 136′ high, steel lined..	Stacks inside B. R. "Berry boilers."
8	Willow Grove......................	1,500	5,400	50 x 90— 4,500	1,300	3.50	110 125	25 36	5. 4.1	....	No bunkers	1— 7′x7′ 100′ high...........	Stacks outside B. R. Return tubular boilers.
10	Second and Wyoming Ave., A. C.......	12,300	16,625	53 x266—14,098	11,600	1.25	700 600	147.4 130	4.74 4.62	51.85 51.4	2,000	1—16′ Diam., 220′ high, steel lined..	Stacks inside B. R. Water tube boilers Stoker.

at one large station located on Wyoming Avenue at Second Street, and extending south to the Wingohocking Creek, and between the Newtown branch of the Philadelphia & Reading Railway and boilers in all, each with a normal rating of 640 hp. Each battery had an independent iron stack erected above the boilers. Below the boilers, extending the length of the building, was constructed a tunnel, through which the cinders were removed. The boilers were operated by forced draft, the air being driven by a 10-ft. Sturtevant blower through a chamber built in connection with the cinder tunnel. The coal handling and stoking were done entirely by hand.



CURVES SHOWING COMBINED OUTPUT OF ALL POWER HOUSES OF PHILADELPHIA RAPID TRANSIT COMPANY

Third Street. The power house is known locally as station No. 10.

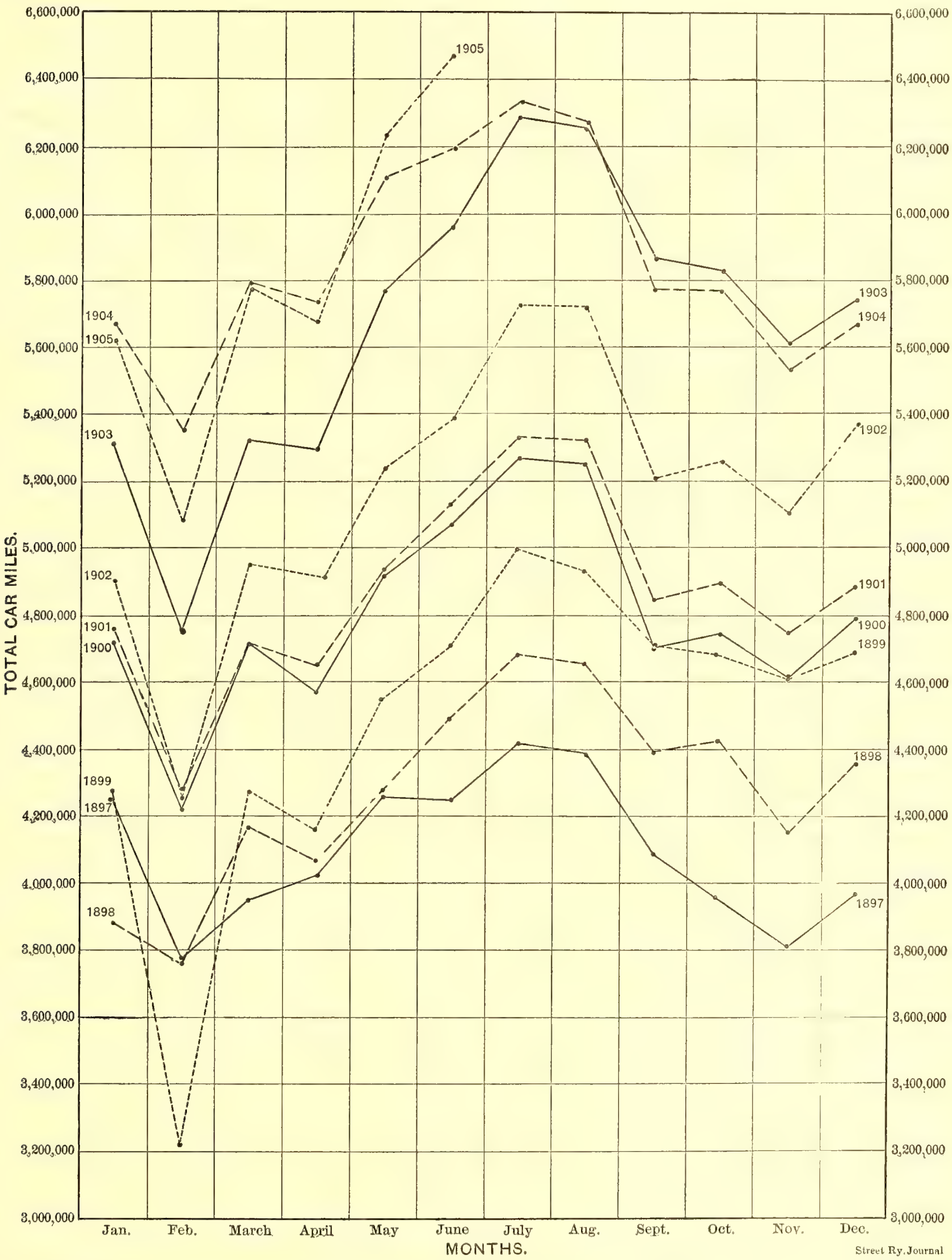
This station was originally intended as a temporary plant only, and practically the entire structure was a wooden frame building.

The original plant, built in 1903, included a boiler room 56 ft. wide and 105 ft. long, with three batteries of Parker boilers, six

The engine room was 70 ft. wide and 105 ft. long, and in it

were installed two 28-in. x 54-in. x 48-in. cross-compound Wetherill engines, each driving a 1000-kw General Electric generator and one 23-in. and 40-in. x 20-in. Westinghouse automatic compound engine, driving a 400-kw Westinghouse generator.

The decision to make the plant permanent and to add to its boilers each were installed, each boiler having a normal rating of 700 hp. An extension to the north has been built to accommodate an additional battery of the same capacity. The new 700-hp boilers are double-end boilers; that is, they are fired from both ends. They are equipped with automatic stokers. The



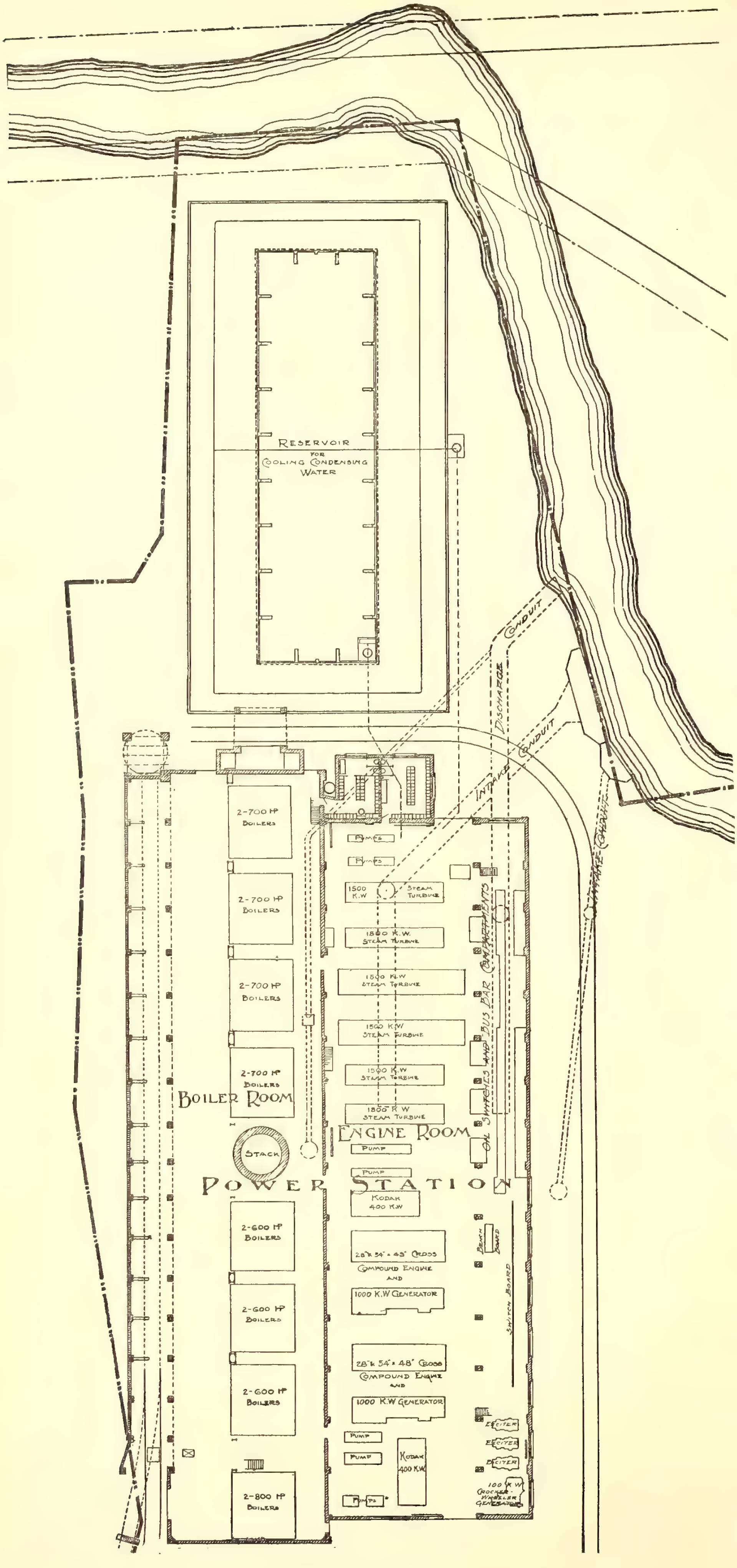
CURVES SHOWING TOTAL CAR-MILES BY MONTHS SINCE 1897 FOR PHILADELPHIA RAPID TRANSIT SYSTEM

capacity meant practically rebuilding the structure without interfering with its operation. The station as it now appears is practically completed, and comprises a boiler room 54 ft. wide and 267 ft. long, and an engine room 70 ft. wide and 242 ft. long.

In the boiler room the six old boilers were rebuilt, and are rated at 600 hp each. South of these four new batteries of two total area of the boiler room is 14,098 sq. ft., making about 1.25 sq. ft. per horse-power.

Between the old and new boilers a brick-lined steel stack 14 ft. in diameter and 220 ft. high has been erected. An extension has been built to the east to enclose the railroad siding.

In the extension to the south of the engine room the installation consists of six 1500-kw Westinghouse-Parsons steam turbines and



GENERAL PLAN OF GENERATING STATION AT SECOND STREET AND WYOMING AVENUE

four dry-vacuum pumps. In the extension to the north is a 23-in. and 40-in. x 20-in. Westinghouse automatic compound engine driving a 400-kw Westinghouse generator, two Heisler and two Scranton boiler feed-pumps, three steam-driven exciter sets and a Reeves automatic engine driving a 100-kw Crocker-Wheeler generator.

The total output of the engine room is 11,990 kw. The area of the entire station is 31,358 sq. ft., or 2.63 sq. ft. per kilowatt output. For the engine room alone there are 1.42 sq. ft. per kilowatt capacity.

In this connection, attention is directed to Table XIX. on page 511, which gives the square-foot area in relation to boiler and engine-room output for several of the Philadelphia stations. It will be noted that station No. 10, at Second Street and Wyoming Avenue, and also station No. 2, which includes the new turbine plant at Delaware Avenue (described later in this article), show remarkable figures in regard to both engine and boiler horse-power developed per square foot of area. This noteworthy economy of floor space has been obtained by the use of turbines and double-end boilers. Attention is also called to the large grate surface, which is demanded on account of the class of fuel that is being burned at these plants.

The overhead traveling crane is 51-ft. span, and between the columns supporting the west crane runway and the west wall (a space of about 16 ft.) are located the switchboard and the oil switch and bus-bar compartments, these compartments being similar in construction to those in the sub-station, described elsewhere.

In the basement under the south extension is the condensing apparatus, water for which is supplied from the creek through a 3-ft. 6-in. x 4-ft. conduit, the discharge conduit being of the same size leading to the creek south of the intake chamber.

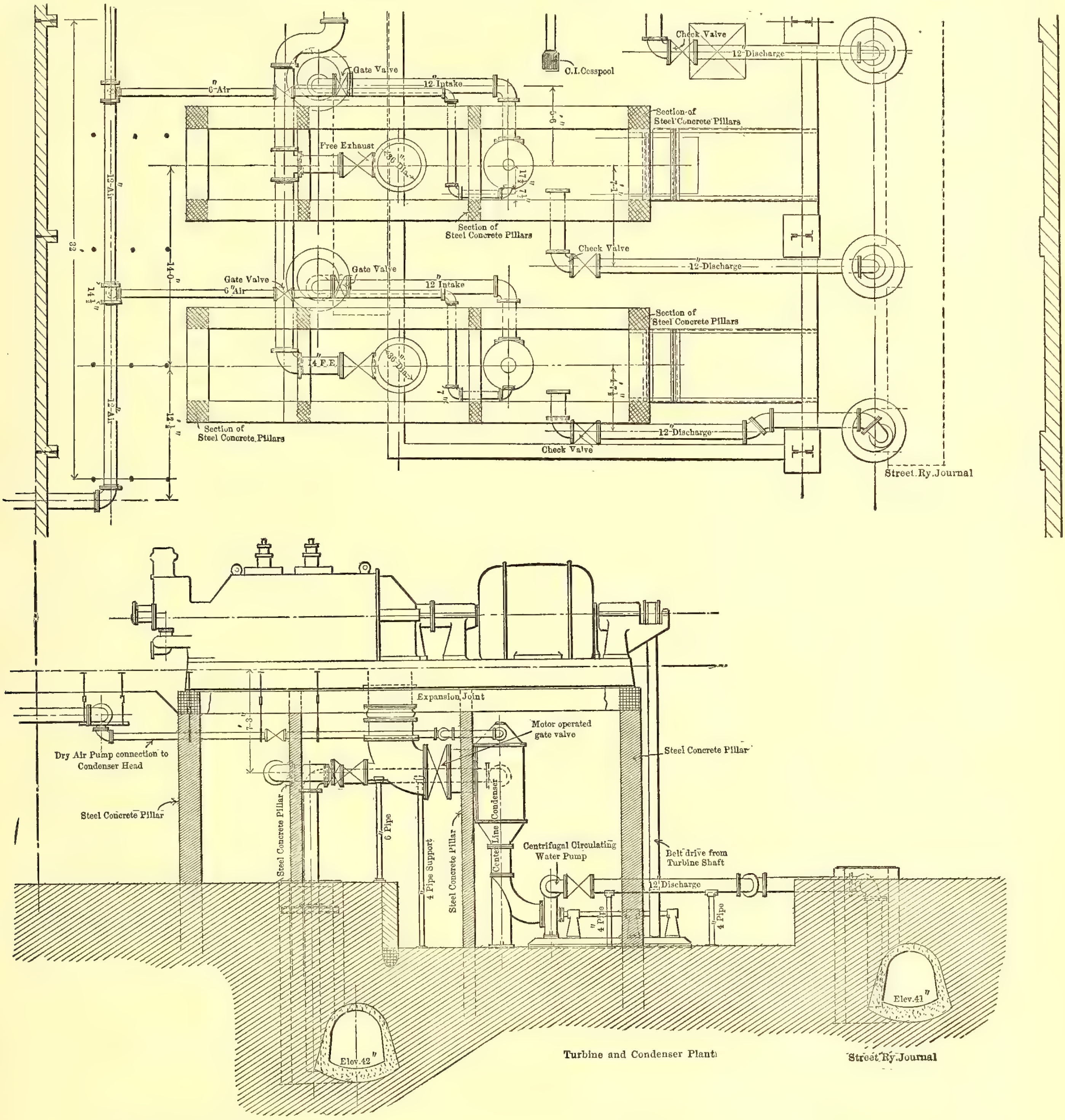
It was the original intention to install but four steam turbines in the extension, and when two more were installed it was found necessary to supplement the supply of cooling water secured through the conduit, and for this purpose the hot water coming from the condensers is piped to the rear of the power house, and cooled by being discharged through spray nozzles into a reservoir 40 ft. wide, 144 ft. long and 11 ft. deep, where it is stored for use in the condensing system.

DETAILS OF EQUIPMENT AT STATION NO. 10

The plant at Second Street and Wyoming Avenue is typical of many others throughout the country in which the rapid advancement of modern engineering practice has brought about the extensive revision of plans even before the station as originally laid out has been but partly completed. In several respects, the station is of more than ordinary interest; in the change from steam engines to steam turbines for the second half of the plant with its present extensions; introduction of a new type of condensing plant; the use of reinforced concrete pillars for turbine foundations; the adoption of a comparatively new type of boiler-superheater unit, and the generation of 13,000-volt current directly at line potential.

As originally planned, the plant was intended for reciprocating engine units, two of which were installed before it was decided to alter plans to provide for steam turbines. The plant was designed for the use of saturated steam, but the original boiler equipment is now being modified to accommodate an internal type superheater, thus conforming with the new extensions.

The plan on page 514 shows in outline the station as it will appear when completed, which will be within the present year. At the present time, however, only four turbine units are in operation, Nos. 3, 4, 5 and 6, with Nos. 1 and 2 engines. The extraordinary compactness of a steam turbine equipment is well brought out in this plant. Two engine units totaling 2000 kw occupy more space than five turbine units totaling 7500 kw, and nearly as much as the entire 9000 kw of turbine machinery, allowing the necessary floor space for the respective units. To some extent this compactness may be accredited to the location of condensers beneath the turbine, so that no extra floor space is necessary for them. This is a distinctive feature of the Parsons type of turbine.



PLAN AND SECTION SHOWING GENERAL ARRANGEMENT OF TURBINES AND CONDENSING PLANT AT SECOND STREET AND WYOMING AVENUE POWER STATION

In this station the outside longitudinal bay of the engine room, 12 ft. in width, is entirely reserved for the controlling apparatus. Operating switchboard, meter board and motor switches are on the main floor, high-tension switches on the second floor, and cable work in the basement. Unlike the usual type of large steam plants, where a double row of boilers is employed, the entire steam-generating capacity is arranged in a single row. The units are, however, exceptionally large in capacity, 600 hp to 700 hp, each with two units in a battery, and the settings are considerably higher than usual, measuring 24½ ft. from the floor level. This largely increases the general compactness of the boiler room.

The Wyoming Avenue station was originally planned to serve city surface lines, the area served extending in some cases as far as 10 miles from the station. This necessitates high-tension alternating-current transmission with low-tension d. c. distribution from rotary-converter sub-station. The transmission lines average 7 miles in length, the longest run being 15 miles. In the present system, current is generated high potential for direct transmission without the use of transformers at the main station. This idea has been embodied in the entire power equipment. The station not only supplies current direct to the various sub-stations, but may also be operated in conjunction with a. c. power plants located in other parts of the city, so the load may be shifted from one plant to another, thereby avoiding possible interruptions to the service, or in normal operation securing the most efficient distribution of load.

TURBINE EQUIPMENT AT STATION NO. 10

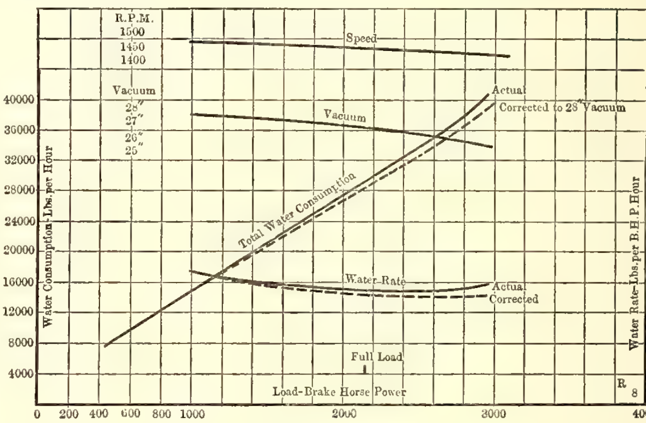
The turbine units are each of 1500-kw rated capacity and of standard Westinghouse construction. The drawings on page 515 show the unit, condenser and circulating water tunnels. Turbine and generator are mounted upon a single bed-plate of box girder construction supported at the four corners, at the center and at two intermediate points by reinforced concrete pillars. These pillars are 20 ft. in height, and are suitably tied together in the concrete body which forms the floor of the unit, and is integral with the concrete flooring. This arrangement gives great rigidity to the general concrete structure. The bed-plates of the turbine units are set down well into the concrete floor, bringing the foot of the equipment nearly to the floor level.

This concrete structure provides a remarkably free basement for the condensers, which are installed directly beneath the turbines in the spaces between the various pillars. Each turbine with its condenser is a unit independent in all respects of the remaining units. The advantages of the arrangement are obvious, not only in the facility and independence of operation, but also in the avoidance of long and troublesome exhaust pipes, with the dependent frictional loss. The condensing equipment consists of one 3500-hp Alberger barometric condenser and auxiliaries used in connection with the reciprocating engines; four 1500-kw Alberger dry-vacuum centrifugal condensers in connection with steam turbines and using natural water supply; two 1500-kw Alberger dry-vacuum centrifugal condensers on steam turbines and using water from cooling reservoir.

As the construction of the turbine units conforms in general to that used by the builders, a detailed description is not necessary. An important point, however, is the use of two independent admission valves, alike in construction, similarly operated from a single governor, yet differing in their functions. The Parsons type of steam turbine increases in efficiency as the load is increased, even if loaded far beyond its capacity. As it is extremely desirable that the turbine should give its best economy when operating on loads within its normal rating, some little efficiency at overloads can well be sacrificed if necessary to accommodate the heavy overloads that occur in traction stations. The function of the primary admission valve is therefore apparent. The secondary valve controls the steam admission during normal loading, within which the turbine possesses its best economy. At a predetermined overload the secondary valve comes into play and sustains the load by admitting more steam at a given speed. The increased power is obtained by the action of this secondary valve admitting high-pressure steam to the lower stages of the turbine where the diameters are greater. Normally, the unit runs at 1500 r. p. m. It is controlled by a sensitive governor, through which any speed regulation can be obtained down to 1½ per cent and 2 per cent. The units not only operate in parallel, but also with two Corliss engine type units, so that less sensitive speed regulation is desirable.

An effective detail of construction is the small motor-driven speed-changing device with which each turbine is equipped. The principle is similar to that which has not infrequently been applied to steam engines in a. c. practice. This apparatus consists essentially of a movable load on the governor spring, the variations being accomplished by a small motor controlled by a double-throw switch mounted upon the switchboard. The attendant synchronizes all machines from this point after they have been brought up to speed and the throttle opened, and also effects the proper distribution of load between the various generating units according to the indications of the meters before him.

The oiling system for each turbine is independent of the others, and upon the closed-circulation principle. As the bearings are proportioned to support the rotating parts without the necessity of forced lubrication, a small plunger pump positively driven through gearing from the main turbine shaft, is sufficient to maintain circulation, the pressure for which is from 5 lbs. to 10 lbs. per square inch. The oil used is a high-grade mineral oil that, under similar conditions, has been used continuously for six months or over in other turbine plants. It enters the bearing shells at the point of least pressure, at the top, and, after thoroughly flushing the journals, returns to a pipe cooler in the bed-plate of the unit, from whence it is again returned to the bearings. Each turbine is equipped with a safety stop mounted at the end of the turbine shaft. It is a small centrifugal governor, which may be set to operate at a definite overspeed, a small trip valve communicating with a quick-closing throttle in the main line. Thus any injury to the governor mechanism cannot result in the destruction of the machine. Should any emeregncy arise making it desirable to shut down quickly, the operator may trip this valve by hand without having to close the main throttle valve.



EFFICIENCY TESTS ON WESTINGHOUSE-PARSONS TURBINES

Some excellent results have been obtained from these turbines during their official tests at the works of the builders.

The accompanying diagram on this page shows the average results of the four turbines installed. Dry saturated steam was used at a constant pressure of 150 ft. per square inch. The vacuum could not be held up to the normal 28 ins. on the heavier loads, but in spite of this the guaranteed economies were exceeded by a good margin. The minimum water rate was secured at slightly over full-load rating, and was about 13.35 lbs. per b. h. p. hr. Had the vacuum been held up to 28 ins., as will be the case in service, the economy would have been much better, as indicated by the dotted line—less than 13 lbs. per b. h. p. hr. at about full load, corresponding to about 18.3 lbs. per kw-hour with saturated steam. The correction for vacuum is based upon comprehensive

tests upon a machine of similar size and design, which showed a decrease in water rate of about 3 per cent per 1-in. increase in vacuum at full load. The average speed variation between half load and 50 per cent overload was 2.68 per cent; from no load to full load, 2.45 per cent. At about 13.7 per cent over speed the automatic stops released and shut down their respective machines.

DETAILS OF CONSTRUCTION OF STATION NO. 10

The character of the ground made it necessary to take the foundations for the columns and piers to rock, and support the walls on girders. These girders, as well as those supporting the boiler walls, are of reinforced concrete. Reinforced concrete has a prominent part in the construction work in connection with the station, and its adaptability to many uses is well shown. In addition to the girders referred to, the cinder bin, the condensing-water reservoir, the drainage sewer and the entire floor construction of the engine room, with the supports for the turbines, are of this type of construction. The columns supporting the turbines are about 16 ft. high, and are 18 ins. x 18 ins. and 12 ins. x 18 ins. in section, reinforced with steel rods.

Above the main floor level the building is of skeleton steel construction, with brick walls and cinder concrete roof, finished with slag and gravel.

The reservoir south of the power house is also of reinforced concrete construction. The walls are 11 ft. high, and are 8 ins. thick, with buttresses spaced 16 ft. center to center, reinforced to withstand the pressure from the earth outside banked up at an angle of 30 degs. Around the four sides of the reservoir are sloping wood platforms carrying two lines of piping fitted with nozzles through which is sprayed the hot water that is caught by these sloping platforms and carried to the reservoir.

The sewer leading past the station and conveying sewage from Wyoming Avenue is of reinforced concrete with flat bottom and semi-circular top, supported at intervals of 16 ft. on piers resting on "simplex" concrete piles driven to rock.

NEW TURBINE STATION ON DELAWARE AVENUE

The property on which the new station is to be erected extends from Delaware Avenue on the east to Beach Street on the west, a distance of 200 ft., with a frontage of 435 ft. on Beach Street and 415 ft. on Delaware Avenue. On the opposite side of Delaware Avenue, with a frontage of 82 ft. and a depth of 400 ft., is pier No. 41, which is also the property of the company.

The site of the station is at present partially occupied by an old station, and the first section of the new station is being erected north of this. Upon the completion of this first section, the old station will be demolished and the new station completed, as shown by the plan on page 518.

GENERAL DESIGN OF NEW DELAWARE AVENUE STATION

On account of the width of the property, the arrangement in both boiler and engine rooms is very compact. The completed boiler room occupies a space 116 ft. wide and 340 ft. long. The arrangement of the boilers across the room divides it into a number of separate firing rooms, with the boilers face to face and back to back, there being 22 ft. between faces and 18 ft. between backs. For each turbine a line of boilers is planned, two in the center and three at each end, separted by narrow alleys. Each line has a separate stack, supported on the steelwork over the center pair of boilers. It was originally intended to have a coal bunker over each firing room. This would have almost entirely shut out the light and ventilation, and the design was accordingly changed, two bunkers being provided extending the entire length of the room over each of the outside batteries. Over the boilers the stack occupies the space between the bunkers, while over the firing room the space is occupied by a ventilating skylight, supplementing the light and air obtained from the windows on Delaware Avenue. Along the fronts and backs of each line of boilers a gallery extends for the more convenient operation of the stokers.

The basement floor under the boiler room is 14 ft. below the main floor, and under each line of boilers is a gallery, with the cinder chambers in the center. In the side walls of these chambers are doors, through which, from the gallery, a poke-bar can be run to loosen up the cinders. In the bottom of the cinder chambers are chutes, through which the cinders can be discharged into cars. Under each line of boilers is a track leading to a main track running the length of the basement, by which the cinder cars are taken to the elevators leading to the cinder bin.

The engine room occupies a space 78 ft. wide and 360 ft. long, with two galleries 17 ft. wide extending the entire length of the room. The plan contemplates the installation of eight turbo units, spaced 40 ft. center to center. In the space between the turbines will be located the exciters, etc. Under the gallery on the main floor will be the oil-switch compartments. The first gallery will contain the switchboard. Over the main portion of the engine room is a three-motor traveling crane, 61 ft. span, with an auxiliary hoist. Over the oil-switch compartments is a smaller traveling crane.

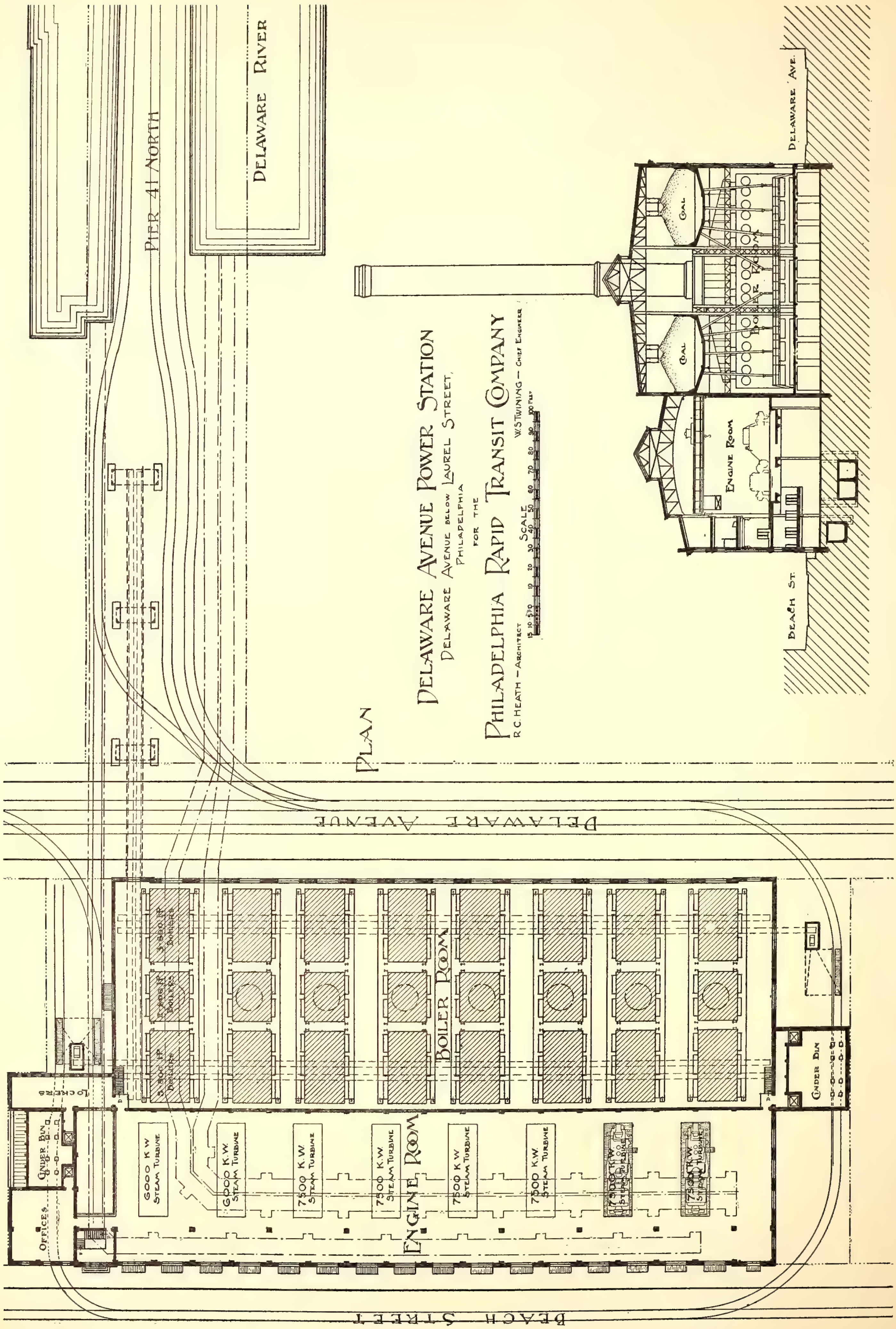
In the basement, the floor of which is 26 ft. below the main floor of the engine room, is located the condensing apparatus. A gallery, on which are located the bus-bar compartments, extends the entire length of the room.

At the north end of the engine room a steam road track extends into the building, allowing machinery and materials to be unloaded by the overhead crane. Beyond this, on the ground level, is a small shop and storeroom; on the main floor, toilet and locker rooms, and on the floor above, the offices of the engineer, etc., adjacent to the entrance and stairs from Beach Street. Adjoining the toilet rooms, and located over the trolley track from Beach Street, is the cinder bin, to which the cinders are conveyed by the two bucket elevators previously mentioned, each bucket having the same capacity as the cinder car used in the basement. The cinders are discharged by chutes into a car, by which they are taken to a dump or to some point for use.

The cooling water for the condensing apparatus is conveyed by two conduits, each 63 sq. ft. in area, from the south side of the wharf, under Delaware Avenue, under the basement floor and down the length of the engine room below the turbines, wells being constructed at the sides, from which lead the pipes running to the condensers. At the entrance to the conduits are two screens of iron bars in channel frames, the second being somewhat closer spacing than the first, both of which can be raised by an overhead hand hoist for cleaning. These screens prevent foreign matter from entering the conduits. Back of these screens is the intake chamber, and from this lead the two conduits, each having a heavy timber gate, one or both of which may be lowered, thus shutting off either conduit, so that it may be pumped out to allow any necessary repairs to be made. Should such a condition arise, water can be supplied through the other conduit, each of the two being of sufficient area to do the work alone.

The discharge conduit extends north along the Beach Street side, and then east under Delaware Avenue to the north side of the wharf.

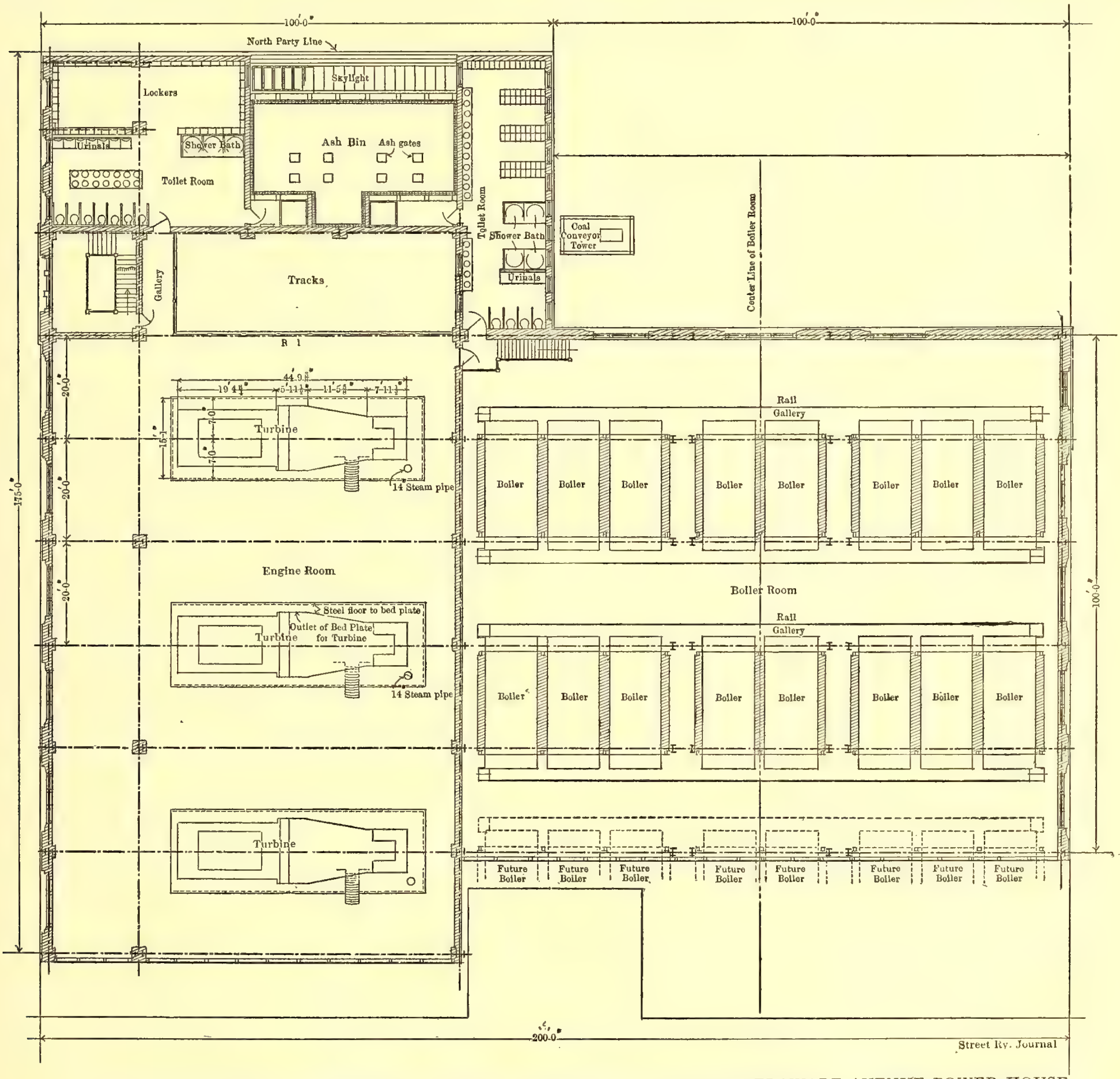
On account of the character of the ground, the foundations presented an interesting problem, complicated by the location of the water conduits between the lines of columns. Below the upper strata, which is a hard, coarse gravel, is a soft, black mud mixed with clay, extending down an average depth of 20 ft. to coarse sand. On account of these conditions, it was decided to use piles for the foundations. Allowing a load of 20 tons per pile for wood piles, the heavy loads due to the coal bunkers and stacks made the areas of the footings such that it was found necessary to take the steel columns down below the bottom of the conduits, allowing the footings to spread out beneath them. As the bottom of these conduits is about 9 ft. below the basement floor level, and as water is encountered over the whole area at a level about 2 ft. below the floor, thus making continual pumping and shoring necessary until the piles were driven and the columns erected, the ob-


Pier 41 North
Delaware River
Delaware Avenue Power Station
Delaware Avenue below Laurel Street, Philadelphia
for the
Philadelphia Rapid Transit Company
R. C. Heath — Architect
W. S. Twining — Chief Engineer
Scale
Plan
Coal
Coal
Boiler Room
Engine Room
Delaware Ave.
Beach St.
Delaware Avenue
Boiler Room
Engine Room
6000 K.W. Steam Turbine
6000 K.W. Steam Turbine
7500 K.W. Steam Turbine
7500 K.W. Steam Turbine
7500 K.W. Steam Turbine
7500 K.W. Steam Turbine
7500 K.W. Steam Turbine
7500 K.W. Steam Turbine
Offices
Lockers
Cinder Bin
Cinder Bin
Beach Street

jections to footings of this character can be readily understood. This led to the adoption of Raymond concrete piles, which, being spaced 30 ins. center to center and sustaining a load per pile of 30 tons, made the areas of the footings about two-thirds the size necessary for wood piles, thus making it possible to construct the conduits between the footings, excavating below the basement floor only to the depth necessary for the concrete pile capping and the column bases. For these piles a tapering sheet-steel casing, in which is a collapsible core, is driven through the mud to hard

and walls, are entirely of reinforced concrete, as are the coal bunkers and stacks. Concrete for the bunkers was considered cheaper than any other construction, because of its requiring practically no expenditure for maintenance or repairs.

To economize space, the stacks were located over the boilers and supported on the structural steel work at a point 50 ft. above the boiler room floor, finishing 175 ft. above this point, the diameter being 14 ft. inside. Reinforced concrete stacks were adopted because of economy in construction and maintenance and light-



PLAN OF FIRST SECTION OF TURBINE ROOM AND BOILER ROOM AT NEW DELAWARE AVENUE POWER HOUSE

sand; the core is then withdrawn and the shell filled with concrete.

The water conduits are square in section, the walls being of reinforced concrete. The superstructure is supported on a skeleton steel construction, the columns having combination steel I-beam grillage and reinforced concrete footings, each column supported on an independent group of piles. The walls are of red brick with terra cotta cornice. The window frames are of metal glazed with wire glass.

The main floor and the gallery floors in the engine room are of reinforced concrete slabs, between the steel beams, in which are embedded the pipes for the cables.

The entire boiler room floor, with the cinder chambers and gallery below and the piers and girders supporting the boiler columns

ness, each stack weighing about 500 tons. They are supported on double-plate girders, between which are placed the anchor-rods, the space between the girders and in the angles forming the circular base being filled with concrete.

The roofs are of cinder concrete slabs, reinforced with steel, supported on steel trusses, the top being finished with tar and gravel roofing. The ventilating skylights over the engine and boiler rooms are of copper glazed with wire glass

EQUIPMENT OF NEW DELAWARE AVENUE STATION

Each line of boilers contains eight Parker boilers, with a normal rating of 800 hp each, equipped with superheaters. Automatic stokers will probably be installed. No mechanical draft or economizers are contemplated.

The three units to be installed in the first section will be Westinghouse-Parsons turbines, each of 6000-kw capacity; the remaining five units will probably be 7500 kw each. Beyond this, the character of the equipment at this writing has not as yet been definitely decided.

The compactness of the entire arrangement can be seen from the following data:

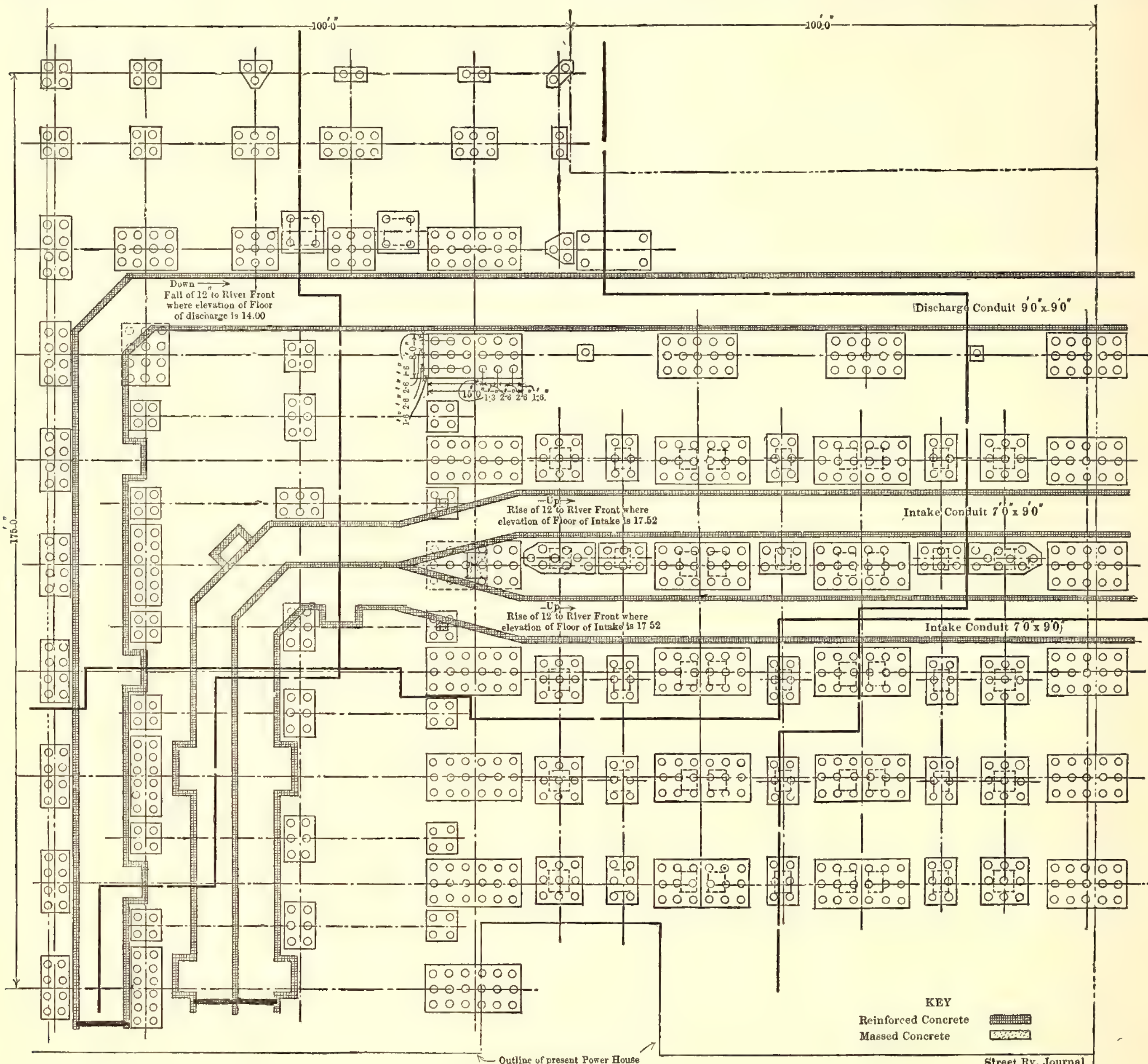
Boiler room, 51,200 hp, 39,440 sq. ft., or .77 sq. ft. per hp.

Engine room, 55,500 kw, 28,080 sq. ft., or .5 sq. ft. per kw.

Or, taking the combined areas of the boiler and engine rooms, the result shows 1.22 sq. ft. area per kilowatt for the entire station, exclusive of offices and storerooms.

HANDLING COAL

Considerable interest attaches to the methods of handling coal and ashes at the various power houses. At the Second Street and Wyoming Avenue plant, the railroad over which is received the coal for the station passes parallel to the boiler room a short distance to the east, and is about 21 ft. above the level of the basement floor. The siding begins at a point about 400 ft. north and extends into the building above the boiler-room floor. Over the firing space, about 22 ft. wide, in front of the boilers and extending the entire length of the building, is a Berquist suspension bunker with a capacity of 8 tons per lineal foot. At the north end of this bunker and under the siding tracks is a reinforced concrete bin with cast-iron pipes leading from it to a pit below the boiler-room floor, in which is the boot of a bucket elevator which carries the coal up to a conveyor over the bunker. A train of cars can be shifted into the station, and as the cars are emptied into the bin, can be shifted out on the siding to the north. The coal passes from the bin to the elevator, thence to the bunker by means of the conveyor. Pipes lead from the bottom of the bunker to the stokers.



PLAN OF FOUNDATIONS AND CONDENSER CONDUITS FOR FIRST SECTION OF NEW DELAWARE AVENUE POWER HOUSE

The coal-elevating and conveying apparatus is of the Link Belt Engineering Company's type. The total elevation of coal is about 90 ft.

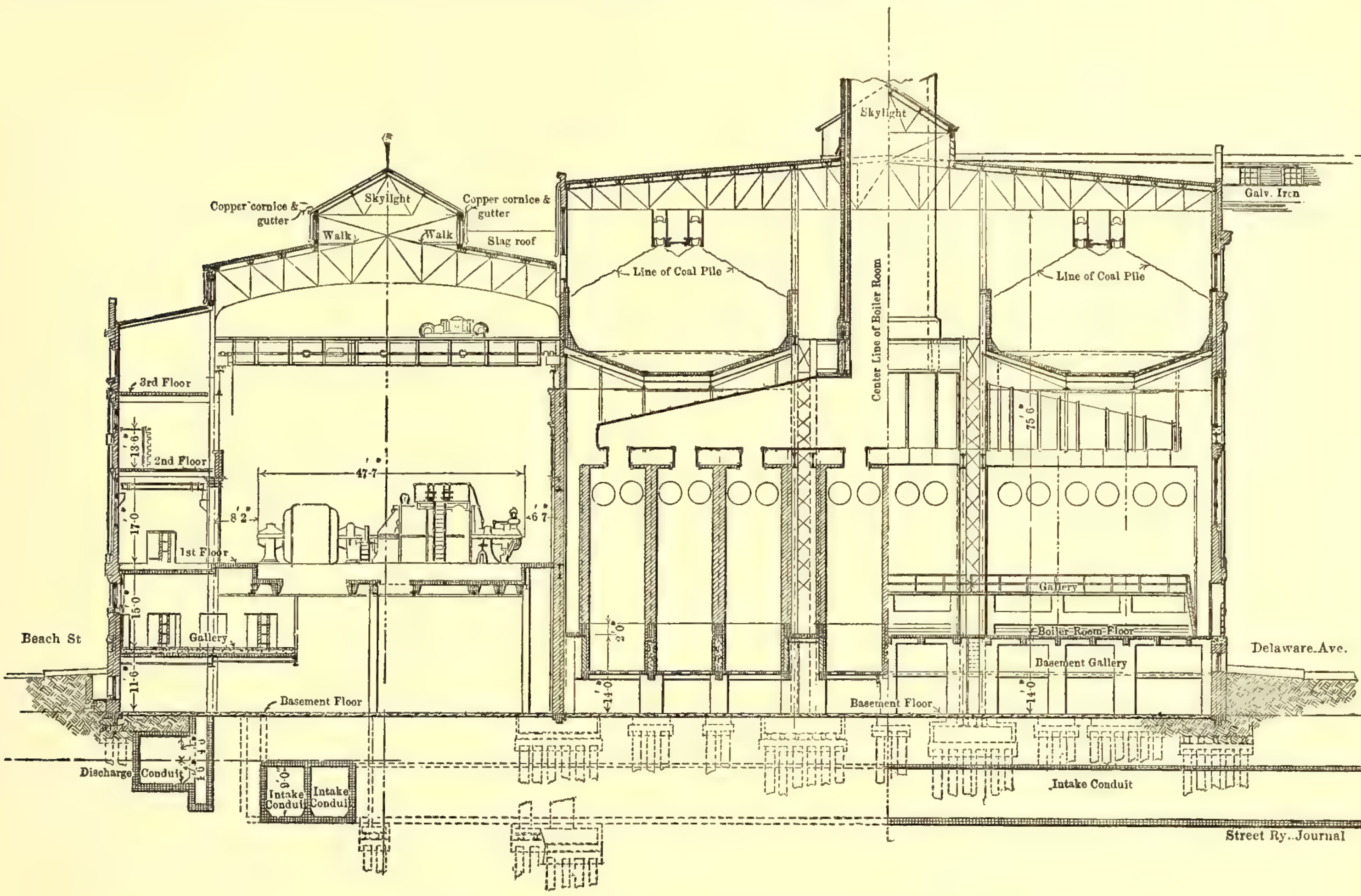
The Berquist bunker is built as part of the structure, and serves not only its purpose of economically storing the coal, but also of bracing the building. The capacity of the bunker is 1800 tons.

The boilers, located on one side only of the house, are spaced 28 ft. center to center. Between these the center row of columns are spaced from which the bunker is suspended; on the wall side the columns are only 14 ft. apart for special reasons, due to the wall and foundation. However, the bunker girders are 28 ft., and the intermediate columns are relieved of the bunker load by

an ingenious connection, plainly seen in the photographic engraving on Plate XXV.

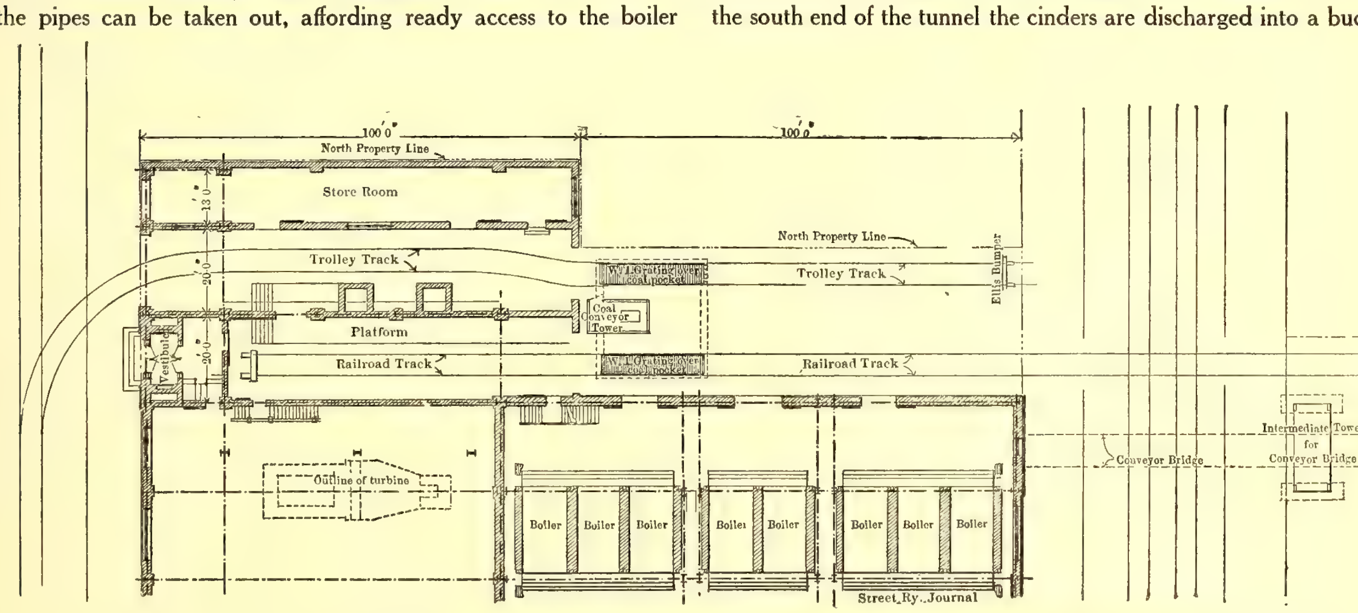
As the boilers are hand-fired, the coal is drawn off from the bunker on the floor as required. The delivery pipes for the coal are fastened to the lower part of the bunker by a special Berquist valve, so constructed that when the boiler tubes have to be cleaned the valve can be readily closed, retaining the coal in the bin, and the pipes can be taken out, affording ready access to the boiler tubes. The delivery pipes are stopped just far enough above the floor to have a constant supply of coal on hand ready for use without littering the floor with unsightly heaps of coal.

The coal-storing and handling scheme at the Second Street and Wyoming Avenue power house is almost identical to those used by the Philadelphia Rapid Transit Company in its power houses at Thirteenth and Mt. Vernon Streets, and Thirty-Third and Market Streets. The steel work for the coal-handling scheme of the three houses was designed by A. Samuel Berquist, C. E., Brooklyn, N. Y., patentee of the Berquist bunker, and was erected by the American Bridge Company.



CROSS SECTION OF NEW DELAWARE AVENUE POWER HOUSE

Below the whole line of boilers and passing through the base of the stack is a tunnel for the operation of the cinder cars. At the south end of the tunnel the cinders are discharged into a bucket elevator, by means of which they are taken up and dumped into the cinder bin. This is built over the trolley track to enable a car to be run under it and be loaded with the contents of the bin.

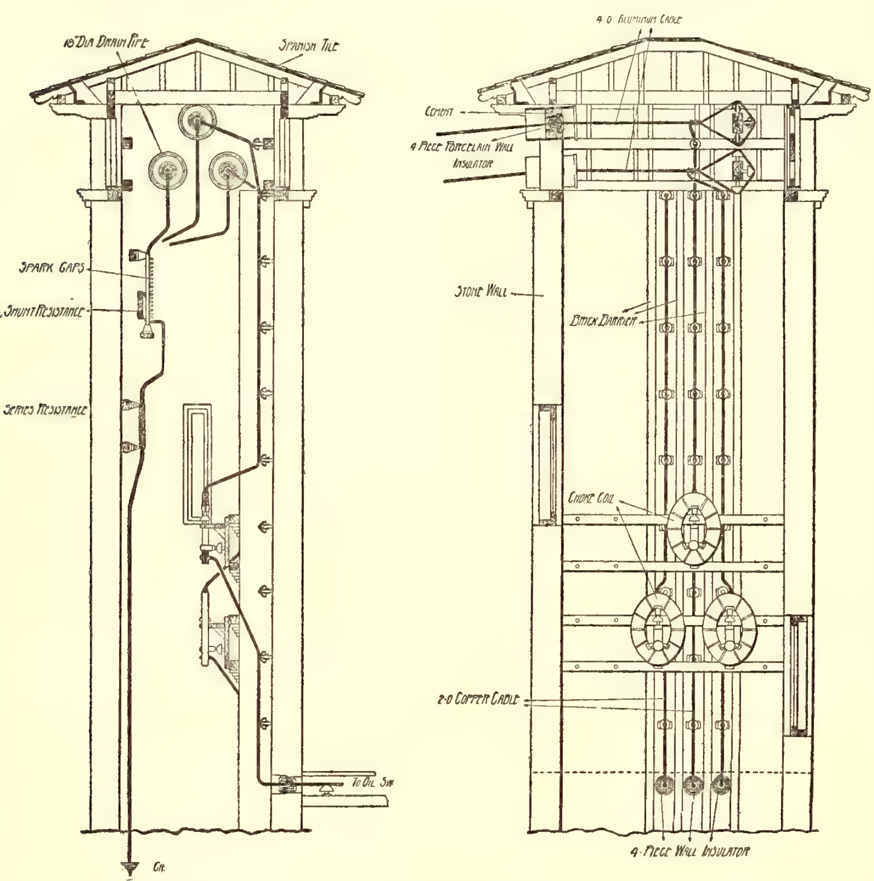


PARTIAL PLAN OF NEW DELAWARE AVENUE STATION, SHOWING LOCATION OF COAL-HANDLING ARRANGEMENTS IN RELATION TO BOILER AND TURBINE ROOMS

At the new Delaware Avenue power house the company has a wharf which is used entirely for receiving and handling the coal, which will come by rail. For this purpose three tracks lead from

the Belt Line tracks in Delaware Avenue and extend the entire length of the wharf. Midway between Delaware Avenue and the end of the wharf, for convenience in unloading and shifting the cars, is located the elevator tower, in which two elevators convey the coal to the conveyor bridge over Delaware Avenue to cross conveyors, one over the center of each bunker. In addition to this, two other elevator towers will be erected, one north and one south of the boiler room and adjoining the tracks, it being the idea to bring coal to these points in the company's own cars from a reserve supply should the supply by rail be at any time cut off. From these two elevators the coal is conveyed to the bunkers by separate conveyors, one over each bunker.

North of the station, at Second Street and Wyoming Avenue, a double trestle is being erected for the storage of about 65,000 tons of coal. The tracks are 30 ft. apart. For supplying coal from this point to other stations, two trolley tracks at grade, or about 25 ft. below the trestle tracks, are being installed. Coal will be loaded on cars on these tracks from the trestle by a small locomotive crane with a clam-shell bucket. The piers supporting the trestle rest on "Simplex" concrete piles driven to rock.



DETAILS OF HIGH-TENSION WIRING IN TERMINAL TOWER AT GLENSIDE SUB-STATION

HANDLING CINDERS

For convenience and economy in handling the cinders at the various power stations, four of the plants have already been equipped with reinforced concrete cinder bins.

The cinders are discharged from below the boilers into cars, each having a capacity of about 1 cu. yd., which empty their contents into a bucket elevator, the bucket having the same capacity as a car. The elevators, driven by motors, convey the cinders to an overhead bin, elevated enough to allow the large car used for hauling coal and cinders to pass beneath it. The cinders are discharged from the bin into this car through cast-iron hoppers and are taken to some point for use in concrete work or in grading.

The construction of these bins is entirely of concrete, reinforced with steel rods, the concrete withstanding the action of the cinders better than any other material. The walls are 5 ins. or 6 ins. thick, braced on the outside by vertical and horizontal beams, the bottom in some cases being inclined to facilitate the movement of the cinders toward the hoppers.

In the case of the bin at the Beach and Green Streets power station, the boilers are on the second floor, and the cinders are taken by cars to the bridge extending across the upper part of the bin, below the monitor, and discharged. In this case, of course, elevators are not necessary.

The capacity of the bins already constructed and in contemplation at the different power houses is as follows: Thirty-Second and Dauphin Streets, 80 cu. yds.; Thirteenth and Mt. Vernon Streets, 500 cu. yds.; Beach and Green Streets, 160 cu. yds.; Second Street and Wyoming Avenue, 150 cu. yds.; Delaware Avenue (contemplated), 500 cu. yds.

The cost of the bin at Second Street and Wyoming Avenue amounted to about $17 per cubic yard, and the bin at Beach and Green Streets $12.50 per cubic yard of capacity. In the former figure the elevators and motors are not included, and in the latter the bin was erected on old steel work, the cost of which is not included.

COOLING CONDENSING WATER

An ingenious method of securing cold water for condensing purposes is employed at several of the power stations where there is not a sufficient water supply to insure cool condensing water at times of heavy load, and where the conditions hardly warrant the installation of cooling towers.

At a small station located at Ogontz, the condensing water is taken from Tacony Creek. The flow of water in this creek is so low during the summer months that it becomes necessary to use some method of cooling the water. This is done by pumping the water through a series of ten spray nozzles placed at intervals of about 15 ft. along the banks of the creek. The water is pumped through these nozzles under a pressure of 15 lbs. to 30 lbs., and returns directly to the creek. The result is rather pretty fountain effect, giving a cooling of about 30 degs. to 35 degs.

At Thirty-Second and Dauphin Streets, the same type of nozzles is used, but the water is sprayed into a cement tank built in between two car houses. The cooling in this case, owing to the confined space, is not so great as at Ogontz, but it is amply sufficient for the purpose. This station was originally non-condensing, but is now equipped with jet condensers in connection with the cooling device described.

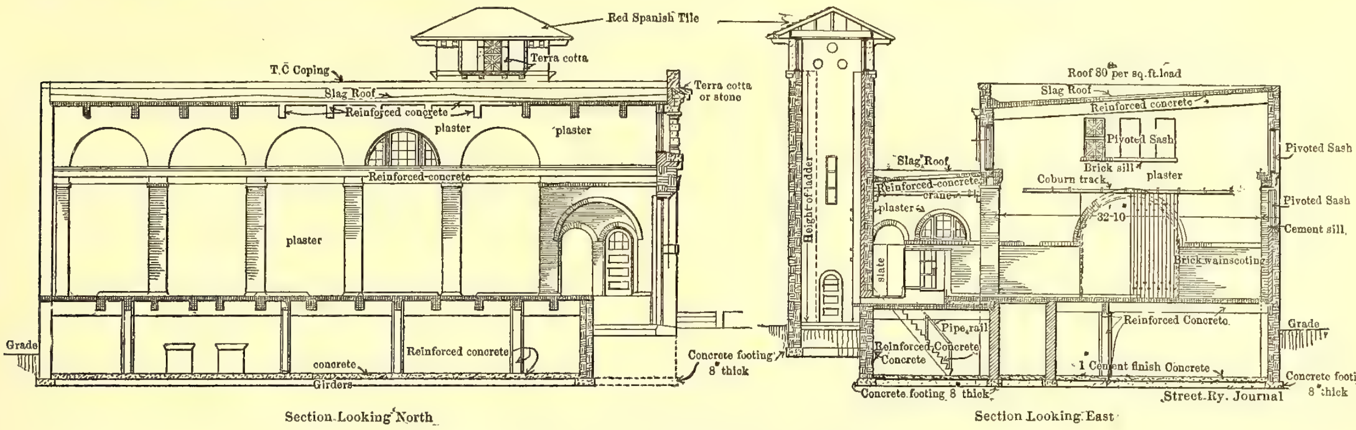
SUB-STATIONS

At the present time six sub-stations have been completed. The location and capacities of these are indicated in Table XVII. on page 510. Two other sub-stations are in course of erection, as follows: One at Eighth and Sansom Streets with four 1500-kw rotaries and an ultimate capacity of eight 1500-kw rotaries, and one at Fifty-Eighth Street and Woodland Avenue with two 1000-kw rotaries and an ultimate capacity of six 1000-kw rotaries. Two other sub-stations will be erected within a year, one on Market Street west of Fifty-Fifth Street, and one on Cumberland Street near Kensington Avenue.

The design of two of these stations was, to a certain extent, fixed by the character of the buildings to which they were added as extensions. Two others were modifications of existing buildings. Those at Glenside, Fifty-Second Street and Lancaster Avenue, and the one in course of erection at Fifty-Eighth Street and Woodland Avenue, are very similar in design, and may be considered typical for their size.

The Glenside station differs from the other two in the cable tower, necessary because of the overhead cables north to Willow Grove. The details of this tower are made clear in the accompanying drawing, page 522.

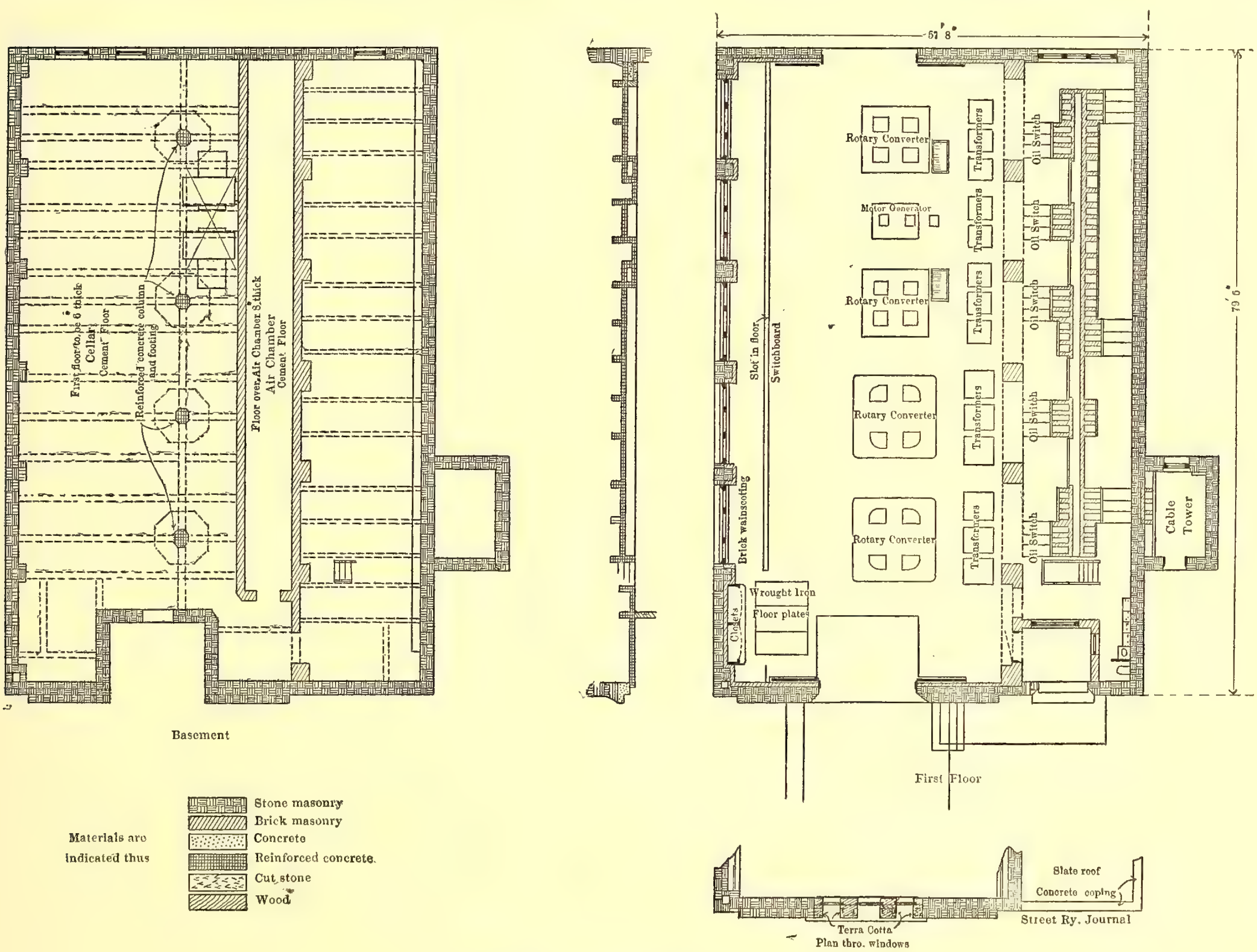
The completed station at Fifty-Second Street and Lancaster Avenue will include six 1000-kw rotary converters, of which three have been installed. These are placed in a line with a motor generator in the center. In a parallel line on the south side is the d. c. switchboard; on the north side are the transformers, and back of these are the oil-switch and bus-bar compartments, all being on the same floor. The oil-switch and bus-bar compartments are located in a space 9 ft. 7½ ins. wide, with a comparatively low roof, separated from the main body of the building by a series of piers and arches supporting the crane runway and the wall above. Over these compartments is a 1-ton traveling crane with a hand hoist. The main building, containing the transformers, converters and switchboard, is 30 ft. wide and 20 ft. high, with a 15-ton three-motor traveling crane. In the basement for cooling the transformers is a brick air chamber, through which air is forced by two Sturtevant blowers.



SECTIONS OF GLENSIDE SUB-STATION

CONSTRUCTION

The building is entirely fireproof, the outside walls being of brick and terra cotta, the roof and floors of reinforced concrete, and the window frames of metal, glazed with wire glass. The especially interesting feature about the construction is the use of reinforced concrete in the floors and roof. The floor under the transformers is a slab, 8 ins. thick, supported on the walls of the air chamber below. The unusual thickness is necessary because of openings under the transformers, which take up the greater part of the area.



PLANS OF GLENSIDE SUB-STATION

The balance of the floor of the main building is supported by reinforced concrete columns, one under the center of each converter, spaced 15 ft. center to center, 16 ins. square, reinforced with four 1-in. diameter steel rods, with ties spaced 12 ins. center to center, the column resting on a reinforced concrete footing.

Each column was designed to carry the weight of the converter, with certain percentage added for vibration, amounting in all, in the case of the 1000-kw machines, to 127,000 lbs., the weight of the floor being taken as a total load of 350 lbs. per square foot. Each column supports transverse and longitudinal beams intersecting over the center of the column, the transverse beams spanning to the wall at each side and the longitudinal beams spanning from column to column and carrying the floor beams, spaced about 5 ft center to center. This plan brings the heavy load directly on the concrete column, and is a radical modification of the usual practice of supporting machine loads by solid concrete or masonry foundations. The economy of the construction in space and cost can be readily seen and the design has given perfect satisfaction. The floor slabs are 6 ins. thick, and embedded in the concrete are the pipes carrying the cables from the converters to the switchboard. During construction, these pipes are laid on the wood centering for the concrete; the reinforcing rods are then placed in position below them and the concrete is then deposited and tamped into position.

In connection with the oil-switch and bus-bar compartments, it being necessary to construct below the floor duct ways or passages for the cables leading from these compartments and to the transformers, an independent floor, with a 6-in. slab, with beams spaced 4 ft. 4 ins. center to center, all of reinforced concrete, was first constructed, finishing 14 ins. below the main floor level. These duct ways were then formed with 4-in. walls of brick and covered with slate, finishing level with the main floor. The floor space not so occupied was then filled up with cinder concrete and finished with cement level with the slate. The roof over the space occupied by these compartments and over the main building is of concrete, with a 4-in. thick slab, supported on beams spaced 5 ft. 6 ins. center to center, having a span of 31 ft., all of concrete, the beams being reinforced with four rods each, 1 in. in diameter, to carry a live load of 30 lbs. per square foot and the dead load from the concrete.

The oil-switch and bus-bar compartments are constructed of a red pressed brick, with 4-in. walls, in which are built the rods which secure in place the channels at the top. This top and the shelves are of Alberene stone. In the first station erected, these compartments were constructed of concrete, but on account of the excessive cost of the centering and the finish after the centering was removed, this was abandoned and brick adopted.

The walls are wainscoted, with red brick matching the oil-switch compartments. Above this they are finished with plaster. The ceiling is simply whitewashed, no other finish being necessary on account of the smooth surface due to the rise of surfaced centering.

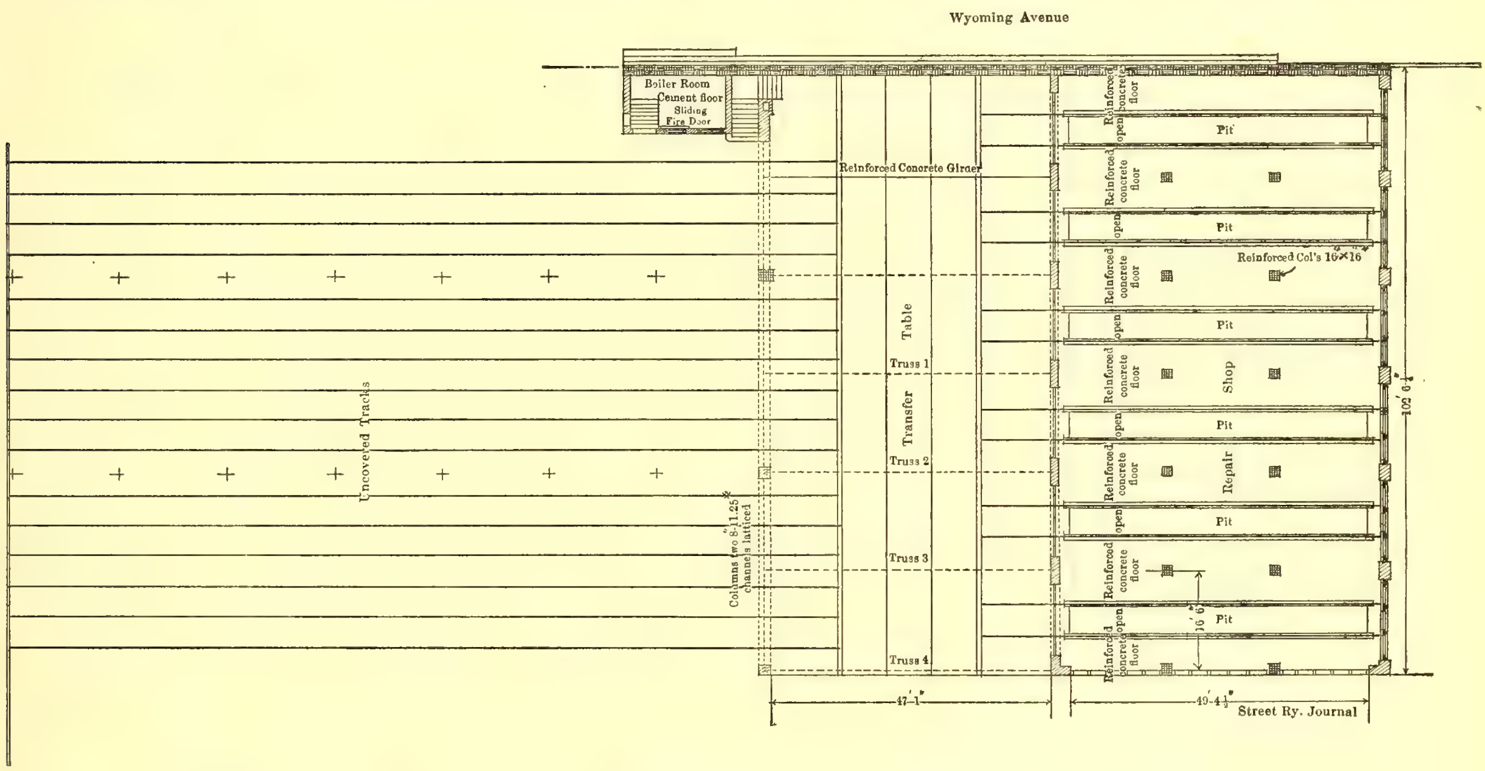
STORAGE BATTERIES

The storage-battery plants of the Philadelphia system have been fully described in past issues of the Street Railway Journal. (See Street Railway Journal for November, 1896, page 741; November, 1897, page 758; and April, 1901, page 421.) There are six of these plants, the capacities of each being given in Table XVII. on page 510. The batteries for the most part are located at points where the tie-lines to two or more power stations cross. They float on the line and act as cushions to relieve the generating stations of the effects of fluctuating peaks. The batteries are charged at semi-regular intervals or when they run low. The charging is usually done at night.

CAR HOUSES, REPAIR SHOPS AND ROLLING STOCK

There are ten storage houses and eighteen operating depots on the Philadelphia system. The houses for storage are plain, unpretentious structures for affording protection to cars which are not in service. They are located at any convenient point and have no special features of interest. The operating houses are located at the ends of the different routes, and in all cases contain a sufficient number of tracks for the storage of cars during the night at the end of the day's runs. Attached to the building in each instance is a building for the accommodation of the conductors and motormen, containing a room where the men make up their accounts of fares, transfers, etc., and rooms for the use of the superintendent and receiver, also lockers and toilet rooms. In most cases a small shop is also included in which minor repairs are made, such as would not make it necessary to send the car to the repair shops.

The house at Wyoming Avenue is the latest one erected, and the shop layout is the result of the experience in the other houses. The house contains nine tracks, with the entrance at the west end from Third Street. As this is the operating end of the lines using the house, there is an office for the use of the superintendent and the depot clerks. This office is on the second floor. On the first or house floor level there is a shop with six tracks, each track long enough for one car. Between the shop and the house tracks is a transfer table by which cars to be inspected or repaired may be transferred from the house tracks to the shop. This shop is intended for minor repairs only, such as can be completed in a short time without the use of machine tools. The entire second floor over the transfer table and shop is of reinforced concrete construction, the girders over the transfer table, carrying the second story walls, being about 50 ft. clear span.



PLAN OF NEW OPERATING DEPOT AT WYOMING AVENUE

REPAIR SHOPS

There are two large repair shops for doing the overhauling and repair work for the entire equipment. One of these is at Eighth and Dauphin Streets, and the other at Kensington Avenue and Cumberland Street. Both of these are old buildings, and the buildings, as well as many of the shop methods and devices, have been described in detail in the columns of the STREET RAILWAY JOURNAL.

Of considerable interest to those interested in general shop design is the addition recently built to the Kensington Avenue plant, for a complete description of which see STREET RAILWAY JOURNAL for Sept. 3, 1904, page 310. This addition, which is a two-story building, is built entirely of reinforced concrete construction, and is 90 ft. x 389 ft.

ROLLING STOCK

It will be seen from Table XX. on the following page, showing number and types of cars in use in Philadelphia, that the company has a wide assortment of rolling stock, this being the result of taking over so many independent companies, each of which had its own ideas as to the best type of car.

Since the last consolidation the company has adopted one standard car that will be used for both winter and summer service in the future. This is a 38-ft. car, over all measurements, of the Brill semi-convertible type, mounted on Brill double trucks. The newer cars are all equipped with Christensen air brakes and have four motors. Various types of motors are in use, Westinghouse No. 3, GE 800 and GE 70 A motors predominating. The company has recently purchased 100 Curtis D-2 trucks.

Practically all of the closed cars are now fitted with electric heaters. The standard panel heaters of the Consolidated Car Heating Company are used in cars with panels, and that company's new design of cross-seat heaters with lead wires at one end in cross-seat cars.

The type of open car most frequently seen on the streets in Philadelphia is a ten-bench car, although there are a large number of single-truck open cars in service. The following is a complete statement of the rolling stock and equipment in use on June 30, 1905:

TABLE XX.—SHOWING ROLLING STOCK EQUIPMENT, PHILADELPHIA RAPID TRANSIT COMPANY

Closed.

No.	Maker.	Length.	Trucks.	Motors.	Brakes.
		Ft.			
35	St. Louis	20	Bemis	2—G. E. 800	Hand
278	"	20	Peckham	2—G. E. 800	"
3	"	20	Bemis	2—West. 3	"
27	Jackson & Sharp	20	"	2—G. E. 800	"
66	"	20	Peckham	2—G. E. 800	"
1	"	20	Bemis	2—West. 3	"
17	"	20	McGuire	2—G. E. 800	"
1	"	20	Peckham	2—West. 3	"
19	Pullman	20	"	2—G. E. 800	"
9	"	20	McGuire	2—G. E. 800	"
12	"	20	Bemis	2—G. E. 800	"
3	Brill	20	Peckham	2—G. E. 800	"
1	"	20	"	2—West. 3	"
2	"	20	Bemis	2—G. E. 800	"
14	"	20	"	2—West. 3	"
1	"	20	Brill	2—G. E. 800	"
1	"	20	McGuire	2—G. E. 800	"
164	"	28	Brill 27 G	4—West. 3	Christensen
117	"	28	" 27 G	4—G. E. 800	"
136	"	28	" 27 G	4—West. 12A	"
83	"	28	" 27 G	4—Lorain	"
81	"	28	" 27 G	4—G. E. 70A	"
1	"	28	Curtis	4—G. E. 800	"
5	"	28	"	4—West. 3	"
9	"	28	"	4—Lorain	"
1	"	28	"	2—Lorain	"
94	American	20	Bemis	2—G. E. 800	Hand
6	"	20	McGuire	2—G. E. 800	"
63	Laclede	24	Brill Max. Trac.	2—West. 56	Christensen
142	"	24	"	2—Lorain	"
2	"	24	"	2—West. 3	"
6	"	24	Curtis	2—West. 56	"
41	"	24	"	2—Lorain	"
3	"	24	"	2—West. 3	"
351	"	20	Bemis	2—West.	Hand
1	"	20	Peckham	2—West.	"
1	"	20	"	2—G. E. 800	"
114	"	20	Bemis	2—G. E. 800	"
1	Electric Traction Co.	20	McGuire	2—G. E. 800	"
1	"	20	Peckham	2—G. E. 800	"
25	Philadelphia Traction Co.	20	Bemis	2—West. 3	"
4	"	20	"	2—G. E. 800	"
1	"	20	Peckham	2—G. E. 800	"
2	"	24	Bemis D. T.	2—West. 3	"
3	"	24	Brill Max. Trac.	2—Lorain	Christensen
26	Union Traction Co.	20	Peckham	2—G. E. 800	Hand
1,974					

Open.

No.	Maker.	Length.	Trucks.	Motors.	Brakes.
4	Brill	30	Bemis	2—G. E. 800	Hand
1	"	30	Brill	2—G. E. 800	"
40	"	30	Peckham	2—G. E. 800	"
150	"	34	Brill Max. Trac.	2—West. 56	Christensen
10	"	34	"	2—Lorain	"
111	American	30	McGuire	2—G. E. 800	Hand
107	"	30	Peckham	2—G. E. 800	"
13	"	30	Bemis	2—G. E. 800	"
443	St. Louis	30	Peckham	2—G. E. 800	"
5	"	30	"	2—West. 3	"
40	Lamokin	30	"	2—G. E. 800	"
209	Laclede	30	"	2—G. E. 800	"
89	"	30	Bemis	2—G. E. 800	"
2	"	30	"	2—West. 3	"
10	Barney & Smith	30	Peckham	2—G. E. 800	"
1	Jackson & Sharp	30	"	2—G. E. 800	"
1,235					

Miscellaneous Equipment.

No.	Maker.	Length.	Trucks.	Motors.	Brakes.
3	Lamokin	16	McGuire	G. E. 800	Hand
2	Union Traction Co.	16	Peckham	G. E. 800	"
1	People's Traction Co.	16	"	G. E. 800	"
3	"	16	Brill	G. E. 800	"
1	St. Louis	16	"	G. E. 800	"
1	Electric Traction Co.	16	McGuire	G. E. 800	"
7	Philadelphia Traction Co.	16	Bemis	West. 3	"
18					

Money Cars.

No.	Maker.	Length.	Trucks.	Motors.	Brakes.
1	Union Traction Co.	16	McGuire	G. E. 800	Hand
1	"	16	Peckham	G. E. 800	"
2					

Parlor Cars.

No.	Maker.	Length.	Trucks.	Motors.	Brakes.
1	Laclede	20	Peckham	West. 3	Hand
1	St. Louis	20	St. Louis	G. E. 800	"
2					

Testing Cars.

No.	Maker.	Length.	Trucks.	Motors.	Brakes.
1	Philadelphia Traction Co.	20	Bemis	West. 3	Hand
1	Jackson & Sharp	16	Peckham	G. E. 800	"
2					

Mail Cars.

No.	Maker.	Length.	Trucks.	Motors.	Brakes.
		Ft.			
4	Union Traction Co.	16	Peckham	G. E. 800	Hand
10	"	16	McGuire	G. E. 800	"
14					

Tower Cars.

No.	Maker.	Length.	Trucks.	Motors.	Brakes.
1	Union Traction Co.	20	Peckham	G. E. 800	Hand
1	"	20	McGuire	G. E. 800	"
2					

Freight Cars.

No.	Maker.	Length.	Trucks.	Motors.	Brakes.
4	Middletown Car Works	40	Peckham	4—Lorain	Christensen
6	"	34	"	4—Lorain	"
1	Union Traction Co.	28	"	4—Lorain	Hand
19	"	28	"	G. E. 800	"
1	"	28	"	G. E. 1200	"
1	"	28	McGuire	No motors	"
3	"	28	Robinson	No motors	"
1	"	28	McGuire	No motors	"
2	Allison Car Works	35	Allison	No motors	"
2	Brill	28	McGuire	G. E. 800	"
1	"	28	"	West. 3	"
1	Philadelphia R. T. Co.	28	Peckham	Lorain	"
1	"	28	"	G. E. 800	"
2	Electric Traction Co.	28	"	G. E.	"
1	"	28	Bemis	G. E.	"
4	"	28	McGuire	G. E.	"
2	People's Traction Co.	28	Peckham	G. E.	"
6	Philadelphia Traction Co.	28	Bemis	West. 3	"
1	"	28	McGuire	West. 3	"
1	"	28	Bemis	G. E. 800	"
60					

Sprinklers.

No.	Maker.	Length.	Trucks.	Motors.	Brakes.
11	Kensington Engine Works	28	Peckham	G. E. 800	Hand
4	"	28	"	Lorain	"
1	Philadelphia Traction Co.	20	Phila. Trac. Co.	West. 3	"
16					

Plows.

No.	Maker.	Length.	Trucks.	Motors.	Brakes.
24	Philadelphia Traction Co.	..	Phila. Trac. Co.	West. 3	Hand
23	Union Traction Co.	..	Union Trac. Co.	West. 3	"
2	"	..	"	West. 56	"
30	Brill	..	Brill	West. 56	"
20	"	..	"	Lorain	"
2	Peckham (Rotary)	..	Peckham	2—G. E. 800 2—G.E. 1200	"
101					

Sweepers.

No.	Maker.	Length.	Trucks.	Motors.	Brakes.
17	Lewis & Fowler	..	Lewis & Fowler	G. E. 800	Hand
5	Brill	..	Brill	G. E. 800	"
57	Union Traction Co.	..	Union Trac. Co.	West. 3	"
79					

Sand Cars.

No.	Maker.	Length.	Trucks.	Motors.	Brakes.
10	Union Traction Co.	16	Bemis	G. E. 800	Hand
40	"	16	Brill	G. E. 800	"
4	"	16	McGuire	G. E. 800	"
1	Philadelphia R. T. Co.	16	"	West. 3	"
4	Philadelphia Traction Co.	16	Bemis	West. 3	"
59					

Rail Car.

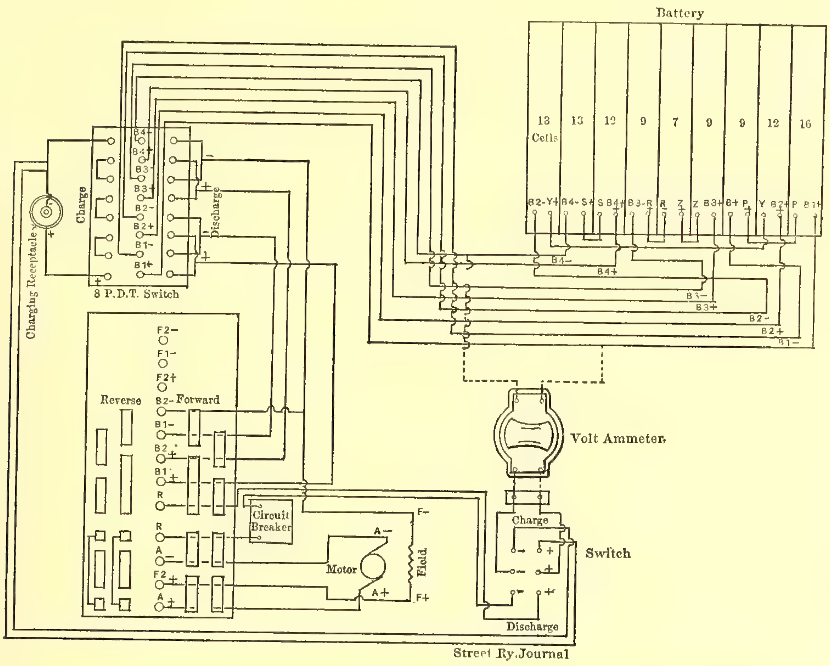
No.	Maker.	Length.	Trucks.	Motors.	Brakes.
1	Philadelphia R. T. Co.	75	Brill	4—Lorain	Christensen
1					

Summary.

Closed cars	1,974	Tower cars	2
Open cars	1,235	Freight cars	60
Miscellaneous equipment	18	Sprinklers	16
Money cars	2	Ploughs	101
Parlor cars	2	Sweepers	79
Testing cars	2	Sand cars	59
Mail cars	14	Rail cars	1
		Total	3,565

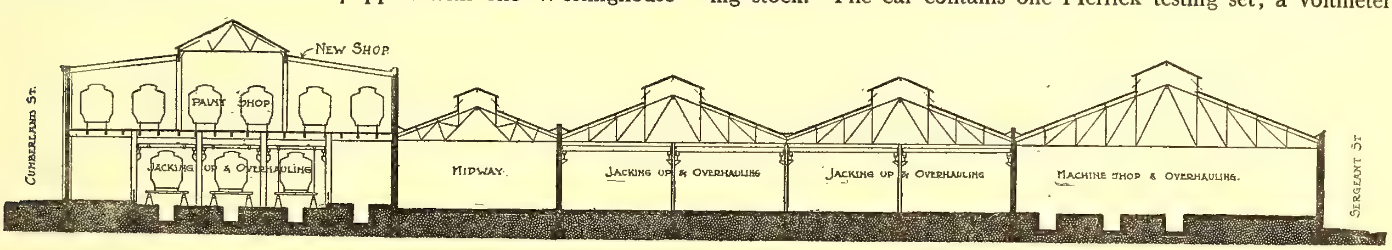
SHIFTING TRUCKS

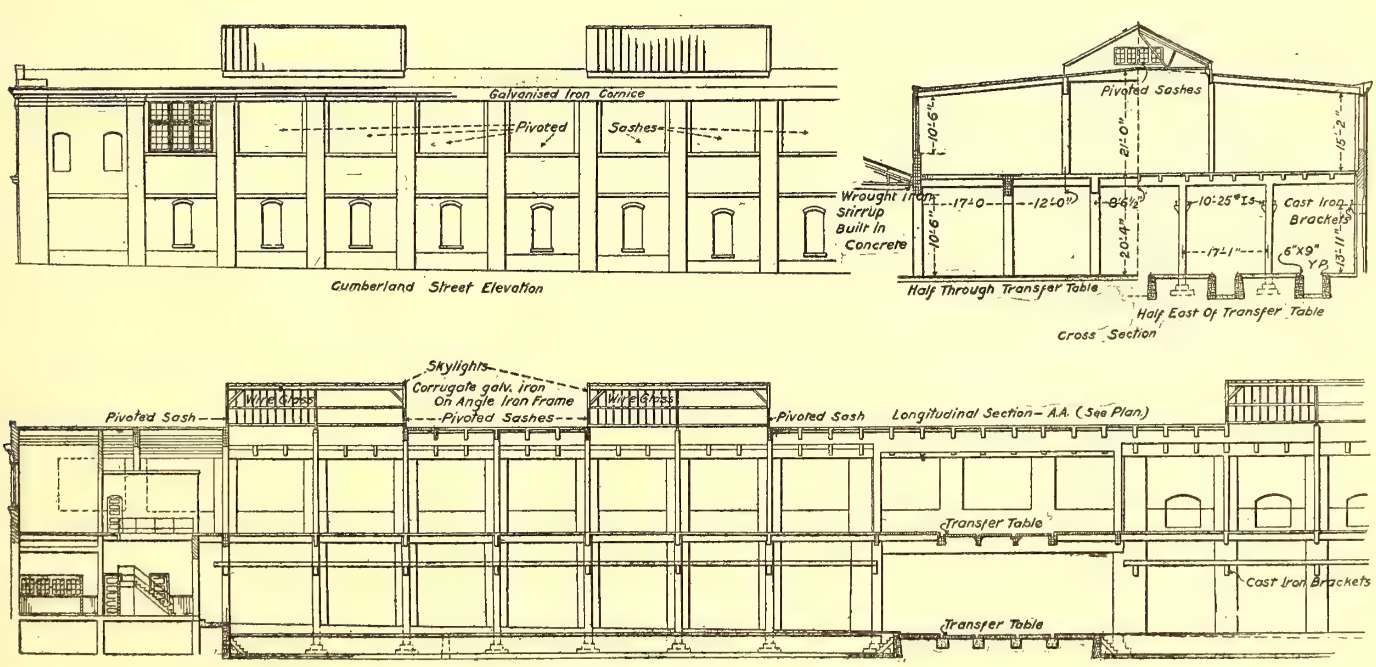
For shifting trucks around the shops a novel storage-battery locomotive is used. There are two of these in service at the



WIRING DIAGRAM FOR STORAGE-BATTERY LOCOMOTIVES USED FOR SHIFTING TRUCKS IN SHOPS

Kensington shops. The locomotives were built by the Baldwin Locomotive Works. Each is equipped with one Westinghouse





SECTIONS THROUGH NEW CONCRETE ADDITION TO KENSINGTON AVENUE SHOPS

10-hp 220-volt motor, No. 61. This motor is mounted on one axle, and the two axles are connected together by roller-bearing chain supplied by the Link Belt Engineering Company. The wheels are 24 ins. in diameter, and the total height of the locomotive complete is 32 ins. It has 100 cells of Electric Storage Battery Company's type MV-7 chloride accumulators arranged in four banks of 25 each, so placed as to be used in series-multiple during discharge, but all to be connected in series during charge. The controller is the Westinghouse No. 145 type, altered to suit the requirements, so that it has five points, the middle point being the off position. The first point either side of the off position connects four banks of 25 cells in multiple. The second point either side of the central connects two banks of 25 cells in series and two in multiple. One side of the central off position is forward and the other side is reverse. The total weight of the complete locomotive is about 7500 lbs.

CAR SIGNS

The Philadelphia signs for designating routes on cars are illustrated on Plate XXXIX. The sign mounted on the hood, as shown, has two designations, one of which is obscured, depending upon the direction of travel, by a swinging flap that can be turned upward or downward, as the case requires. The side sign is a four-face block, any one face of which can be made to show outward by turning a small hand wheel inside of the car.

TEST CAR

The company keeps in service the year round a car especially equipped for testing the electric equipment on all rolling stock. The car contains one Herrick testing set; a voltmeter with graduations reading from 1 to 600 for making drop-volt tests; an ammeter reading from 1 to 750 for testing circuit breakers, and other instruments. During the out-of-season period, when one set of

cars is in the storage houses, the test car is stationed at the storage depots and the attendant goes over each car one by one, testing out fields, armatures, cables, circuit breakers, air-brake compressors and other parts of the electrical equipment. If defects are discovered, notation is made on the proper blank form, and this blank is sent to the repair shop so that when the particular car is taken to the shop for overhauling, the master mechanic is informed as to just what repairs are necessary.

If a car comes in from service with any portion of the electrical equipment out of order, the test car is sent for and the exact trouble is at once located.

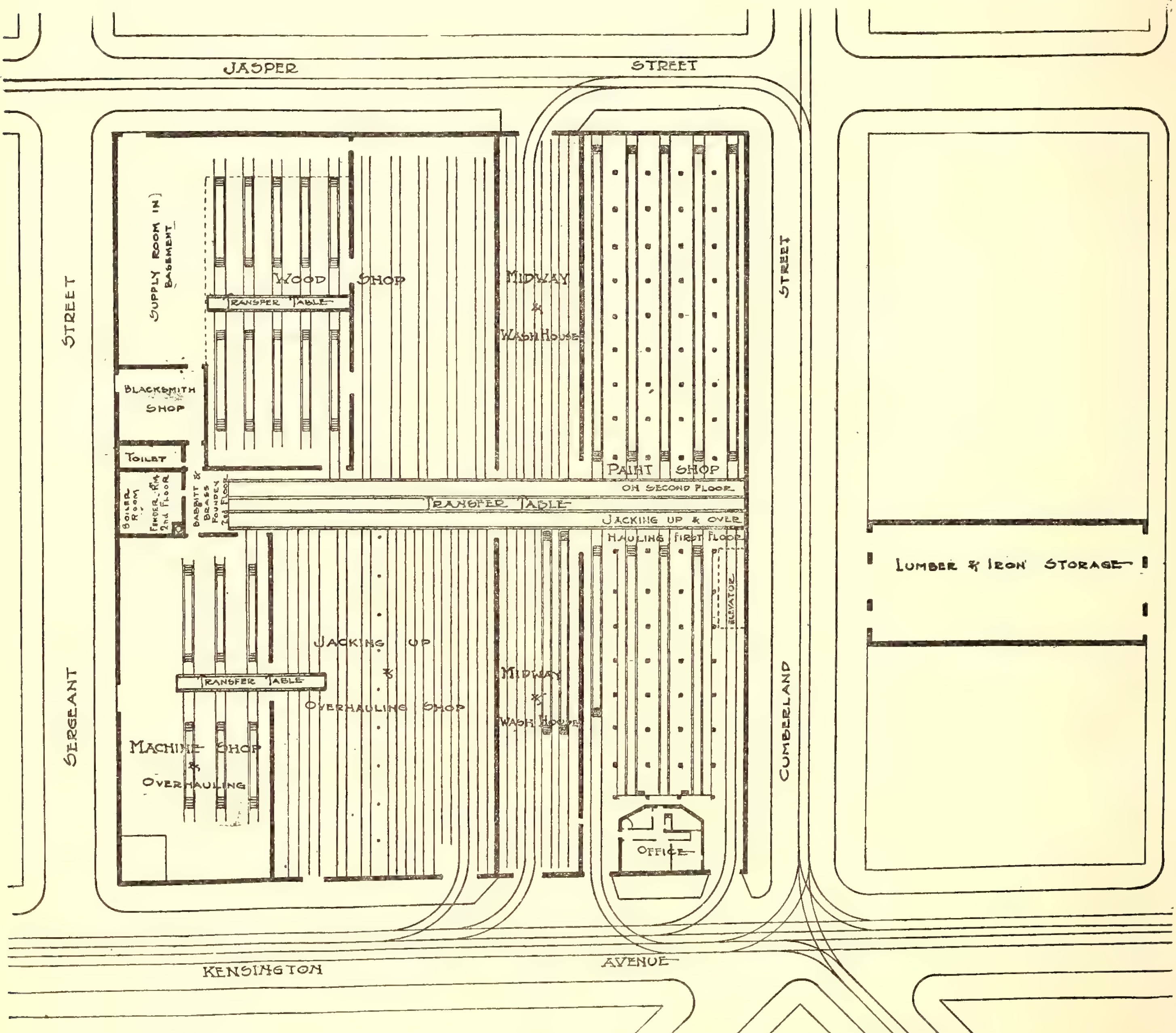
The car has flexible leads terminating in a small switchboard within the car, the other ends of these leads being used to connect up the equipment to be tested. In going over a car, the first step is to try out the circuit breakers. A helper connects one of the flexible leads to each side of the breaker, and the operator in the test car, by means of a small series controller, slowly cuts out resistance until the breaker actuates, when the ammeter will give the reading as to the load for which the breaker is set.

The cables of the car under test are next tried for leaks or poor insulation, this being done in the usual way by using the voltmeter.

Attention is then given to the resistance of rheostats, the measurements being taken by drop-volt test. In the same way fields, armatures and ground connections are gone over and the readings are noted. A car can be thoroughly tried out in this way in about 10 minutes. A very material reduction, not only in the number of crippled cars, but also in the cost of car maintenance, has been effected through the systematic testing accomplished by means of this car. The car is in charge of H. Branson.

MECHANICAL AND ELECTRICAL INSPECTION DEPARTMENT

The company has lately established a mechanical and electrical inspection department. It is the duty of the inspectors to carefully examine every car at the various depots once a week, with the end in view of discovering mechanical and electrical defects before they cause actual breakdowns. Each car is thoroughly gone over for low bearings, truck, wheel, brake and other mechanical troubles. This department also investigates the more frequent causes of troubles, and in its weekly reports to the general manager makes suggestions and recommendations as to ways of reducing the number of causes for which cars have to be taken from service. The institution of this careful inspection, whereby defects are discovered before they become serious, has resulted in greatly reducing the number of cars sent to the shop for repairs.

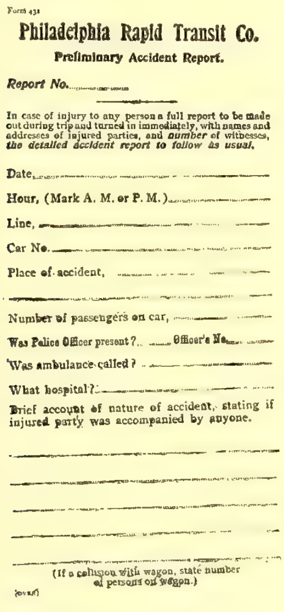


GROUND PLAN OF NEW CONCRETE ADDITION TO KENSINGTON AVENUE SHOPS

CLAIM AND OTHER DEPARTMENTS

In reviewing the work of the claim adjusting department of the Philadelphia Rapid Transit Company it will be in order first to outline the details of the machinery of the department by means of which the routine work is conducted, and then to describe the general policy of the company with respect to the handling of accidents and accident claims.

The claim department of the Philadelphia Rapid Transit Company is in charge of a general claim agent, who reports directly to the second vice-president and general manager. Those who report to the general claim agent are: the chief clerk, with an office force consisting of seven stenographers and eight filing



Form 431

Philadelphia Rapid Transit Co.

Preliminary Accident Report.

Report No.

In case of injury to any person a full report to be made out during trip and turned in immediately, with names and addresses of injured parties, and *number* of witnesses, *the detailed accident report to follow as usual.*

Date,

Hour, (Mark A. M. or P. M.)

Line,

Car No.

Place of accident,

Number of passengers on car,

Was Police Officer present? Officer's No.

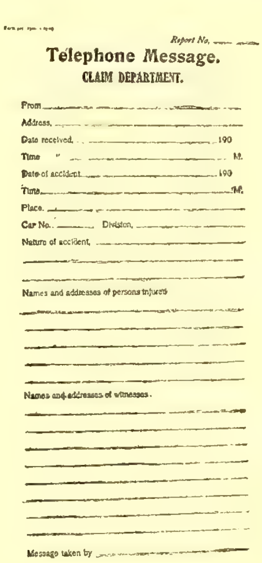
Was ambulance called?

What hospital?

Brief account of nature of accident, stating if injured party was accompanied by anyone.

(If a collision with wagon, state number of persons on wagon.)

FORM 431.—CONDUCTORS' PRELIMINARY ACCIDENT REPORT



Report No.

Telephone Message.

CLAIM DEPARTMENT.

From

Address.

Date received. 190

Time " M.

Date of accident 190

Time M.

Place.

Car No. Division,

Nature of accident,

Names and addresses of persons injured

Names and addresses of witnesses.

Message taken by

FORM 327.—BLANK FOR TAKING DOWN TELEPHONE MESSAGE CONCERNING ACCIDENT

and record clerks; the chief detective and detective force, and an assistant general claim agent. Those who report through the assistant general claim agent are the chief adjuster, with a staff of nine adjusters; the chief inspector with a staff of ten inspectors, and the chief investigator with a staff of sixteen investigators. The distinction made by the company between adjusters, inspectors and investigators is as follows: The force of adjusters attends to the settling of cases before any claim is brought or before the claim is taken to court; the inspectors are engaged on those cases on which suit has been commenced; the investigators, as their name implies, investigate current work; that is, cases that have not yet been brought to court, and report on them to the chief investigator, who in turn reports on them to the chief adjuster.

As on other large street railway properties, effective work on the part of the claim department is dependent in very large measure upon the thoroughness of the reports concerning accidents furnished by the conductors and the promptness with which these reports reach the proper hands in the claim department for suitable action. In these days, when the policy of rendering of just compensation for injuries and damages unwittingly inflicted by public-service corporations is general, justice and fair dealing must run a swift race to keep ahead of the accident doctor and the ambulance-chasing lawyer.

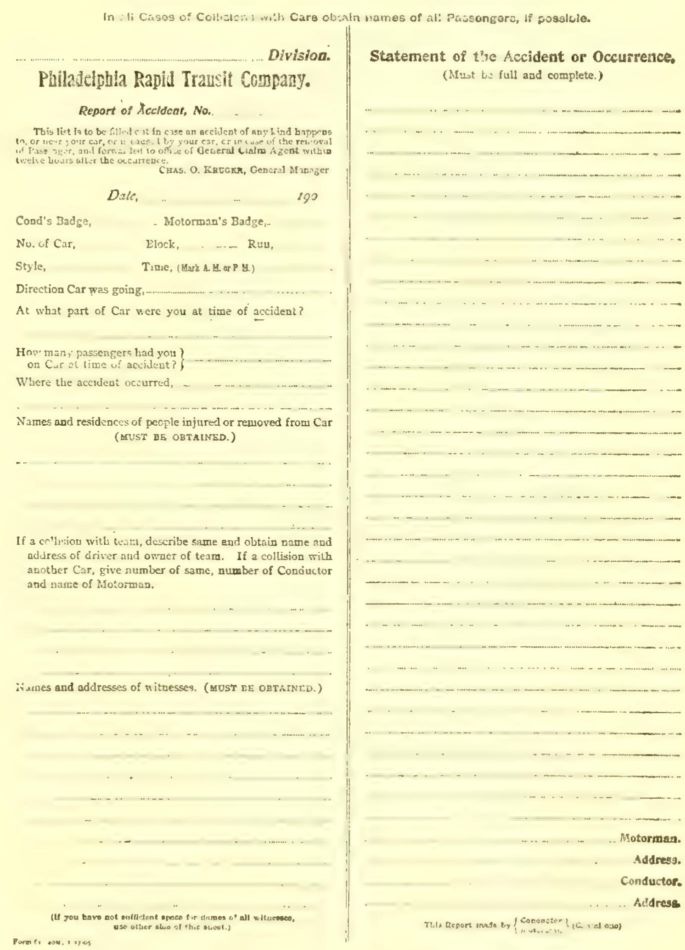
On the Philadelphia system emphasis is laid on the issue of instructions to employees in regard to accidents by covering this subject in the first and second rules in the book of rules and regulations for the guidance of conductors and motormen. The prevention of accidents is covered in Rule I., of which the following is an epitome: The safety of the public is the first consideration in the operation of a street railway, therefore the utmost care must be exercised at all times to prevent accidents. The motorman should always be on the alert to avoid danger, and his attention should never be diverted from his duties. He should keep his eye constantly on the track before him, to prevent accidents or injuries to persons who may not at the moment be able to get out of the way of the car. The conductor's first duty in the safe operation of the car is to allow ample time for passengers to get on or off the car before pulling the bell. If the passenger is old or feeble, time should be allowed for him to be seated, as a fall on the car can be of as much consequence as a fall off. In fine, the conductor should realize that he is the conductor of the car, and that implies that he is a safe and competent person to "conduct" the car, or otherwise he should not hold his position.

Rule II. of the instructions to employees covers so comprehensively the question as to what to do in case of accident as to warrant its reproduction in full here. It reads as follows:

ACCIDENTS—IN CASE OF

Every disturbance on, or occasioned by the cars, every collision or accident to individuals or to animals, vehicles, or other property—if such occurrence is caused by the cars, by their operation, or by the act or operation of any employee when engaged in duties for the company—must be reported.

In the matter of accidents to individuals, it must never be as-



In all Cases of Collisions with Cars obtain names of all Passengers, if possible.

Division.

Philadelphia Rapid Transit Company.

Report of Accident, No.

This list is to be filled out in case an accident of any kind happens to, or near your car, or is caused by your car, or in case of the removal of Passenger, and forward to office of General Claim Agent within twelve hours after the occurrence.

CHAS. O. KRUGER, General Manager

Date, 190

Cond's Badge, Motorman's Badge,

No. of Car, Block, Run,

Style, Time, (Mark A. M. or P. M.)

Direction Car was going,

At what part of Car were you at time of accident?

How many passengers had you on Car at time of accident?

Where the accident occurred,

Names and residences of people injured or removed from Car (MUST BE OBTAINED.)

If a collision with team, describe same and obtain name and address of driver and owner of team. If a collision with another Car, give number of same, number of Conductor and name of Motorman.

Names and addresses of witnesses. (MUST BE OBTAINED.)

(If you have not sufficient space for names of all witnesses, use other side of this sheet.)

Statement of the Accident or Occurrence, (Must be full and complete.)

Motorman.

Address.

Conductor.

Address.

FORM 61.—CONDUCTORS' COMPLETE REPORT OF ACCIDENT

sumed that "no harm has been done," no matter what the individuals say themselves. The assumption must always be that "harm has been done," and the report must be as promptly and accurately filled, and the names of witnesses, etc., taken with as great care as if actual and visible injury had been inflicted. Much loss has been occasioned by the neglect of employees to properly report

cases of accidents which seemed trivial at the time of occurrence, but which developed into important and expensive cases. The invariable rule must be to report every accident to individuals with full and equal care.

1. Upon the occurrence of an accident, the first duty is to render assistance to the person or persons involved in it.

2. The next duty is to obtain the full and correct name and address of the person or persons injured, or the drivers or owners of animals, vehicles, or property injured or damaged.

3. The next duty is to obtain the full and correct names and names and addresses of all eye witnesses. If they refuse or seem unwilling to give their names, tell them it is the strict rule of the company, and that your failure to obtain names of witnesses will look as if you had not tried to obey the rules of the company.

4. The next duty is to make out the report. State clearly just what occurred as you saw it. State fully the nature of injury to persons or property, give your reasons why you could not prevent the accident, and state what you did to prevent it. State whether person injured was lame, deaf, intoxicated or of defective vision, and give his or her approximate age. If property was injured, describe condition of property. State any act done by the person injured, or whose property was injured, or any circumstances connected with such person which in the slightest degree contributed to the injury. State what, if anything, was said by the person injured immediately after the accident. State if the person injured was alone or with whom, and give such further information as you may deem important.

5. Under no consideration must the matter be discussed with,

Form 295. 10m. 5-2-05

Philadelphia Rapid Transit Company,

CLAIM DEPARTMENT.

No.......... Case of..........

INDIVIDUALITY OF WITNESSES.

Name,.......... Age,.......... White. Black.
Male. Female. Nationality,.......... Occupation,..........
Permanent. Transient. Bright. Dull. Willing. Unwilling.
Remarks,..........

Name,.......... Age,.......... White. Black.
Male. Female. Nationality,.......... Occupation,..........
Permanent. Transient. Bright. Dull. Willing. Unwilling.
Remarks,..........

Name,.......... Age,.......... White. Black.
Male. Female. Nationality,.......... Occupation,..........
Permanent. Transient. Bright. Dull, Willing. Unwilling.
Remarks,..........

Name,.......... Age,.......... White. Black.
Male. Female. Nationality,.......... Occupation,..........
Permanent. Transient. Bright. Dull. Willing. Unwilling.
Remarks,..........

Respectfully submitted,

.... *Inspector.*

FORM 295.—BLANK FOR STATING CHARACTERISTICS OF WITNESSES

or any information given to, anyone outside the officers of the company. Representatives of the accident department that are entitled to the information you may have concerning an accident must show to you their card of authority, which must be endorsed by the general manager and claim agent.

In practice, the conductors make out a preliminary report of the occurrence at the time of the accident, using for this purpose Form 431, reproduced on preceding page. On the back of this form are blank spaces for filling in names and addresses of persons injured, and for the names and addresses of witnesses. This form is furnished to the conductors in pads of twenty-five, and each conductor is required to have in his pocket one of these pads when on

Form 296. 10,000. 7-1-00

Philadelphia Rapid Transit Co.,

CLAIM BLANK.

Case of.......... No..........
(Must be filled out and then Signed by the Claimant.)

Philadelphia, Pa.,.......... 190

Date of accident, (Give day of week, date of month and hour.) ....
Place of accident, (State exactly) ....
Nature of accident, (State in detail just what happened.) ....

Name and address of attending physician,..........
Nature of injuries,..........

Names and addresses of all witnesses,..........

Total amount of claim,..........

WITNESS: Signature,..........
Address,..........

FORM 296.—BLANK FOR TAKING SWORN STATEMENT OF CLAIMANT CONCERNING ACCIDENT

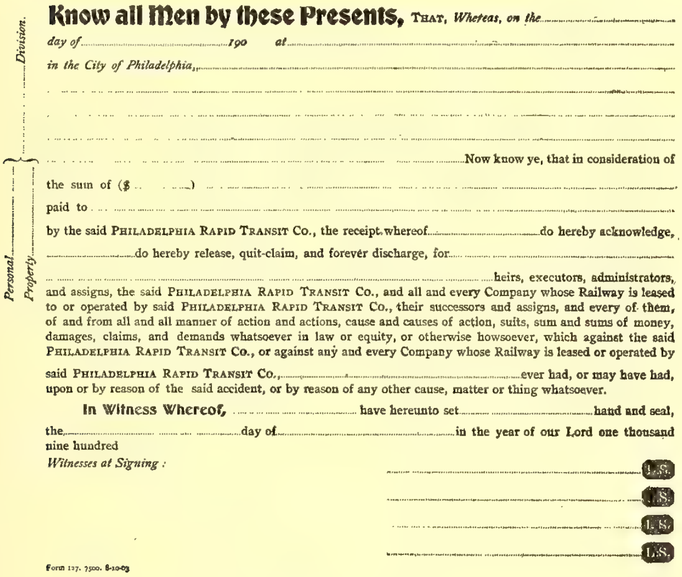
duty. This preliminary report is turned into the car depot at the first opportunity.

When the conductor is relieved from duty he is required to go immediately to the employees' room at his car house and write out a more comprehensive report, giving all of the details in regard to the occurrence, using for this purpose Form 61. The fuller reports are all forwarded to the claim department from all the depots at 2 o'clock each morning, but the depot superintendent or inspector in charge has instructions that as soon as the conductor's preliminary report is received, if the accident involves personal injury, this preliminary report must be repeated at once over the telephone to the chief adjuster or chief investigator, at the office of the claim department. This telephone message is taken down by a stenographer in the claim department from the telephone receiver, on Form 327. It is thus provided that the machinery of the claim department will be in motion within thirty minutes after the accident, on all cases involving personal injury.

Inspectors who may witness the accident, or who arrive on the scene soon after, have instructions to secure statements of witnesses on the spot, giving all the details of the occurrence. These statements are written by the inspector on blank forms prepared for the purpose, and the witnesses are requested to sign these statements. The inspector also makes a report of the accident in accordance with the facts he is able to gather.

When the detail accident reports previously referred to are received in the early morning hours at the claim department, they are immediately placed in the hands of an expert examiner, who

goes through the individual reports carefully and classifies them. Two copies of each report are then made. One copy goes to the office of the general superintendent for the information of the operating department, and one copy goes to the employees' record files. The originals are numbered consecutively (this number then becomes the reference and filing number of the case), and the papers are routed to the attaches of the claim department delegated to handle the particular class. It thus comes about that by 8 o'clock



Division.
Personal. Property.

Know all Men by these Presents, THAT, *Whereas, on the*
day of .... *190* *at* ....
in the City of Philadelphia, ...
.... Now know ye, that in consideration of
the sum of ($ ....) ....
paid to ....
by the said PHILADELPHIA RAPID TRANSIT Co., the receipt whereof .... do hereby acknowledge,
.... do hereby release, quit-claim, and forever discharge, for ....
.... heirs, executors, administrators, and assigns, the said PHILADELPHIA RAPID TRANSIT Co., and all and every Company whose Railway is leased to or operated by said PHILADELPHIA RAPID TRANSIT Co., their successors and assigns, and every of them, of and from all and all manner of action and actions, cause and causes of action, suits, sum and sums of money, damages, claims, and demands whatsoever in law or equity, or otherwise howsoever, which against the said PHILADELPHIA RAPID TRANSIT Co., or against any and every Company whose Railway is leased or operated by said PHILADELPHIA RAPID TRANSIT Co., ... ever had, or may have had, upon or by reason of the said accident, or by reason of any other cause, matter or thing whatsoever.

In Witness Whereof, ... have hereunto set .... hand and seal, the .... day of .... in the year of our Lord one thousand nine hundred

Witnesses at Signing:
L.S.
L.S.
L.S.
L.S.

Form 127. 7500. 8-10-03

FORM 127.—RELEASE

every morning each adjuster and investigator finds upon his desk his assignment for the day's work, these assignments in the main consisting of the accidents that occurred the previous day.

In the handling of these accident reports the first step is for the adjuster or inspector, as the case may be, to see the person injured. The practice in Philadelphia is to tender the services of a doctor, and the company will furnish a reputable physician if the party desires it. If the injured person prefers his own doctor, the company asks the privilege of sending one of its doctors, in company with the injured person's physician, it being the duty of the company's doctor to find out the physical condition and give aid when requested, but these doctors do no settling or adjusting with respect to financial compensation. The doctors so employed by the company are all physicians in private practice. They are of high standing in their profession, and do not give all of their time to the company's business, but are called by telephone to treat individual cases when their services are needed.

The adjusters, when they start out in the morning, are supplied with a certain amount of cash, the amount depending upon the cases they are to handle during the day. The individual adjusters have authority to settle cases for cash and take releases by payments of from $1 to $500. They work under the general director of the chief adjuster, but they have instructions if special conditions arise to act on their own discretion in the settling of cases. The adjusters replenish their supply of cash by turning into the treasurer the releases and vouchers for expenses. All employees of the claim department, with the exception of the office force, are under bonds in a surety company.

The form of release used by the company has been devised with especial care. A simple form has been adopted, and the company has been singularly successful in establishing the validity of releases. The releases are printed on bank safety paper, which is proof against erasions or alterations. (See Form 127.)

If the adjuster or investigator is unable to effect a settlement of the case, he requests the injured person to fill out a blank (see Form 296), giving the claimant's version of the case, names and addresses of witnesses, and total amount of claim. To have the claim considered, the claimant must sign this statement, and the company then sends a notary public to the address of the person, and the statement is sworn to. This form is considered a very important one, inasmuch as it aids in securing a correct statement of the claimant's version of the case while all the facts are still fresh in his mind.

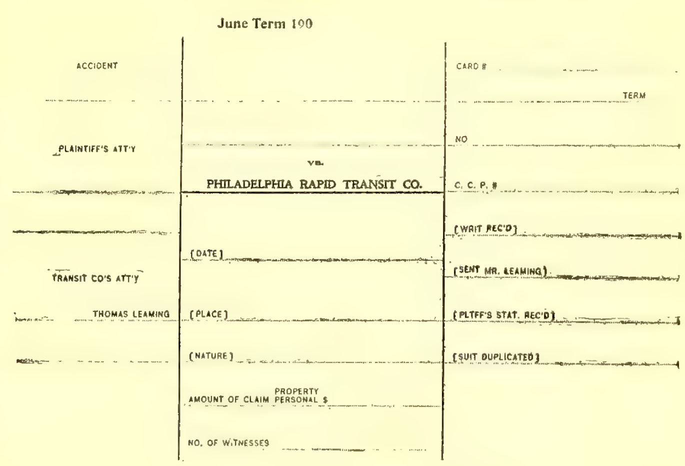
It should be stated here that practically all the blank forms, letter heads, etc., used by the claim department are of the same size, 8¼ ins. by 10½ ins., which has been adopted as standard. This uniformity introduces conveniences in filing.

As to the system of filing papers, the original reports from the conductors in regard to the accidents are numbered consecutively, and are filed in filing boxes, each box holding seventy-five cases. All papers referring to each case are, of course, attached to the original report, and bear the corresponding case number.

As an index to these filing cases, a large book is kept, which is known as the accident register or index. The column headings at the top of the pages in this book call for entries, giving the file number, date of accident, name of division, car number, block number, conductor's badge number, motorman's badge number, closed or open car, time of day, direction in which car was moving, place of accident, name of injured party, address of injured party, nature of injury, date of settlement, amount paid for personal injury, amount paid for property injury, amount collected for damage to cars.

If suit is brought on a case, all the papers referring to that case are transferred from the original filing boxes to a separate file known as "suits pending." It is known, therefore, that the papers for any accident that ever happened on the road are in either one of two files. This is thought to possess advantages over the more common practice of having separate files for various classes of accidents. The files are kept in fireproof vaults.

About two years ago the claim department began keeping very elaborate records of accidents, classified in various ways. A table setting forth these classifications, together with the number of accidents of each class, is presented on page 533. The records with reference to the system of classifying are kept by the card system, the cards used for this purpose being reproduced on page 532. A card index is also maintained, giving the name of each doctor with whom the claim department has had dealings, together with the accident cases which he has attended. Another card index of lawyers' names is kept in the same way. The value of all these records will be at once apparent as furnish-



June Term 190

ACCIDENT
PLAINTIFF'S ATT'Y
TRANSIT CO'S ATT'Y
THOMAS LEAMING

vs.
PHILADELPHIA RAPID TRANSIT CO.
(DATE)
(PLACE)
(NATURE)
AMOUNT OF CLAIM PROPERTY PERSONAL $
NO. OF WITNESSES

CARD #
TERM
NO
C. C. P. #
(WRIT REC'D)
(SENT MR. LEAMING)
(PLTFF'S STAT. REC'D)
(SUIT DUPLICATED)

COURT DOCKET CARD INDEX

ing progressive data and averages that are of the utmost importance in the intelligent handling of future cases.

Such cases as are to be taken into court are referred to the company's general counsel, under whose direction they are referred to assistant counsel for preparation and trial. A number of methods in the nature of aids for expediting and facilitating the work of preparing and trying cases have been worked out, and

some of these merit particular mention. For instance, it is often of prime assistance to the trial lawyer if he knows something of the individuality and character of the company's witnesses in a given case. To supply this information, the claim department fills out Form 295 (see page 530), and sends this with the other papers in each case to the general counsel.

As an aid to the trial lawyer in presenting accident cases to juries, the claim department frequently prepares rather elaborate plan drawings showing in detail the layout of the locality in which the particular accident occurred. The drawings are made on long sheets of heavy linen paper, and show street and track intersections, location of curbs and sidewalks, building lines, etc., together with all dimensions and distances, that will serve to explain the situation. These drawings are usually made in different colors, and all lettering and dimensions are indicated in large size, so that as the trial lawyer displays the chart in front of the jury box, each member of the jury and the court can readily follow and understand the explanations as given by the lawyer. These charts are constructed from original surveys made after the accident has happened, and all distances are determined and verified by actual measurements made on the spot, and are not taken from records. The surveyors and draftsmen who do this work are always put on the stand, and are able to testify from their own knowledge as to the accuracy of the charts. Drawings of this kind have been found invaluable in properly presenting cases to juries.

The camera is also used systematically and effectively in the preparation and trial of cases. Frequently photographs showing the scene of the accident, the car involved in the occurrence, and any other features that would throw light on the case, are prepared, and, if the case goes to trial, are presented to the jury. The camera has been employed with conspicuous success in the ferreting out and exposing of fraudulent claims, and the detective force of the company makes extensive use of this means for breaking down false claims and bringing fraudulent claimants to justice.

A number of photographs are reproduced on Plate XL. as showing concrete examples of the effective use of the camera.

In the case of Patrick Crossen, the man was struck by a car and knocked down. He claimed spinal injury and total disability, and on the stand at the trial testified he had done absolutely no work since the accident. On cross-examination, the original photographs were laid before the jury, and by them the company was able to establish that the plaintiff had been engaged regularly before the trial at his occupation of shoveling dirt. The jury lost no time in finding for the company.

In the case of a driver of a brewery wagon, who was hit by a car, the plaintiff claimed injury to his back and total disability. The photographs taken soon after the accident showed the man engaged at his regular occupation of handling beer barrels. The introduction of the photographs at the trial resulted in a verdict for the company.

As another instance of a similar nature, may be cited the case of a young foreigner, who claimed heavy damages for alleged

	Date of Settlement	No of Settlements	Cost	Average	Male		Female		Open		Closed		
					No.	Cost	No	Cost	No.	Cost	No.	Cost	
	July												
	Aug												

CARD INDEX FOR CLASSIFYING SETTLEMENTS ACCORDING TO SEX, AND WITH REGARD TO OPEN AND CLOSED CARS

DATE OF SETTLEMENT	NO OF SETTMT	COST	AVGE.	IRISH		ITALIAN		HEBREW		NEGRO		AMERICAN		Other Foreigners		Unreported		Attorney's Fees							
				No	COST	No	COST	No.	COST	No	COST	No	COST	No	COST	No	COST	No	COST	No	COST	No.	COST	No.	COST
JULY																									
AUG.																									

CARD INDEX FOR CLASSIFYING SETTLEMENTS ACCORDING TO NATIONALITIES OF CLAIMANTS

	DATE OF SETTLEMENT	NO OF Settlement	COST	Average		DATE OF SETTLEMENT	NO OF Settlement	COST	Average
	JULY					JULY			
	AUG.					AUG.			

CARD INDEX FOR KEEPING RECORD OF SETTLEMENTS ACCORDING TO COSTS

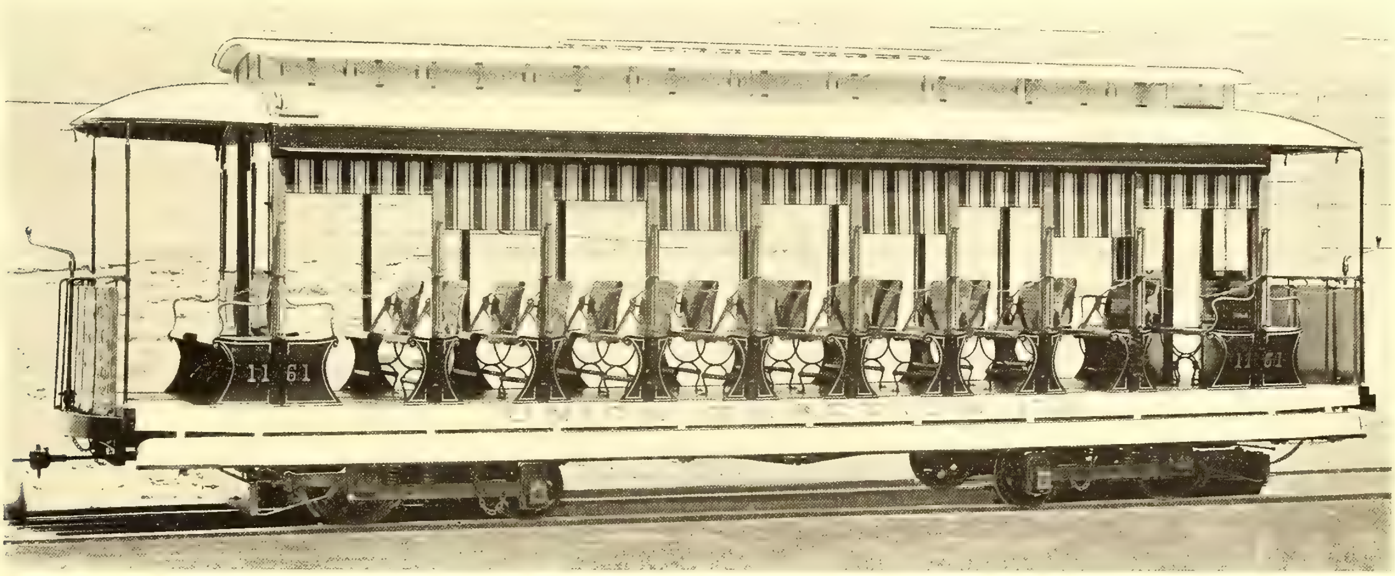
Doctor ______________________ of ______________

Report No.	Claimant	Date	Address

CARD INDEX FOR KEEPING RECORDS OF PHYSICIANS

INTERIOR OF CENTER AISLE OPEN CAR

INTERIOR OF STANDARD SEMI-CONVERTIBLE CAR



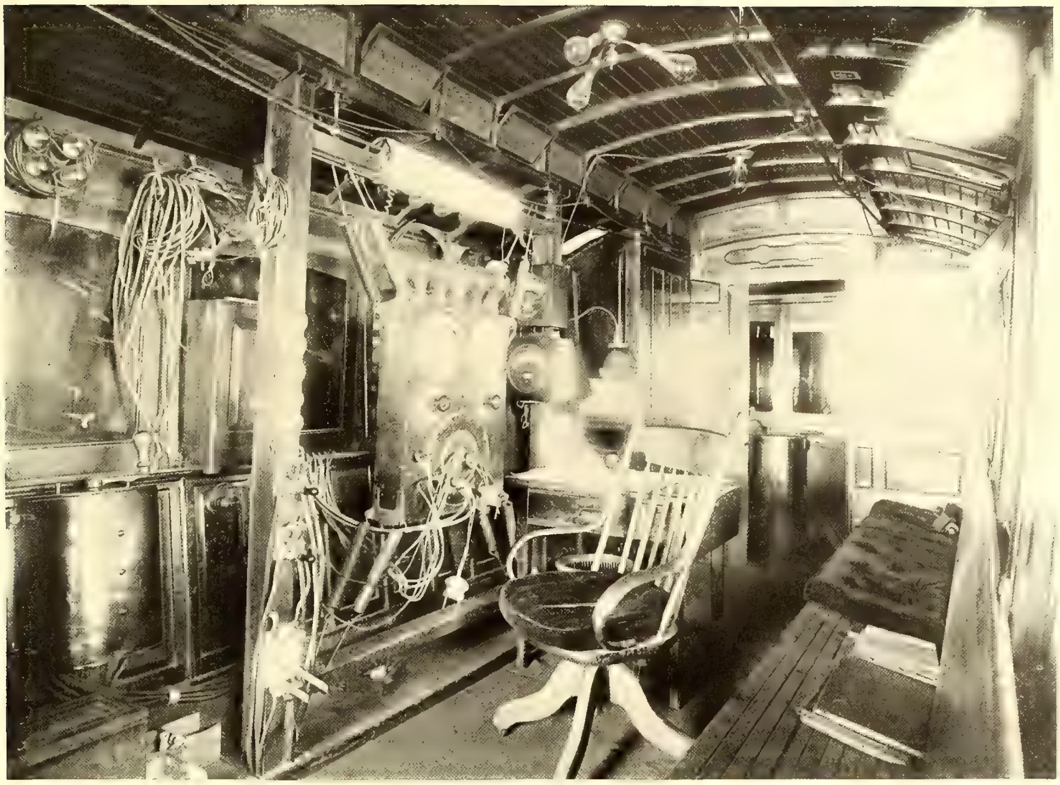
EXTERIOR OF OPEN CAR WITH CENTER AISLE

EXTERIOR OF STANDARD SEMI-CONVERTIBLE CAR

INTERIOR OF MAIL CAR

DUMPING SNOW INTO MELTING PITS

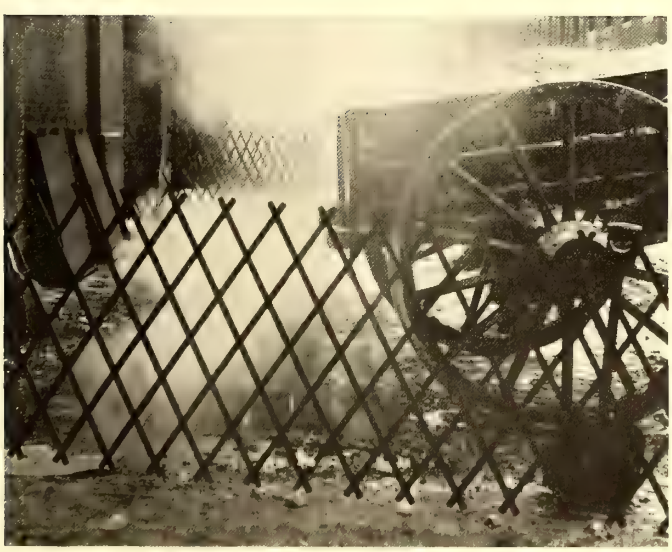
GENERAL STOREROOM, EIGHTH AND DAUPHIN STREETS



INTERIOR OF TESTING CAR

HOOD DESTINATION SIGN

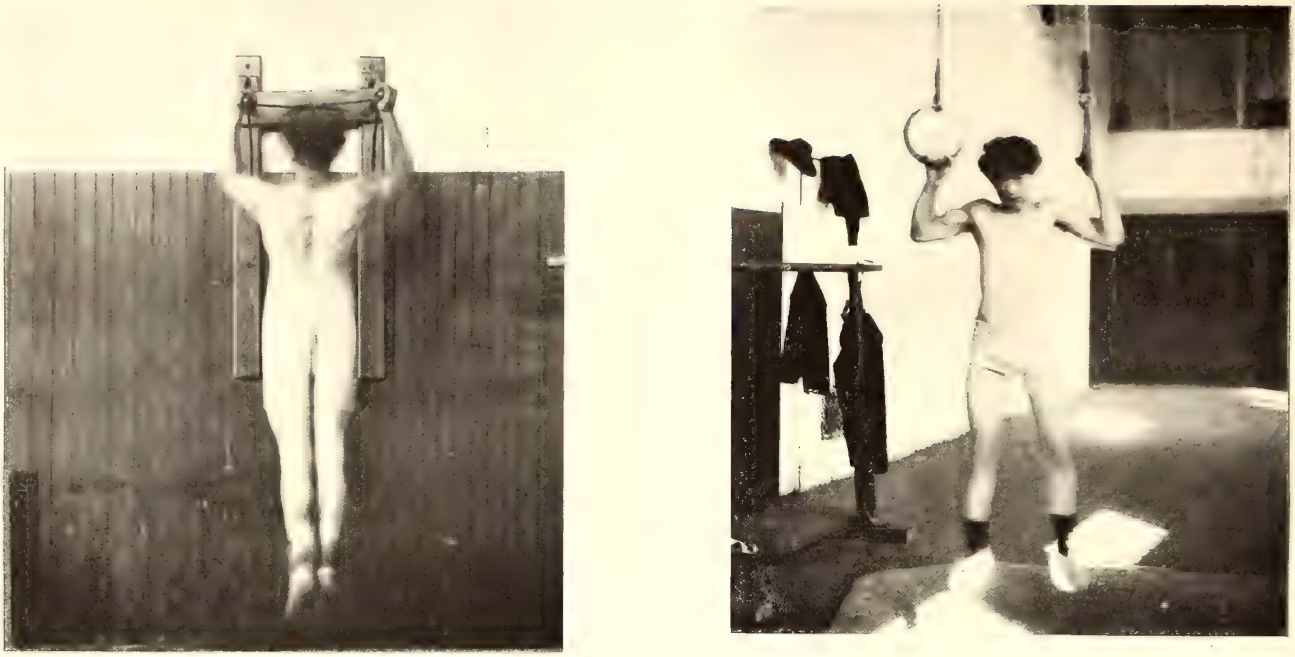
HOOD DESTINATION SIGN, SHOWING METHOD OF CHANGING DESIGNATION BY MEANS OF MOVABLE FLAP



SNOW-MELTING PITS

DESTINATION SIGN FOR SIDE OF CAR

Plate XL



This Claimant Alleged Curvature of Spine and Total Paralysis.—The Photographs Showed Him Performing Feats in Gymnasium While His Claim Was Pending

This Claimant is Shown at His Regular Occupation of Handling Beer Barrels While His Claim for Injury to Back and Total Disability was Pending

A Claimant Who Alleged Spinal Injury and Total Disability

REPRODUCTIONS FROM PHOTOGRAPHS SHOWING THE VALUE OF THE CAMERA IN CLAIM ADJUSTING.—THE PHOTOGRAPHS WERE TAKEN SOON AFTER THE ACCIDENTS IN WHICH ALLEGED INJURIES HAD BEEN RECEIVED

curvature of the spine and total paralysis as the result of a street railway accident. Soon after the entry of the claim the young man was induced by a representative of the detective force to join a gymnasium, and the alleged sufferer from total paralysis was photographed while going through various difficult gymnastic stunts. It is needless to say, the photographs constituted good evidence for the defendant.

The detective department is considered one of the most valuable adjuncts to the successful operation of the claim department. The company has adopted the policy of prosecuting fraudulent claimants to the last ditch, and, when sure of its evidence, has followed would-be impostors as far as Canada, and it does not stop until the offender is landed in jail. During the past two years the department has secured over sixty convictions in accident frauds, some of them involving deep-laid conspiracies against the company's treasury. As a result of this relentless activity, this class of claimants is beginning to give Philadelphia a wide berth.

The docket of cases set for trial is arranged in card index form, this arrangement having been found to possess advantages over the more common "book" docket. Each case is entered on a separate card, a sample of which is reproduced on page 531.

The policy of the Philadelphia Rapid Transit Company with respect to the handling of accident claims may be summed up in the statement: Settle honest and meritorious claims; when the degree of the company's liability is open to question, compromise; but resist and fight to a finish all exorbitant and fraudulent claims, and follow up and prosecute fake claimants.

The claim department has authority to settle according to its own discretion the ordinary run of cases. In special cases, and when the degree of the company's liability is debatable, the general claim agent confers with the general counsel in conjunction with the general manager.

The closest co-operation is maintained between the claim department and the operating department, and a representative of the claim department attends the regular meetings of the division superintendents. The entire staff of the adjusting department is on the lookout for methods of preventing accidents, and suggestions are made freely to the general manager, and these receive the fullest consideration.

The following table gives the relative number and cost of all classes of settlements:

PERSONAL INJURY AND PROPERTY DAMAGES.

	Year Ending June 30, 1904.			Year Ending June 30, 1905.		
	Number of Settlements.	Per Cent to Total No.	Per Cent Cost to Total Cost.	Number of Settlements.	Per Cent to Total No.	Per Cent Cost to Total Cost.
PERSONAL AND PROPERTY:						
Personal injury cases	6,896	91.53	95.83	4,935	91.51	97.02
Property damage cases	638	8.47	4.17	458	8.49	2.98
Total	7,534	100.00	100.00	5,393	100.00	100.00
RATIO OF SETTLEMENTS:						
From $1 to $100	6,517	86.50	27.01	4,197	77.82	13.55
From 100 to 250	601	7.98	15.25	631	11.70	11.53
From 250 to 500	220	2.92	12.91	253	4.69	10.33
From 500 to 750	80	1.06	7.90	109	2.02	7.54
From 750 to 1,000	33	.44	4.90	41	.76	4.26
From 1,000 to 1,500	32	.42	6.31	52	.96	7.78
From 1,500 to 2,500	28	.37	8.64	39	.72	9.37
From 2,500 to 3,500	11	.12	5.58	37	.69	13.64
From 3,500 to 5,000	6	.08	4.14	21	.39	10.40
From 5,000 to 7,500	3	.04	2.83	9	.17	7.05
Exceeding $7,500	3	.04	4.53	4	.07	4.54
Total	7,534	100.00	100.00	5,393	100.00	100.00
PUBLIC AND EMPLOYEES:						
Public	7,505	99.62	99.76	5,356	99.31	99.74
Employees	29	.38	.24	37	.69	.26
Total	7,534	100.00	100.00	5,393	100.00	100.00
CARS:						
Open cars	2,271	30.13	31.35	1,233	22.86	24.95
Closed cars	5,191	68.90	68.17	4,075	75.56	74.38
Not on or by cars	72	.96	.48	85	1.58	.67
Total	7,534	100.00	100.00	5,393	100.00	100.00

PERSONAL INJURY CASES.

	Year Ending June 30, 1904.			Year Ending June 30, 1905.		
	Number of Settlements.	Per Cent to Total No.	Per Cent Cost to Total Cost.	Number of Settlements.	Per Cent to Total No.	Per Cent Cost to Total Cost.
NATURE OF INJURIES:						
Lacerations and contusions	3,586	52.00	26.26	2,297	46.55	11.31
Simple fractures, sprains and dislocations	1,233	17.88	13.18	901	18.26	10.85
Fractures	91	1.32	7.45	101	2.05	11.51
Neurasthenia	616	8.90	13.19	667	13.51	23.94
Spinal	121	1.75	8.31	160	3.24	12.07
Internal	231	3.35	10 56	281	5.69	16.51
Death, adults	11	.16	1.78	14	.28	1.08
Death, children	8	.12	.58	9	.18	.71
Loss of leg	1	.01	.03	19	.39	6.71
Loss of arm	......	......	......	2	.04	1.02
Injuries to sight	16	.23	.72	4	.08	.48
Unclassified, serious	139	2.02	13.67	12	.24	1.53
Unclassified, slight	837	12.14	4.07	455	9.22	2.07
Electricity	6	.10	.20	13	.26	.30
Total	6,896	100.00	100.00	4,935	100.00	100.00
NATURE OF ACCIDENTS:						
Alighting	1,541	22.35	20.28	783	15.87	19.63
Boarding	1,256	18.21	15.08	844	17.10	15.65
Collision of cars	1,507	21.85	24.86	1,231	24.94	23.73
Vehicles struck	1,366	19.81	17.63	1,134	22.98	20.64
Pedestrians struck	421	6.10	6.64	242	4.90	10.22
Bicycles struck	21	.30	.30	3	.06	.02
Thrown from car	123	1.79	1.95	85	1.72	2.38
Ejectments	34	.49	.63	29	.59	.43
Paving	59	.86	.38	54	1.09	.61
Miscellaneous accidents	559	8.11	12.05	516	10.46	6.36
Electricity	9	.13	.20	14	.28	.30
Total	6,896	100.00	100.00	4,935	100.00	100.00
SEX:						
Male (14 years and over)	3,746	54.32	44.73	2,405	48.73	39.42
Male (under 14 years)	303	4.39	2.76	210	4.26	6.69
Female (12 years and over)	2,709	39.28	51.20	2,214	44.86	51.76
Female (under 12 years)	138	2.00	1.30	106	2.15	2.13
Total	6,896	100.00	100.00	4,935	100.00	100.00
CARS:						
Open cars	2,142	31.33	32.25	1,174	24.06	25.32
Closed cars	4,695	68.67	67.75	3,706	75.94	74.68
Total (excluding accidents by paving)	6,837	100.00	100.00	4,880	100.00	100.00
NATIONALITIES:						
Irish	1,361	19.74	16.32	624	12.64	13.37
Italian	205	2.97	2.19	95	1.92	1.22
Hebrew	743	10.77	14.04	442	8.96	10.88
Negro	322	4.67	2.31	229	4.64	4.73
American	3,393	49.20	53.82	3,056	61.93	59.64
Other Foreigners	193	2.80	3.74	149	3.02	3.08
German	679	9.85	7.58	340	6.89	7.08
Total	6,896	100.00	100.00	4,935	100.00	100.00
REPORTS:						
Reported accidents	6,007	87.11	87.45	4,299	87.11	90.39
Unreported accidents	889	12.89	12.55	636	12.89	9.60
Total	6,896	100.00	100.00	4,935	100.00	100.00
CREWS:						
Unreported (crews found)	116	13.05	19.33	84	13.21	17.53
Unreported (crews not found)	773	86.95	80.67	552	86.79	82.46
Total	889	100.00	100.00	636	100.00	100.00

PHOTOGRAPH DEPARTMENT

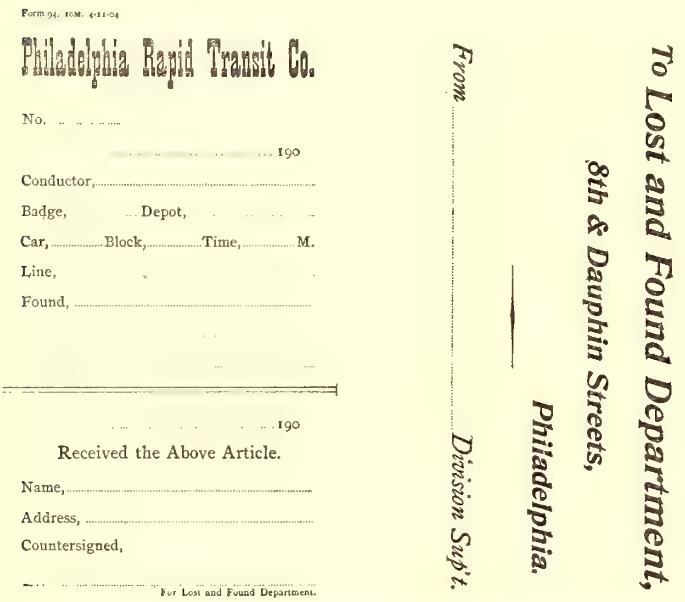
The company has found it advantageous to have its own photograph department for taking negatives and printing and developing work. This department was established about four years ago, but has rapidly increased its scope, and now constitutes an important part of the organization. The department is in charge of E. F. Harrison, who takes all the negatives required for both the engineering department and the claim department. Negatives are carefully filed and indexed, and constitute important records to which reference is constantly being made. The department has a complete photographic gallery fitted with dark room and all modern appliances for doing high-grade photographic work. An important phase of the department's work has been the taking of record and progress views in connection with the construction of the subway and elevated lines.

LOST-PROPERTY DEPARTMENT

About 5000 articles every month pass into the lost and found department. As in other large cities, this lost property forms a heterogenious assortment of articles, ranging as widely in variety as, for instance, human skulls and live puppies, and including now

and then articles that it would hardly seem as though anyone would think of carrying into a street car, to say nothing of forgetting. Employees have instructions to turn property left in the cars into their operating depot at the end of the run. To each article so found is immediately attached a tag (see Form 94), upon which is written the time, date, etc., and a description of the article. A portion of this tag comprises a receipt, which is signed by the owner when the article is claimed.

If the article is not claimed from the depot master the same day it is found, it is sent to the central lost and found department at the company's main offices early the following morning, a car making the rounds of all the depots, beginning at 5:30 in the morning, for the purpose of collecting lost articles. Each depot master enters in a special book a transcript of the tags for all the lost articles that may be turned in to him for each day. Each morning, when the lost articles for the previous day arrive at the lost and found department, a clerk first stamps each tag with a consecutive number and a transcript of the tag is entered in a book at the side of the corresponding number. The articles are then classified according to the operating depots from which they are


Form 94. 10M. 4-11-04

Philadelphia Rapid Transit Co.

No. ....

.... 190

Conductor, ...

Badge, ... Depot, ...

Car, ... Block, ... Time, ... M.

Line,

Found, ...

.... 190

Received the Above Article.

Name, ...

Address, ...

Countersigned,

.... For Lost and Found Department.

To Lost and Found Department,

8th & Dauphin Streets,

Philadelphia.

From .... Division Sup't.

FORM 94.—FACE AND REVERSE OF TAG ATTACHED TO FOUND ARTICLES

received, and are stored in bins, there being a bin for each depot. A separate set of bins is kept for umbrellas, as there are often as many as 1500 umbrellas on hand during a single month.

Persons making inquiries for lost articles are required to go to the lost and found department in person and identify the property. The owner signs the receipt portion of the tag, and also writes his name in the lost-property book after the description of the article, the company thus having a double receipt.

Any article that is not claimed within thirty days is returned to the employee who found it. If the article is claimed before the expiration of thirty days, the original tag, with the signed receipt attached, is sent to the proper depot, and is posted on the bulletin board, so that the employee interested may know that the goods were returned to the owner. The statistics of the department show that only about 50 per cent of the property found on the cars is ever claimed.

Although it costs several thousands of dollars a year to maintain the lost and found department, the company takes good care of everything left in the cars, and makes every effort to restore the property to the rightful owner. If there is anything about the article by which it can be identified, the owner is notified by letter to call and claim the same. The clerks in the department also watch the lost advertisements in the daily papers, and if the published descriptions correspond to anything that has been turned in, a letter is sent to the owner advising him of the fact and inviting him to call and identify his property if possible. The department is in charge of William W. Dwier. It takes a portion of the time of four men to handle the lost and found department, in addition to the time of the men at the depots.

As a precautionary measure, it is thought best to thoroughly disinfect once a week the room in which the lost property is stored.

PRINTING DEPARTMENT

The Philadelphia Rapid Transit Company operates its own printing department, which now turns out all the printed matter, including tickets, transfers, advertising posters and literature, and all the blanks and forms used by the company in its various departments. The printing department was instituted in 1880 by the Union Passenger Railway Company, and after each of the successive consolidations its scope was broadened to include the acquired properties, until now, as stated, it includes facilities for turning out the printed matter required to meet the varied needs of the entire street railway system of Philadelphia. This printed matter aggregated in bulk last year nearly 400 tons.

The printing department occupies a specially-designed portion of the storage-battery station, near the company's main offices. The press room includes 3800 sq. ft. of floor space, the room being well lighted from skylights in the roof and heated by steam pipes suspended from the roof girders. All of the presses and other machinery are operated by individual electric motors of the Crocker-Wheeler manufacture, taking 550-volt direct current from the station storage battery. The wiring for this electric-drive system is carried in conduits beneath the press room floor, the branch-offs to each machine being brought up through the floor in iron pipes.

The equipment includes the following: Two-cylinder presses, six job presses, one Kidder press of special design, which prints, numbers and perforates exchange tickets or transfers at one operation; one Sterling punching machine, two Brown & Carver cutting machines, one hand press, two New Jersey wire-stitching machines, and a complete equipment of numbering machines.

The composing room is located in one corner of the building, and is provided with about 300 fonts of job type, various sizes of body letter for book work, and a miscellaneous assortment of wood type.

The establishment also includes a storeroom for paper stock, and the varied nature of the printing called for requires that nearly four carloads, or 60 tons, of paper be carried in stock at all times.

About 50 per cent of the work passing through this department consists of transfers and exchange tickets. As previously stated, these are now printed on a special press built by the Kidder Press Company from plans suggested by the superintendent of the printing department. This machine is capable of turning out 1,000,000 tickets a day. The tickets are printed thirty to a sheet, and the machine prints these on both sides of the web, numbers each ticket twice on one side and perforates and counts them during one process. Until the introduction of this machine, the tickets had to be put through a cylinder press twice, in order to print both sides, and then they had to be numbered and perforated. One man and a boy are now doing the work that formerly required seven men.

As outlined on page 482 of this issue, the layout of the street railway lines and the number of intersections require a multiplicity of different forms of transfers and exchange tickets. Each transfer and exchange ticket bears the run number under which it is to be issued, and, in addition, the transfers and tickets for each run number are numbered consecutively. Transfers and tickets are bound in pads of 100, wire stitched at the end, with a cardboard backing. It will be readily understood that this complicated system of tickets requires great care in making sure that tickets properly numbered as to runs, and bearing consecutive numbers are supplied at the proper time to all the various operating depots. Accuracy and care are all the more necessary, inasmuch as each

exchange ticket has a cash value of 8 cents, and the accounting between the company and its conductors with reference to these transfers and tickets is carried on entirely by means of the system of numbering, so that it is very essential that nothing but perfectly-printed and numbered pads be issued.

The responsibility for issuing the tickets in proper form, and also for seeing that the necessary number of transfers and tickets of each series are supplied to the proper depots as required, devolves upon the superintendent of the printing department. By an ingenious and comparatively simple system of records, the department is able to keep track of the number of each form of transfers and exchanges and the numerical series furnished to each depot. Every week each operating depot turns into the printing department a memorandum, giving the last ticket number issued for each run number operating from the particular depot. The superintendent of printing examines these returns, and, by noting the numbers that are running short, he is able to take steps for replenishing the stock. This system does not require that a large number of tickets of any form or series be carried in stock, and the waste is therefore reduced to a minimum. About 174,000,000 of tickets, involving 127 tons of paper, were printed during the last fiscal year with practically no serious errors and with minimum waste.

The printing of the forms and blanks used in the routine work of the various departments comprises an important part of the work of the printing department. There are now about 400 different forms used by the company.

The method of keeping track of these forms and duplicating them when necessary is interesting. Sample books are kept containing samples of each form, classified according to the departments using them. In a separate book ruled with the heading as

Form No.____

Date	Quantity	Date	Quantity	Date	Quantity	Date	Quantity	Date	Quantity	Date	Quantity

COLUMN HEADINGS IN RECORD BOOKS USED BY PRINTING DEPARTMENT FOR KEEPING RECORD OF BLANK FORMS PRINTED FOR EACH DEPARTMENT

shown herewith is recorded the quantities of each form printed. As will be seen, this book gives the form number and the dates and quantities printed. Each form printed bears in one corner the form number, the number printed and the date of the last run, as for instance, "Form 68, 6 m. 6-26-05."

As to the financial results of this department, it may be said that the company believes it is saving about 30 per cent on its printing bills over and above what it would cost to have the work done outside. In addition, it is getting better work, and its printing is done under its own supervision. On the single item of tickets, the records show that the total cost of transfers and exchanges, including paper, printing, clerical work for keeping records, and distribution to the various depots, is now about 7½ cents a thousand, which is from 2 cents to 3 cents cheaper than the work could be secured on the outside. It cost about $4,000 to fix up the building for the use of the printing department, and the equipment cost about $20,000 additional. The expense of running and maintaining the printing department is about $30,000 per annum. The department is in charge of J. S. Skinner, superintendent of printing.

TESTING LABORATORY

An important feature of the machinery of the purchasing department is a complete chemical testing laboratory. This laboratory was established about six years ago on a very small scale, primarily to test babbitt metal. From this small beginning the testing department has grown rapidly, and is now considered one of the most important on the road. The chief purpose of the laboratory as at present organized is to furnish data from which the purchasing agent is enabled to draw up specifications for a wide variety of supplies, such as babbit metal, oil, grease, paint, metals, etc., and, after materials have been received, to see that they are up to specifications. By this means the company is able to make its own chemical determinations, and is in a position to avoid paying fancy prices for fancy brands, and is also enabled to keep close check on materials and supplies purchased. It is now the practice to send samples of materials purchased to the laboratory before any of the material is used, for the purpose of demonstrating whether or not the goods are as specified. This usually involves a delay of not over forty-eight hours, as the determinations can be made within that time.

The laboratory occupies the second story of one of the storage-battery houses near the general offices of the company. The equipment of the laboratory includes the following:

A gas-burning combustion furnace for analyzing iron and steel samples.

Two ventilating hoods, formed with tile floor, wooden sides, roofs and glass sliding doors, and equipped with motor-driven fans. In these hoods are carried on various tests of metals, etc., in which obnoxious vapors are given off, the ventilating features being designed to carry off through a flue all unpleasant or dangerous vapors and gases.

Apparatus for making flash and fire tests of oils.

A Doolittle's torsion viscosimeter, for determining the viscosity of oils.

Small gas oven and drying and heating apparatus.

Condensers in connection with distilling and extraction apparatus.

Electrolytic apparatus, for analysis of metals.

Crushing and pulverizing apparatus, for reducing coal, metals, etc.

Calorimeter, for determining calorific values of coals.

In addition to the foregoing, there is a large assortment of apparatus and furnishings that go to make up a well-equipped laboratory, including several working tables, a water vacuum pump, sink with running water, numberless glass tubes, jars and bottles, crucibles, mortars, scales, chemicals, etc.

There is also a standard voltmeter, for calibrating all the voltmeters used on the road.

As an indication of the variety of work carried out at this laboratory, the following partial list is given of analyses made during the past few months for the purpose of securing data for working up specifications.

Solder, gasoline, pipe covering, motor grease, turpentine, coal oil, linseed oil, engine cylinder deposit, journal oil, brass of various kinds as trolley ears, wire, grab handles and car trimmings, overhead material, etc., zinc, babbit metal and alloys, pig iron and manufactured iron products, signal oil, sulphuric acid for storage batteries, shellac, lead, putty, tool steel, paints, cement, boiler compounds, boiler scale and feed-water, track salt, etc.

The cost of installing the laboratory complete, exclusive of the building, was something less than $1,000. As to the financial results, it may be said that the expense of maintaining the laboratory, including the chemist's salary, is not over $2,000 per year. During the last fiscal year over 800 separate analyses were made, involving on the average three different determinations to each analysis. This shows an average of about $2.50 for each analysis, or 75 cents for each determination. An outside chemist would probably charge about $3 per determination. As to the economy, a single instance may be cited. The company is now buying babbit metal at 3 cents per pound less than the same brand can be purchased under trade name, the metal being based on specifications drawn in accordance with data secured in the laboratory. This price for babbitt means a saving to the company of at least $2,100 a year in this one item alone. It

is estimated the laboratory department enables the purchasing agent to effect a saving of from $7,000 to $10,000 per annum in the purchasing of material and supplies.

SNOW FIGHTING ORGANIZATION AND METHODS

For the purpose of removing snow from the streets, the city is divided into districts and thoroughly organized gangs are assigned to each district. The details for a redistribution of the snow-fighting forces and methods of fighting snow for the coming winter are now receiving attention, but at this writing are not ready for publication.

The company is somewhat hampered in handling this problem by not having suitable snow dumps. To overcome this there have been used successfully melting pits, which are located at the power houses, and consist of open wells filled with hot water, heated by exhaust steam in a specially constructed heater. The snow is dumped from the wagons directly into these pits and is melted by coming in contact with the hot water. The melted snow is then run off into the sewers. Experience with these melting pits does not indicate a reduction in cost over carting the snow away and dumping it. The indirect advantage of the method, however, is considerable, as it requires less wagons on the street and reduces the street congestion.

The company owns 105 snow-plows, all of which are of the single-truck, nose and shear type. The distinguishing feature of the Philadelphia plows is the shape of the shear and nose, which are made unusually high, and are curved over at the top to an unusual degree. This form serves to break up the snow by rolling it over on itself.

LAUNDRY FOR WASTE AND RAGS

The company operates its own laundry for cleaning waste, commutator cloths, etc. This is located at the Beach and Green Streets power house.

The laundry machinery is driven by a 9-amp. 500-volt GE motor. In the laundry the company has the following apparatus: One 20-in. turbine washer, built by the Oil & Waste Saving Machine Company, Rochester, N. Y.; one 20-in. belt-driven whizzer, built by the Troy Laundry Company, Troy, N. Y.; one boiling tank, 3 ft. in diameter and 4 ft. high, piped up with steam and cold water, built by the railway company; two brass barrel washing machines, size 2 ft. 6 ins. in diameter by 4 ft. 6 ins. long inside measurement, built by the Wilson Laundry Company, Columbia, Pa.

Adjoining the washing room is the drying oven. This is built of brick with fireproof doors. To guard against fire, water and steam fire sprays are also installed. The drying room has three tiers of shelves, under which are two heating coils, made of 1½-in. black pipe, of which there are 12 lengths, 12 ft. long, in the two coils. The steam going through the coils is trapped, thereby insuring dry steam circulation. The temperature of the drying room is kept at about 135 degs. night and day.

The shelves of the drying tables are 3 ft. 3 ins. wide by 12 ft. long, and are made of heavy galvanized wire screening ½-in. mesh. They are built in sections, each being 2 ft. x 3 ft. x 3 ins. The waste is spread out over these shelves very thinly and dried. Experience has shown that too heavy a layer of wet waste on these shelves is liable to catch fire from spontaneous combustion.

In the drying room above the shelves are a series of pipe rods let into the wall, on which the commutator rags are dried. The wash room and the drying room are both well ventilated, excellent ventilation being very necessary, as the humidity in these two rooms otherwise would become unbearable.

The motor room is partitioned off from the wash room, and is sufficiently large to be used as a stock room, in which the laundryman keeps each month's supply of soda, soap and cheesecloth for commutator rags. Here he also stores the dry-finished waste and rags from which he fills the waste cans and bundles the commutator rags for the various power houses and sub-stations.

A strict account is kept of the work done in the laundry from month to month, and the cost is charged up pro rata to all the stations having laundry work done. The expense of operating each station is kept separate, and a very interesting report is sent out annually by the superintendent of motive power to each engineer in charge, bearing on this expense.

The method of carrying out the work of this department is as follows:

A wagon is detailed to collect from the various power houses each day's quantity of dirty waste and dirty commutator rags which have previously been placed in waste cans and bundles, with the number thereon. These the driver delivers to the laundry, and in return takes back to the said power house or station a similar number and quantity of commutator rags and waste that have been washed. The laundryman then takes the waste from the cans and puts it into the turbine waste-saving machine. In this machine the waste is revolved at a high rate of speed, a portion of the exhaust steam from the turbine passing through the waste as it is being revolved. The action of this steam is to cut all of the oil and grease out of the waste, and the steam naturally condenses and carries the oil with it out through a trap and pipe connection at the bottom of the turbine, where it is caught in a bucket and dumped into a "perfection" filter, which separates and cleans the oil. This turbine holds 30 lbs. of wet oil-soaked waste when filled, and it takes from 30 minutes' to 40 minutes' whizzing to extract all of the oil and dross from each charge. The turbine does not take all of the dirt out of the waste, but after being put through this process there still remains a gritty sediment. To force this out, the laundryman puts the cleaned waste into one of the Columbia washers. The amount of waste constituting one wash in the Columbia washer is 60 lbs., for which he uses 4 lbs. of sal soda and 7 lbs. of soft soap. This quantity of waste is kept revolving and reversing slowly in the washer for about 35 minutes or 40 minutes, when it is finally rinsed out clean with fresh cold water and put into the whizzer, where the water is all forced out of it by centrifugal motion. After this process, the waste is spread out in the drying room to dry.

The commutator rags are not put into the oil and waste-saving turbine at all, because the rags come into the laundry as black as ink and are filled with carbon and copper dust. The rags are therefore thrown into the boiler, where they are boiled in ever-changing, clean boiling water, without soda or soap, for about 45 minutes. After this they are taken out, put into a Columbia washer, and washed and rinsed clean by a mixture of 6 lbs. of sal soda and 6 lbs. of soft soap to every 200 rags. These are also whizzed dry and then hung in the drying room.

As to the amount of oil saved by the waste machine, it is worth noting that the dirty waste, previous to being sent to the laundry by the various power houses, is squeezed in a screw press by a janitor, and such oil as can be extracted that way is kept; but even with this precaution the laundry redeems every month between seven and eight barrels of good oil.

It may be interesting to state that four years ago the superintendent of motive power tried the washing of waste and rags as an experiment; to-day it is an absolute necessity. Five years ago the consumption of new waste in the station at Beach and Green Streets alone was 15 bales per year, but for the past two years it has been only 1 bale per year. This year it will be a trifle over 1 bale. The item of commutator rags is also a very important one, there being about 2500 rags washed weekly in the laundry. The quantity of waste washed in the laundry averages 1500 lbs. for seven days' run. There is but one man in the laundry, and he is paid $1.75 per day.

MATERIAL AND SUPPLIES ACCOUNTING

It is the practice for each department of the company on the first day of each month in advance to make up requisitions for material and supplies required. This reduces the amount of stores on hand and cuts down the stock of dead material. The

requisitions are sent to the purchasing agent and are passed to the general manager for approval. They are then returned to the purchasing agent, who obtains quotations or places orders for the materials as the case may be. A considerable portion of the supplies are purchased on standard specifications made up from data secured in the testing laboratory. Four copies are made of all orders for goods. The original is sent to the firm from which the material is purchased. The second copies are filed numerically and indexed alphabetically. The third copy is forwarded to the department that ordered the goods. The fourth copy is kept as a price card index and is filed according to the individual items.

All bills against the Philadelphia Rapid Transit Company for supplies ordered must be made out upon bill heads furnished by the railway company with the order, and must show the order number and requisition number. Shippers are instructed to make out one set of bills for each order. All bills must be rendered in triplicate and bills, together with bill of lading, must be sent to the purchasing department the same day shipment is made.

When the bills in triplicate are received the duplicate copy is retained in the purchasing agent's department for charging against the proper account. The original and triplicate copies go to the department that ordered the material. The head of the department signs and returns the original and keeps the triplicate. The original is marked "O. K." in the order book and is sent to the auditor. The duplicates are filed under proper firm name in a file provided for the purpose.

When notice is received that shipments have arrived at the freight or express office, the company sends one of its own freight cars after the goods. A system has just been inaugurated for handling all of the supplies from the railroad stations to the proper department in the company's own freight cars. The street railway tracks in Philadelphia are a different gage from the entering railroads, and it is therefore impossible to haul the original freight cars to the store yards. The company's freight cars are 34 ft. long, mounted on double trucks and are equipped with crane, air hoist, etc. Each car has a capacity of 100,000 lbs. The conductor of the freight car obtains the destination of material from the chief clerk of the purchasing department. The conductor signs receipts for the goods to the railroad company and makes a manifest of material on a daily manifest sheet of goods received. When he delivers the shipments to any one of the departments he takes a receipt from the head of the department on his manifest. When the shipment is received at the proper department the packages are opened, examined and checked and slips are made out by the department receiving clerk showing by whom the packages were shipped and the contents. The receipts are entered in the receiving book and are held until the bills come in, when the cash value is also entered on the receipts.

Each department carries its own supplies in its own store rooms and in the distribution of accounts of materials and supplies the individual departments are charged with the goods delivered to them. Supplies for the power houses are charged to "Accrued Power Account," for line and track to "Accrued Maintenance of Way and Building Account;" general supplies, including car maintenance, to "General Supply Account;' and material for new work to "Purchase Direct" account.

In keeping its general stores the company has recently abolished the bin card system as too cumbersome and otherwise unsatisfactory. It is now the practice to give each item a separate bin number, by means of which the distribution accounts are kept, but there are no bin cards on the bins themselves. Entry of goods in and out of stores are made by means of memorandum slips which are filled in by the storekeeper and are sent to the purchasing department daily. This does away with the necessity for keeping in the storeroom accumulative records of material received and distributed.

WILLOW GROVE AND WILLOW GROVE TERMINAL

WILLOW GROVE PARK

In many respects Willow Grove Park is the finest amusement park in the world. It is situated 13 miles from the Philadelphia City Hall and at the terminus of six direct lines of cars, making it easy of access from all parts of the city of Philadelphia and its suburbs. The park covers an area of more than 100 acres, the natural beauties and picturesque surroundings making it an ideal outing spot. The natural charm and beauties of the place have been accentuated and enhanced by careful cultivation and intelligent landscape gardening.

Perhaps the chief distinguishing and the most popular feature is the high quality of band and orchestral music that is provided free of charge for the enjoyment of the park patrons. For example, during the season just closed, the management engaged five of the best musical organizations in this country, these including Sousa and his Band, Victor Herbert's Orchestra, Conway's Ithaca Band, Wheelock and his United States Indian Band and Damrosch's Orchestra. The privilege of listening to the world's finest classic and popular musical compositions as rendered by these famous musical organizations was thus extended to Philadelphia's recreation seekers at absolutely no other expense than the cost of street car fare.

Vieing in popularity with the musical attractions is an electric fountain said to be the largest and finest of its kind ever built.

In addition to the music and the fountain are about 100 amusement concessions, many of which are entirely new, and all of which are of a character pleasing to the most refined taste. And here it is in order to emphasize another distinguishing characteristic of Willow Grove, and the one to which perhaps more than any other the success of the place is due, that is, the superior order and discipline that is maintained at all times. No intoxicating liquors are sold in the park, and a corps of uniformed policemen is on duty morning, noon and night, quietly but firmly to discourage the slightest signs of disorder or rowdyism. So successfully is perfect order maintained that women and children are free to come and go at any hour without the faintest chance of being subjected to experiences in any way unpleasant or annoying. There are parks in and around Philadelphia provided for those who must have an element of loudness and rowdyism in their recreation, but at Willow Grove the reception afforded to these is discouraging to repetition. The management is convinced that in this policy lies the secret of success in maintaining with profit a street railway park.

The park was first open to the public in he summer of 1896, from which time great improvements have marked each succeeding year. So rapid has been its progress and increase in popularity that at the beginning of the present year it became necessary to build another electric road to serve the travel, in addition to the several routes previously available between the city and the park. On all the routes the fare is 10 cents one way, but the park itself with the music and the fountain is free to all. No attempt is made to give free outdoor attractions other than the two mentioned, with the possible exception of fireworks displays on special occasions. Nor is any attempt made to give vaudeville or theatrical entertainments; the park in this respect differs from the resorts of a similar nature in most other large cities.

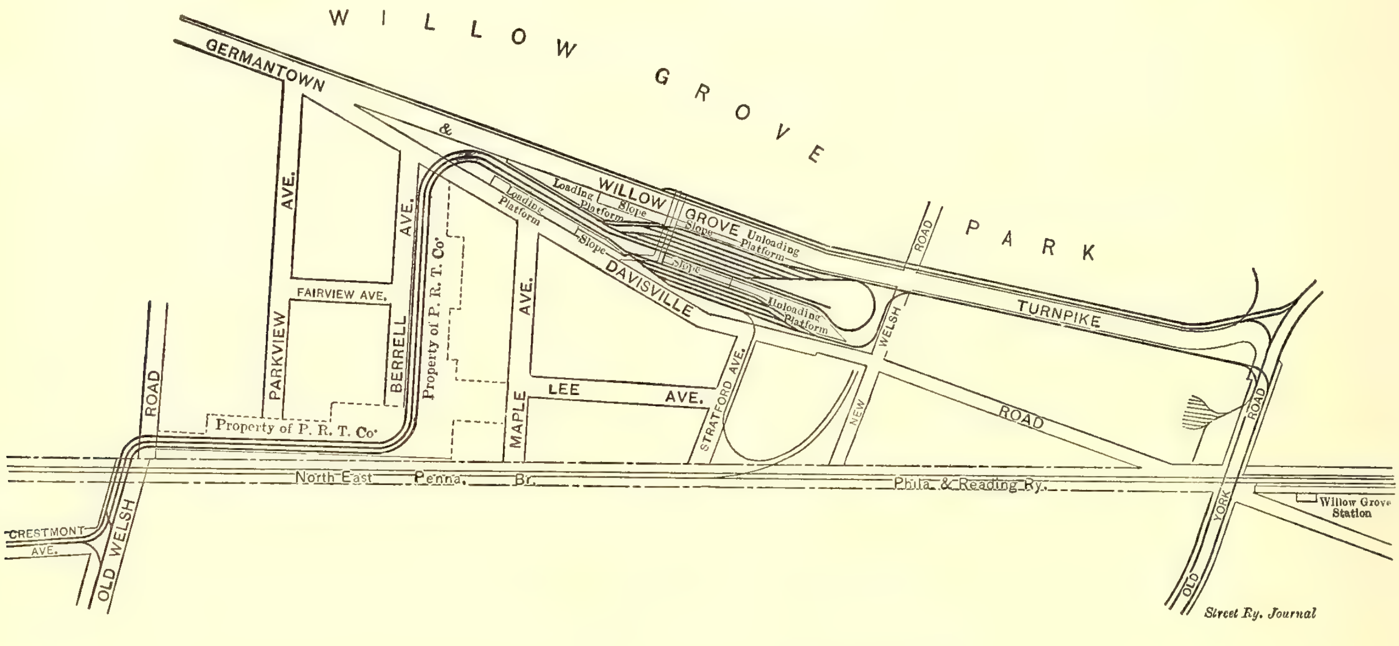
The park in itself, with its artistic settings of shrubbery, flower beds and greensward, constitutes an attraction destined to please the eye and fancy. A lake covering an area of 4 acres is one of the features popular with those who take delight in boating; an electric launch and fleet of rowboats are available for those who desire them. The night scene is remarkable for its brilliancy. Over 20,000 incandescent lights artistically placed along the avenues and lawns, and used to develop the graceful architectural lines of the buildings, serve to beautify the effect, while a multitude of arc lights give the needed illumination at important points.

The buildings at the park are all built with the view of permanency, and most of them are painted white. Mention of the principal buildings follows:

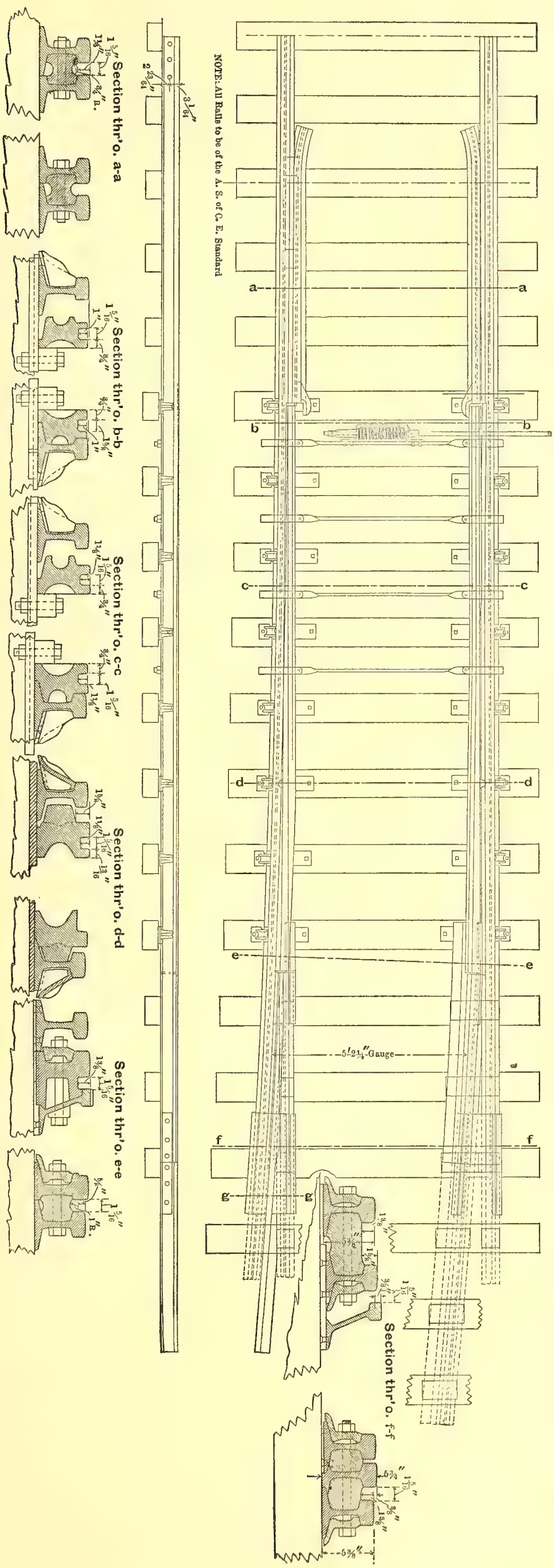
The administration building, the headquarters from which the varied affairs of the park are directed, is a pleasing structure of brick and stone, fashioned in colonial style. Here are the executive offices and bureau of information, and in one corner is a miniature hospital. One of the commendable features of the park management is the presence of a physician, whose services are at all times at the command of the patrons gratuitously.

The mountain scenic railway is the largest attraction on the grounds, and is one of the largest and finest scenic railways in the country.

A captive flying machine is one of the newest novelties. The machine consists of a central structure 100 ft. high, with two long



PLAN OF WILLOW GROVE TERMINAL LAYOUT



SPECIAL HARDENED STEEL T-RAIL SWITCH FOR WILLOW GROVE TERMINAL

extending arms, from which are suspended by cable ten boats or "airships" in which the passengers take their novel flight, and which, as the arms revolve, are carried outward and upward in widening circles by their own momentum.

The music pavilion is a large, cheerful and comfortable open-air pavilion, with an enclosed stage at one end for the use of the musicians. Under cover there is seating capacity for 4000 people, and outside there are enough seats within sound of the music to comfortably accommodate over 15,000 people. It is not an unusual experience on a pleasant Saturday or Sunday to find 25,000 people grouped around the pavilion enjoying the music. On Labor Day of the present year 52,000 people visited Willow Grove Park.

For those who desire refreshment or meals at the park there are ample accommodations. A superior restaurant service is given at the Casino, which is a modest building, finished entirely in white, located in close proximity to the music pavilion, and having spacious porches on which over 500 people may be served with meals at one time. The company handles the restaurant privileges itself, and the Casino is noted for the superior quality of the cuisine. In addition to the Casino there are two well-equipped light lunch cafes, one in the upper part of the park, where the amusements are located, and one in the lower part, overlooking the lake and in full view of the electric fountain. A well-equipped soda fountain is located in a separate building, which affords an attractive place not only for those desiring to allay their thirst, but to those wishing a place to rest, as ample accommodations in the way of benches and comfortable chairs are at the disposal of the patrons. For those desiring to take their own lunches there are three natural groves, in the midst of which are to be found fully equipped kitchens, tables, benches, hydrants and all conveniences, especially adapted for the use of picnic parties and excursions. The use of the groves and the appurtenances is free to all.

The ladies' building is in the center of a broad lawn dotted with large shade trees, and is set apart for the exclusive use and convenience of women. Everything is free and the visitor is made to feel at home.

For the park patrons in search of light and harmless amusement there is a beautiful Midway, which in novelty and attractiveness of amusement rivals the Midways of the recent world's exhibitions at Buffalo and St. Louis, but differs somewhat from those more or less renowned affairs in that no conduct of an unruly or boisterous nature is permitted, or, in fact, attempted. Willow Grove Midway is a broad, well-paved street, upon which are found many of the latest amusement attractions, including a mirror maze, photographic gallery, coal mine, old mill, two carousels, scenic railway and the Willowgraph Theater, in which are given exhibitions of moving pictures, including an entirely new assortment of comic, magic, historical and mystic trick film novelties. The Willowgraph takes the place of the vaudeville or operatic concerts usually found in street railway parks.

The park has its own hot houses, wherein are raised the shrubbery and plants used in the landscape gardening. During the summer the force of park employees numbers about 500.

Several up-to-date methods are used for advertising this resort. These include billboard posting, small standing ads. in all the leading papers in Philadelphia and the suburbs, handbills and display cards in the cars, and an attractive booklet, copies of which are distributed freely throughout the territory from which the park travel is drawn. A feature is made of setting aside certain days for special events or societies. For instance, during the past season, days were designated as "Sunday-school Day," "Christian Endeavor Day," "America Day," "Children's Day," "Independent Order of America Day," "Grand Army Day," etc. On Christian Endeavor Day the company printed and distributed free of cost a 24-page pamphlet containing the music and words for several of the favorite Christian Endeavor hymns, and a feature was made of the music and chorus singing at the music pavilion.

The park does not yield any profit to the Philadelphia Rapid Transit Company, but during the last few years has been practi-

cally self-supporting. It was not started by the present management, and it is doubtful whether the officials of the company would recommend the creation of such a property simply for the traffic which it attracts. As the property belongs to the company, however, the wise policy has been adopted not only of keeping up its standard in every particular, but also of reserving the management to its own employees, so that by no chance can any undesirable features creep into the park operation.

NEW LINE TO WILLOW GROVE

To afford the residents of North Philadelphia and Germantown a new direct route to Willow Grove, an entirely new line was built in the spring of the present year. The line starts at Second Street and Lehigh Avenue, in Philadelphia, and runs over the new route to the park, distant from this point about 8 miles. For a considerable portion of the way the new road runs on private right of way, and for 2 miles passes through a new 100-ft. street to the city limits. Beyond the city limits the road is laid with 90-lb. A. S. C. E. T.-rail on yellow pine ties placed on rock ballast. Power is taken from the Glenside and Willow Grove sub-stations.

OTHER PARKS

The Philadelphia Rapid Transit Company, in addition to Willow Grove Park, serves Fairmount Park, Woodside Park, Chestnut Hill Park, Central Park and other smaller parks and pleasure resorts, all of which have natural or artificial attractions of various sorts and enjoy a considerable local patronage.

WILLOW GROVE TERMINAL

Prior to the present year the terminal facilities at Willow Grove Park were not entirely satisfactory. Most of the lines serving the resort approached the park over what is known as "The Old York Road," and the situation required that they make a wide detour around the park. The unloading platform was at the north end and the lay-over sidings and loading platforms at the south end, the cars leaving the park near the same point at which they entered. The cars from Doylestown did not enter the grounds, but unloaded their passengers at a point at a considerable distance from the main attractions. The construction of the new Willow Grove line early in 1905, the cars on which approached the grounds from the south, necessitated the rearrangement of the terminal facilities and the occasion was taken to lay out a comprehensive terminal that would better accommodate the travel on all the lines.

A plot of ground irregular in shape, but approximately 1200 ft. long and 195 ft. wide, was secured, and after several different terminal arrangements had been discussed, the one illustrated on page 538 was finally adopted. The terminal property is located very near the music pavilion, so that passengers are not required to walk any very great distance to and from the cars. The location also has the advantage that the topography of the property and the approaches were such that the building of bridges or trestles was avoided, and although seven different lines enter the terminal there are no grade crossing either for cars or passengers. It was also possible to lay out separate and commodious loading and unloading platforms and ample lay-over tracks.

The lines entering over the Old York Road were deflected from the former circuitous routes and are now led into the park on the eastern side of the turnpike. The new Willow Grove line is built on private right of way and enters the terminals by a nearly direct course.

The terminal property was graded so as to give room for a subterranean passageway crossing under all of the tracks at a point near the center of the property and connected to the loading and unloading platforms by inclined subway passages. The main cross passageway has a minimum head room of 8 ft. and is 36 ft. wide in the widest part. The side walls are formed of mass concrete and the roof is built of I-beams on which are laid concrete slabs with layers of waterproofing material on top.

A center line of posts and iron fence divides this main passageway in halves longitudinally, one half constituting the entrance and the other the exit passageway.

There are two unloading platforms and two loading platforms. These are connected to the main cross passageway by long slopes, each 18 ft. wide. There are no steps for passengers to ascend or descend. The floors of the inclined passageway rise on a grade of about 8 per cent. and are paved with vitrified brick. The side walls of the inclined passageways are also of mass concrete.

These passageways are used by passengers from all the cars with the exception of the lines from Doylestown, which are taken into the park over the top of the tunnels and load and unload at a separate platform, also located near the music pavilion.

As will be understood from the diagram showing the lay-out, the cars in every case pass directly to the unloading platforms and then enter the lay-over tracks where they lie until required. The cars are dispatched empty from the exit ends of the lay-over tracks and pass directly to the loading platforms. These loading platforms are arranged with fences and exit gates leading to pens, each pen constituting a berth for a particular line of cars. Over each exit gate is an illuminated sign indicating the destination of the cars stopping at the particular gate. The arrangement gives excellent control over the crowds and avoids any wild rush and scramble for seats, as passengers are admitted to the pens only in numbers as can be accommodated by the number of cars at the stand.

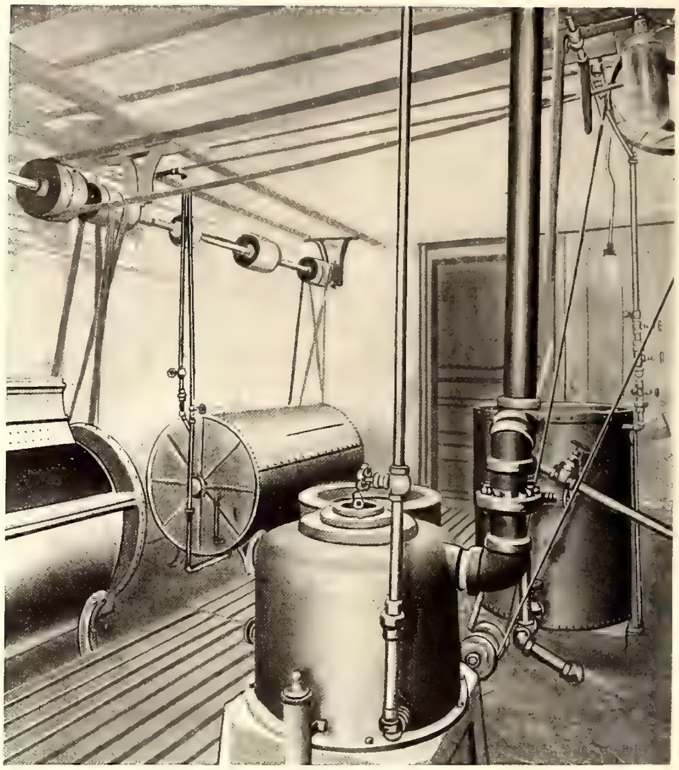
The switches leading into the lay-over tracks are of special design to meet the exacting conditions. All of the switches are made of hardened steel and are designed to accommodate M. C. B. standard car wheels. The switches at the ends of the lay-over tracks are operated by switch stands and levers from a small switch house located near the entrance, so as to enable the man at the levers to readily see the route signs on the cars as they approach. The leaving ends of the lay-over tracks are controlled by ground throw switches having the usual spring attachment, so cars can trail through without throwing the lever. The frogs are hardened steel center construction and the track is laid with 90-lb. T-rail, A. S. C. E. section. All the track layouts in the terminal were constructed and furnished by the Lorain Steel Company.

A commodious building for the use of conductors and motormen was built adjoining the lay-over tracks. The building is constructed entirely of concrete. As many as an average of 5000 people per hour have been handled at the terminal on special days.

INTERIOR OF COMPANY'S CHEMICAL TESTING LABORATORY

INTERIOR OF LOST AND FOUND DEPARTMENT, SHOWING BINS AND UMBRELLA RACKS

A CORNER OF THE COMPANY'S TYPE COMPOSING ROOM



LAUNDRY FOR CLEANING OILY WASTE AND COMMUTATOR RAGS

INTERIOR OF COMPANY'S PRINTING ESTABLISHMENT

PANORAMA OF LOWER END OF WILLOW GROVE, SHOWING ELECTRIC FOUNTAIN AND MUSIC PAVILION IN DISTANCE

THE MIDWAY AT NIGHT, WILLOW GROVE PARK

Plate XLIV

PART OF WILLOW GROVE MIDWAY

PANORAMA OF WILLOW GROVE, SHOWING TERMINAL TRACKS AT RIGHT

WILLOW GROVE TERMINAL, SHOWING GATES AND INDICATING SIGNS ON LOADING PLATFORMS

GENERAL VIEW OF WILLOW GROVE TERMINAL

LOOP AND LAY-OVER TRACKS AT WILLOW GROVE TERMINAL

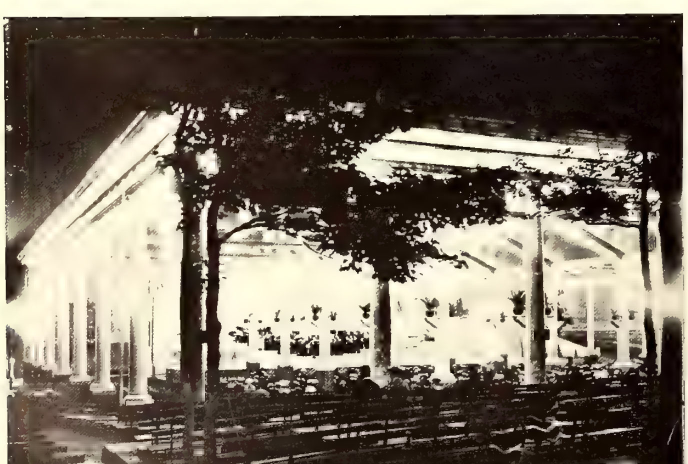
ENTRANCE TO UNDERGROUND PASSAGEWAY AT WILLOW GROVE TERMINAL

BUILDING FOR CONDUCTORS AND MOTORMEN AT WILLOW GROVE TERMINAL

HARDENED STEEL SWITCHES AT ENTRANCE TO WILLOW GROVE TERMINAL

THE TWO LAKES AT WILLOW GROVE PARK

ELECTRIC FOUNTAIN AT WILLOW GROVE



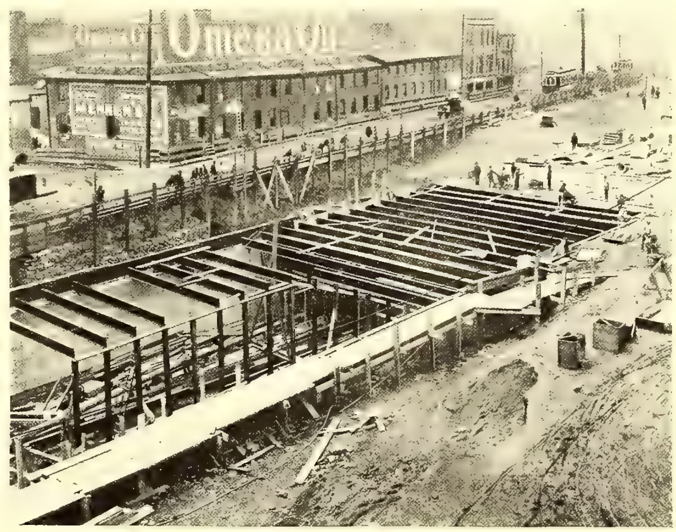
WILLOW GROVE MUSIC PAVILION

THE WILLOW GROVE CASINO

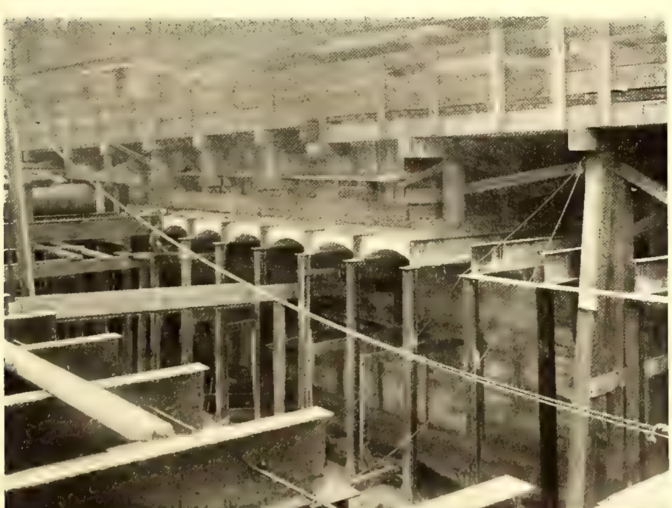
COMMENCING EXCAVATION WORK ON SUBWAY TRENCH

VIEW SHOWING METHOD OF SUPPORTING TEMPORARY TRACK FOR SURFACE CARS, 12-IN. CITY HALL WATER MAIN SUPPORTED AS SHOWN

SURFACE VIEW OF SUBWAY DURING CONSTRUCTION, SHOWING PLANKING OVER PART OF ROOF TO FORM PLATFORM FOR UNLOADING TEAMS

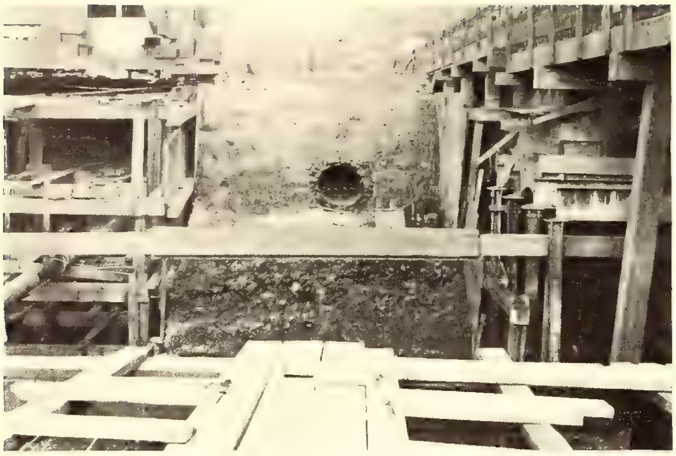


VIEW SHOWING SUBWAY ROOF CONSTRUCTION BEFORE CONCRETE WAS IN PLACE



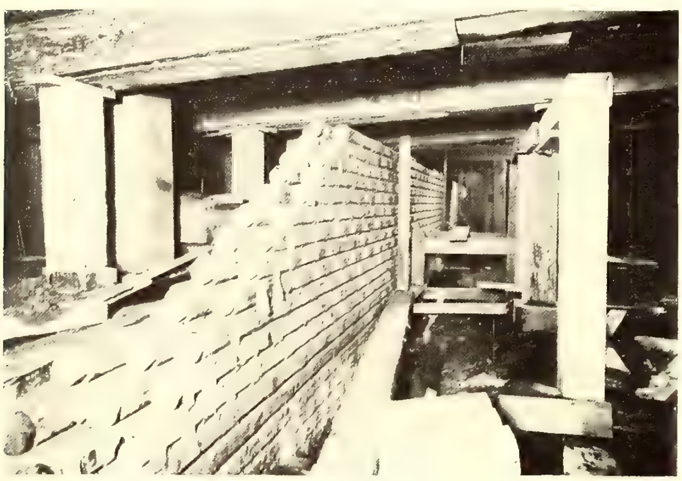
PARTIALLY COMPLETED SECTION OF SUBWAY, SHOWING GIRDERS AND ROOF AND METHOD OF CARRYING STREET TRAFFIC DURING CONSTRUCTION

VIEW SHOWING SUBWAY ROOF CONSTRUCTION



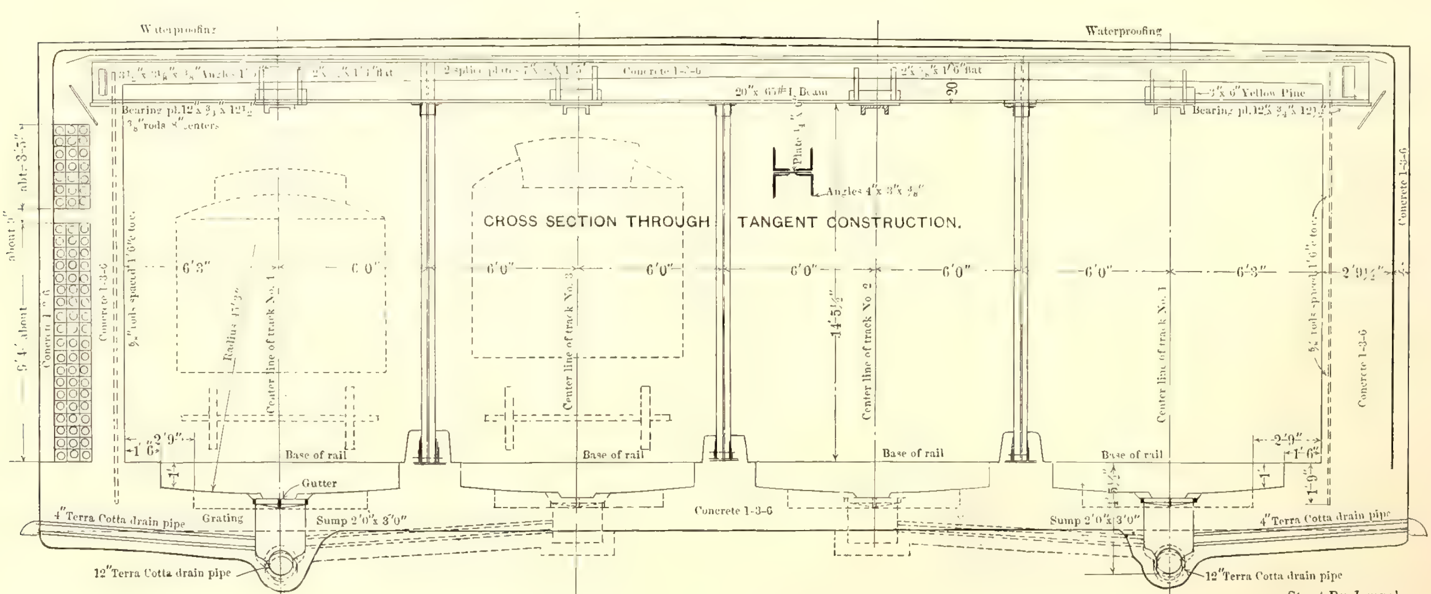
VIEW OF SUBWAY TRENCH, SHOWING CORE ENCLOSING SEWER REMAINING TO BE EXCAVATED

REINFORCED CONCRETE SEWER, BUILT TO REPLACE OLD SEWERS IN LINE OF SUBWAY UNDER MARKET STREET



TERRA COTTA DUCTS TO CARRY CABLES BELOW SUBWAY STATION

TYPICAL VIEW IN SUBWAY BEFORE TRACKS WERE LAID

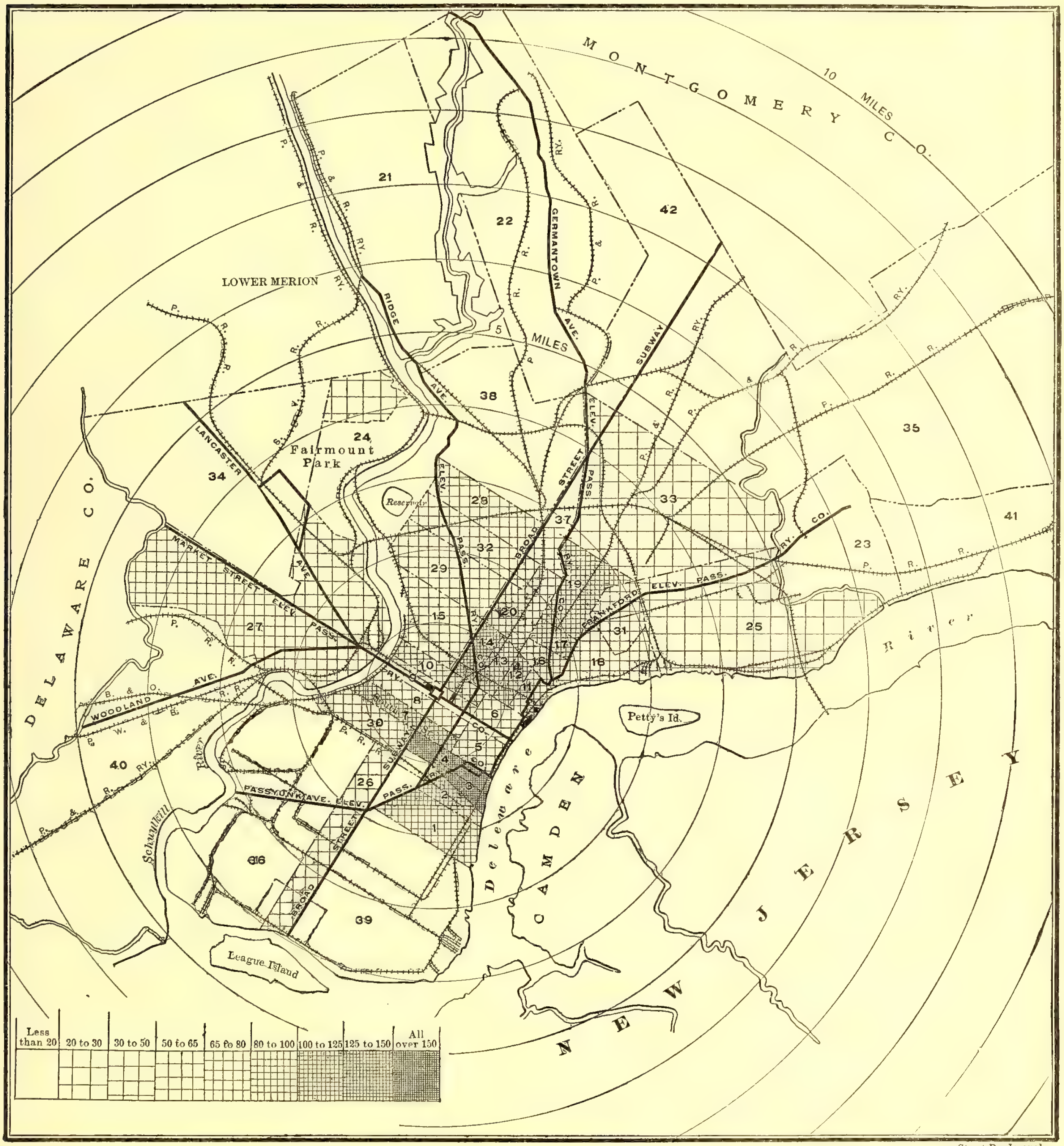


TYPICAL CROSS-SECTION THROUGH SUBWAY

THE SUBWAY AND ELEVATED LINES IN PHILADELPHIA

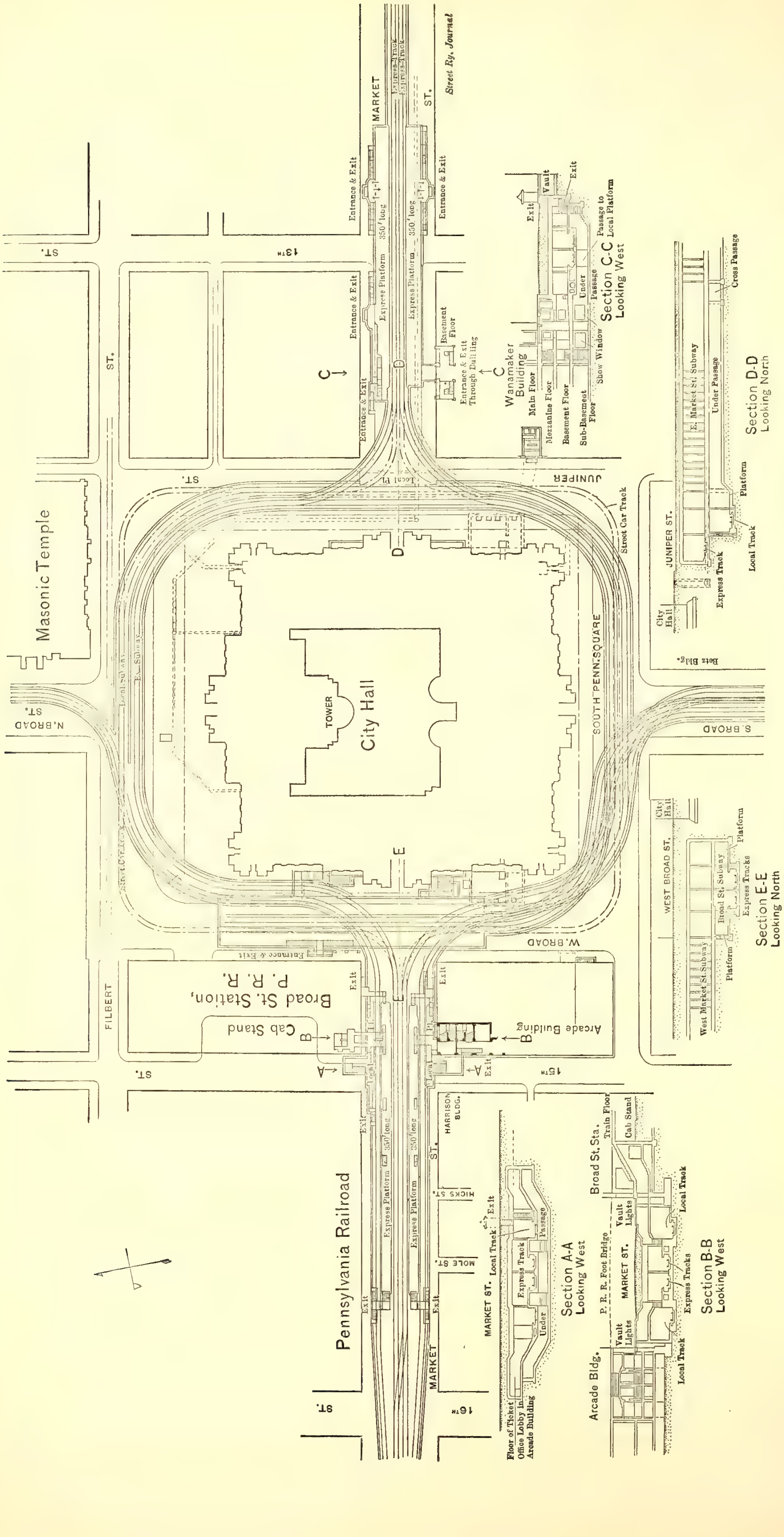
As has been briefly pointed out in the previous articles in this issue, the traffic in the central portions of the city within recent years has grown beyond the capacity of the street railway lines to handle it. For instance, cars are now being operated on Market Street on 30 sec. headway during the rush hours, and inasmuch as the maximum length of car has been reached, the present lines on this street can no longer be relied upon to meet the future increase in traffic, nor for that matter to fill the present demands.

In 1901 the State Legislature passed an act sanctioning the incorporation of elevated and subway rapid transit companies, and the Philadelphia Councils granted franchises for several projects, including elevated lines on Market Street, Ridge Avenue, Frankford Avenue, Passyunk Avenue and Germantown Avenue, and subways under Broad Street. By ordinance passed in 1902 the Councils authorized the building of a subway on Market Street east of the Schuylkill River, this subway to take the place of the elevated road on Market Street as contemplated in the original franchises. In October, 1902, the charter was amended to provide for the construction of a loop subway from City Hall south on Broad Street to Walnut Street, thence east



Street Ry. Journal

MAP OF PHILADELPHIA, SHOWING DENSITY OF POPULATION PER ACRE BY WARDS, AND PROPOSED ELEVATED AND SUBWAY RAPID TRANSIT LINES



PLAN OF SUBWAYS TO BE BUILT AROUND CITY HALL

on Walnut Street to Fifth Street, thence north on Fifth Street to Arch Street, thence west on Arch Street to Broad Street, thence south on Broad Street to Filbert Street, thence on Broad Street south to City Hall.

All of these franchises were subsequently acquired by the Philadelphia Rapid Transit Company, and a broad scheme for giving genuine rapid transit facilities in conjunction with the existing surface lines was formulated.

Anxious not only to demonstrate the feasibility of the plans under discussion, but also to afford the much needed relief for the badly congested lines, the company decided to build the first section of the rapid transit route in West Market Street, commencing as a subway at the west side of the City Hall in front of the Pennsylvania Railroad Broad Street Station and running under Market Street due west to the Schuylkill River, thence by a bridge over the river and continuing as an elevated structure on Market Street to Sixty-Third Street. The line will primarily serve the newer sections of the city west of the Schuylkill River known as West Philadelphia, which is rapidly becoming one of the chief residential districts, and secondarily in conjunction with the loop subways around the City Hall and thence east to the Delaware River will relieve Market Street of its present surface congestion.

To show the need

of relief on the busy streets, the condition on that section of Market Street running east of Ninth Street may be cited as a single illustration. During the morning and evening hours 104 cars are scheduled to pass a given point in this section per hour in each direction, or 208 cars on the two tracks. The schedule headway is 34 sec. on each track and is disarranged by the obstruction of street traffic. The schedule speed in the locality referred to is about 600 ft. per minute, or 6.8 miles per hour. The speed between the termini is about 700 ft. per minute, or about 8 miles per hour.

The relief afforded by the operation of trains in the subway at points on the system where the traffic is now, or will in the future, equal the volume in the locality referred to may be considered as follows:

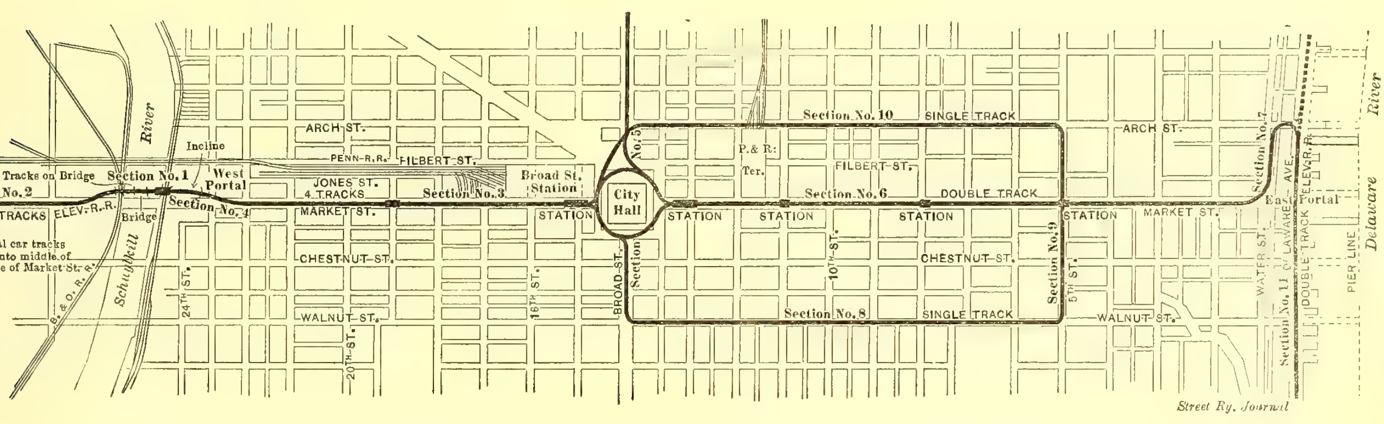
The volume of traffic passing an assumed point, based on the seating capacity of the present surface cars, is 3936 passengers per hour. The number of passengers passing a given point in an hour in the subway based on six-car trains seating 50 passengers each on two-minute headway is 9000 per hour, so that the relief to be afforded by the subway with two-minute headway between trains may be represented as 230 per cent; with 1½-minute headway it will equal 307 per cent.

It may be of interest to state that the number of passengers

WEST MARKET STREET SUBWAY

The West Market Street section of the subway now nearing completion includes provision for four tracks, the two outer tracks to receive the regular surface cars from West Philadelphia and the two inner tracks to receive the trains from the elevated railway, extending west on Market Street from the Schuylkill River to a terminal west of the county line near Sixty-Third Street. As before stated, the connection between the West Market Street elevated structure and the Market Street subway is made on inclined tracks across the bridge over the Schuylkill River. According to the plans for extensions east of the City Hall terminal of the West Market Street subway, the two outer tracks for surface cars will connect by a subway loop around the business districts by Walnut, Fifth and Arch Streets, so that the cars bound east will run on the south outside track and return to the west by the north outside track. The two inner tracks reserved for trains will be connected with a subway under East Market Street extending to a point between Water and Front Streets, and thence by an incline between the two latter streets to Arch Street, where connection will be made to an elevated structure leading to and on Delaware Avenue.

The four-track subway is now practically completed from Sixteenth Street near the City Hall west to a point near the Schuyl-



PLAN OF OUTER AND INNER SUBWAY LOOPS IN DOWNTOWN DISTRICT

per hour during the rush hours morning and evening has been found on the elevated railways in New York and Chicago to reach as high as 6.96 times the average number of passengers per hour for the entire 24 hours. Although this is perhaps an exceptionally high figure, the average for a number of points where passengers have been counted is between three and four times the average number per hour for the entire twenty-four hours.

The tendency of increased facilities for travel to reduce the density of population around the business centers and increase that of the outlying districts is shown in the map on page 541, which gives the distribution of population per acre by wards. The wards in the business district have been reduced during the past few years in residential population by percentages ranging from 5.7 per cent to 44.3 per cent. The only ward that may be considered a central ward which shows an increase is the Fifteenth, located near the Schuylkill River, where the population has increased 5.2 per cent. In contrast with the depopulation of the downtown districts as residential sections, the increase in the outlying wards has been very marked, that in the Twenty-Eighth amounting to nearly 318 per cent, in the Twenty-Fifth to 224 per cent, and in the Twenty-Second to 124 per cent.

The same map shows the subway and elevated rapid transit lines contemplated and under way by which the congestion of surface street traffic in downtown districts will be relieved, and means of quick transportation provided between the rapidly growing outlying wards and the center of the city.

kill River. This section has a width of 48 ft. 6 ins. in the clear between walls and is 14 ft. 6 ins. high in the clear above the base of the rails. Three intermediate lines of columns support the roof, which is designed to carry the heaviest street traffic likely to be imposed upon it for many years to come.

The roof is formed of concrete arches supported on steel I-beams 5 ft. apart placed across the subway. The side walls are of concrete, reinforced with steel rods, and the floor is of concrete alone.

Terra cotta ducts with manholes at frequent intervals are built in the south wall, forming the conduits for feeder cables carrying current for the operation of the railway and for lighting the subway and stations.

The roof over its entire length is waterproofed with asphaltic mastic 1 in. thick. The side walls are waterproofed where necessary with layers of burlap coated with a compound consisting of the residuum from the refining of petroleum.

For the most part the line of the subway lies in earth and gravel, very little rock formation having been encountered. But a more or less serious problem was brought into the work by reason of the presence of inflowing ground water between Twenty-First and Twenty-Third Streets, the gravel bed in many places being thoroughly saturated. To take care of this sub-surface water and insure perfect underdraining for all time to come, there were laid two lines of terra cotta pipe, one under each outside track, with lateral drains passing to the exterior of the side walls every 50 ft. The main drains lead in each direction to the low point at Twenty-

Second Street, where a well or sump collects the contents of the drains. A pumping station is operated in conjunction with the sump, and the water is discharged into a sewer by electrically driven centrifugal pumps regulated automatically by floats. The conditions as to under drainage permitted the placing of these longitudinal sub-drains below the floors of the subway, and by this means any appreciable head of water against the side walls is prevented, thereby increasing the dryness of the structure and permitting the omission of the waterproofing on the parts of the side walls where they had been made thick to promote facility of construction.

Ground was broken for the subway work on April 6, 1903, at Twenty-Third Street and Market Street, to begin the reconstruction of the sewerage system which necessarily preceded the work on the subway proper. The most important feature of this work involved making provision for a large sewer main running under Market Street, which intercepted the drainage from all of the cross streets to the south. To replace this trunk main, an entirely new sewer ranging from 3 ft. to 4 ft. 9 ins. in diameter was built just outside the south wall of the subway. This sewer was built wholly of reinforced concrete with the invert lined with brick. Other less important cross and lateral sewers and water mains were deflected outside the line of the subway or, when necessary, were replaced by lines on other streets.

There were also lines of underground conduits containing telephone and lighting wires for which provision had to be made. Prior to the beginning of construction, contracts were made with the companies owning these conduits permitting the alterations and re-adjustments required by the subway construction. The conduits of the Bell Telephone Company were re-laid on Arch Street, a parallel thoroughfare, while provision was made for a portion of the conduit system of the Keystone Telephone Company in the south wall of the subway proper, the remaining portion being re-laid on the north side of Market Street in practically the original position.

The work also included the widening of Market Street on the north side west of Twenty-Second Street, raising the grade of Market Street about 12 ft. at its intersection with Twenty-Third Street, repaving the driveways and sidewalks, and also raising the grades and repaving the adjacent streets to meet the revised grade of Market Street.

The raising of the grade of Market Street was necessary to allow the subway tracks to make the ascent to the Schuylkill River bridge and pass over the tracks of the Baltimore & Ohio Railroad along the east bank of the river. The grade of the railway on the ascent was established at 5 per cent and the roof of the subway is about 9 ft. above the old surface of Market Street at its intersection with Twenty-Third Street, and about 3 ft. below the present surface of Market Street.

Contract for all of this work was carried out by the E. E. Smith Contracting Company.

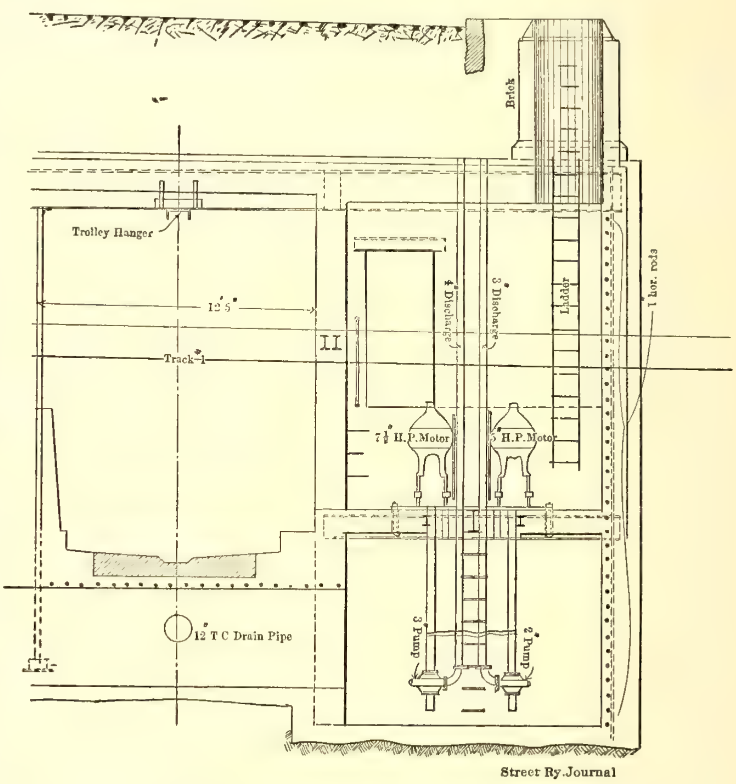
All of this work has been managed to make as little interference as possible with the street traffic, the street railway cars on West Market Street having been kept in operation without any interruption. The space between the car tracks and the nearest curb on one side of the street was always kept open for travel, the work being confined to one side of the street at a time. In general, the cut and cover method was pursued in building the subway, and the work was carried out in three stages, as follows:

(1) The south shoulder of the street was first trenched to a sufficient width to allow the building of the main sewer and a longitudinal section of the subway approximating one-quarter of the full cross section, to include one track. The street was then back-filled and repaved.

(2) When the closing up of the south side had progressed for about two blocks, the operation was repeated on the north shoulder and the floor and side wall built. The top was left uncovered on the north portion until a later period to facilitate the removal of material from the middle section or core.

(3) The middle section, or core, under the street car tracks was the last to be taken out, following the construction of the wall and floor for the north track. To support the surface tracks during the removal of the core beneath, stringers had previously been placed under the rails and a plank floor laid upon them for the full width of the track bed. Upon the plank flooring the block paving was replaced, practically maintaining the original surface conditions over the excavation. Posts placed under the stringers as the excavation advanced supported the tracks until the permanent steel roof beams could be slipped into position, the columns supporting them having previously been set in place. The weight of the tracks was then transmitted to the steel beams by means of blocking. Upon the removal of the core, the north and middle sections were roofed over, completing the full cross section of the subway. The back-fill and the repaving followed, restoring the street to its original condition.

The center line of the subway coincides with the center line of Market Street to a point 47 ft. west of Twenty-Second Street,



SECTION THROUGH PUMP CHAMBER AT TWENTY-SECOND AND MARKET STREETS, FOR LIFTING WATER FROM DRAINAGE SUMP IN SUBWAY

where it deflects to the north on reverse transition curves to meet the bridge over the Schuylkill River, the center line of the bridge being 100 ft. north of the center line of the present city bridge which carries Market Street over the river to West Philadelphia. The western end of the covered subway terminates at the portal about 137 ft. west of Twenty-Third Street, from whence the railway ascends to the bridge between retaining walls of concrete.

The stations on the West Market Street section will be located respectively at Fifteenth Street, Nineteenth Street, and at the end of the Schuylkill River bridge near Twenty-Fourth Street, the latter station designed to make connection with the Baltimore & Ohio Railroad. Stations at Nineteenth Street and Twenty-Fourth Street are intended for the regular surface cars operating on the two outer tracks of the subway. At present the Fifteenth Street station, which is just west of the City Hall, will be used temporarily as a terminal station with cross-overs until the eastern sections of the subway are completed. The stations intended for the single cars have short platforms, capable of accommodating two or three cars at a time. At the Eighteenth Street station, which will be used by both the trains and single cars, island platforms will be

built with concrete passageways above and underneath the tracks to connect the different platforms.

The roadbed in the subway will be laid with 90-lb. T-rails. The two inner tracks will each have a third rail, the exact location of which at this writing has not been decided upon. The two outer tracks for the use of the surface cars will have an overhead trolley.

It may be of interest to note the basis upon which the subway structure has been designed in order to carry the various loads imposed. In arriving at the dead-load allowance was made for the heaviest pavement liable to be placed, viz.: granite blocks on 6-inch concrete base. The weight of this pavement allowing for depth of 15 ins., which includes a 3-inch sand cushion under blocks, is 175 lbs. per square foot. The weight of the earth is taken at 110 lbs. per cubic foot, below the base of the pavement. The total dead weight resting on the top of the roof thus varies between 260 lbs. per square foot for 2 ft. cover up to 1140 lbs. for a 10-ft. cover, and proportionately for other depths. The minimum cover above the top of the roof is 4 ft., except in special cases, and the maximum, as far as the work has progressed up to this time, is between 9 and 10 feet.

The roof, including concrete steel slabs, metal girders at the stations, sidewalks, columns, etc., are proportioned by the following live loads:

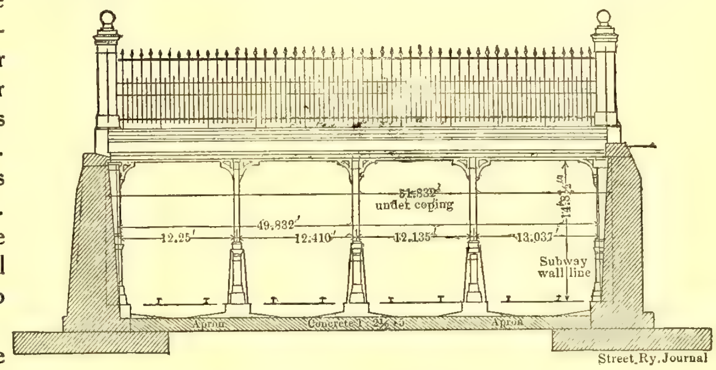
The concentrated load consists of 10 tons on each of four wheels, making 40 tons in all, 20 ft. between axles, and gage of 5 ft. This load is considered distributed by the pavement and the earth, between the pavement and the roof. In this distribution, equivalent loads for simplicity of computation are worked out so that each of the two pairs of wheels is replaced by a rectangle loaded with a load equivalent to the weight on the wheels. These rectangles are the same distance center to center as the axles, namely, 20 ft. The equivalent distributed load on the said rectangles varies from 1180 lbs. per sq. ft. for a 4-ft. cover to 200 lbs. per sq. ft. for a 16-ft. cover—the loads for intermediate covers varying, though not directly with the depth. Where the cover is 3 ft., the load is 1330 lbs per sq. ft. Special shallow construction is treated as each individual condition makes necessary. In addition to the foregoing concentrated loads, a general load of 200 lbs. per sq. ft. is applied exterior to a space 30 ft. long and 11 ft. wide, placed symmetrically to the concentrated load, the greater length parallel with the longitudinal axis of the latter.

The foregoing loads are applied so as to produce the maximum effect on any member of the construction. The concentrated load used in this work is in accordance with experience in Philadelphia covering a number of years, and is considered an adequate allowance for the heaviest loads liable to be transported about the streets.

The lateral pressure on the sidewalls consists of two parts, namely, the dead weight of the material exterior to the walls, and a superficial load taken as 200 lbs. per sq. ft. The pressure on the walls is computed by the theory of earth pressure as developed by Rankin. The co-efficient by which the pressure is determined varies in the different soils, and is based on experience in dealing with the soils in this city.

In special cases where the work approaches closely to heavy buildings, the weight of the latter are considered in determining the strength of the walls, as there is no rock above the floor of the subway except in very few places.

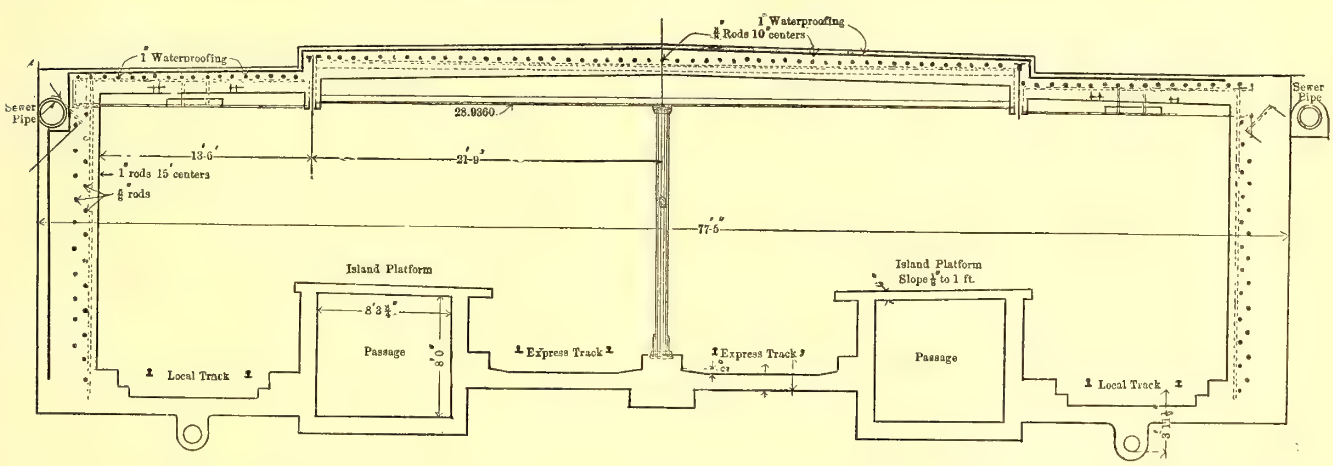
Where continuous masonry structures, such as manholes, or other street appurtenances are founded upon the roof of the subway, by which the estimated distribution of the concentrated loads would be partly vitiated, grillages will be placed in special cases to insure proper distribution to correspond with the allowed loads.



ELEVATION OF WEST PORTAL TO SUBWAY

VENTILATION

Provision has been made for ventilating the subway by building chambers along the sides with connections to the outer atmosphere so arranged that fans may be installed if found necessary. There are six of these chambers on the section between the City Hall and the Schuylkill River, and at Twenty-Second Street a ventilating stack is under construction designed to give a natural draft and provide an outlet for the foul air. At the base of the stack provision has been made for the installation of a fan if necessary. The stack is built of masonry work and is 60 ft. high and 8 ft. 4 ins. in diameter. In arranging the ventilating chambers and ducts previously mentioned, advantage was taken of the fact that the north side of the subway extends in close proximity to the Pennsylvania Railroad freight buildings along Market Street. The ventilating ducts from the air chambers are brought up against the piers of the Pennsylvania buildings in the form of masonry stacks, the stone facings of these stacks corresponding in material, workmanship and finish to the wall of the Pennsylvania Railroad buildings to which they abut. These ventilation stacks will be of concrete, reinforced with horizontal and vertical Thatcher rods, following the general construction pursued in building the subway walls.

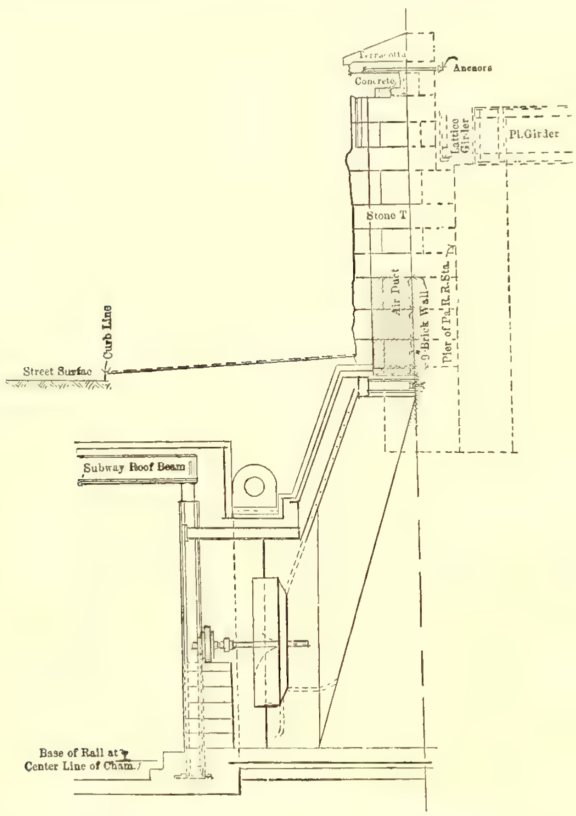


SECTION THROUGH SUBWAY STATION AT FIFTEENTH STREET, SHOWING ISLAND PLATFORMS

In arriving at a basis as to the quantity of air required to properly ventilate the subway, an estimate was first made of the number of passengers that will use the subway at one time, and the scheme of ventilation has been laid out to allow for completely renewing the air four times per hour, taking 1800 cu. ft. of fresh air per person per hour as the requirement. It is believed the system of having several comparatively small ventilating ducts connecting with the outside air will give better results than would be secured by admitting the air through fewer large openings. The distribution of the air between ventilating chambers will be accomplished mainly by the plunger-like motion of the cars. If the circulation due to the movement of cars and trains, accentuated by the 60-ft. ventilating stack at Twenty-Second Street, is not found sufficient, motor-driven fans will be placed in as many of the ventilation chambers as may be found necessary.

SCHUYLKILL RIVER BRIDGE

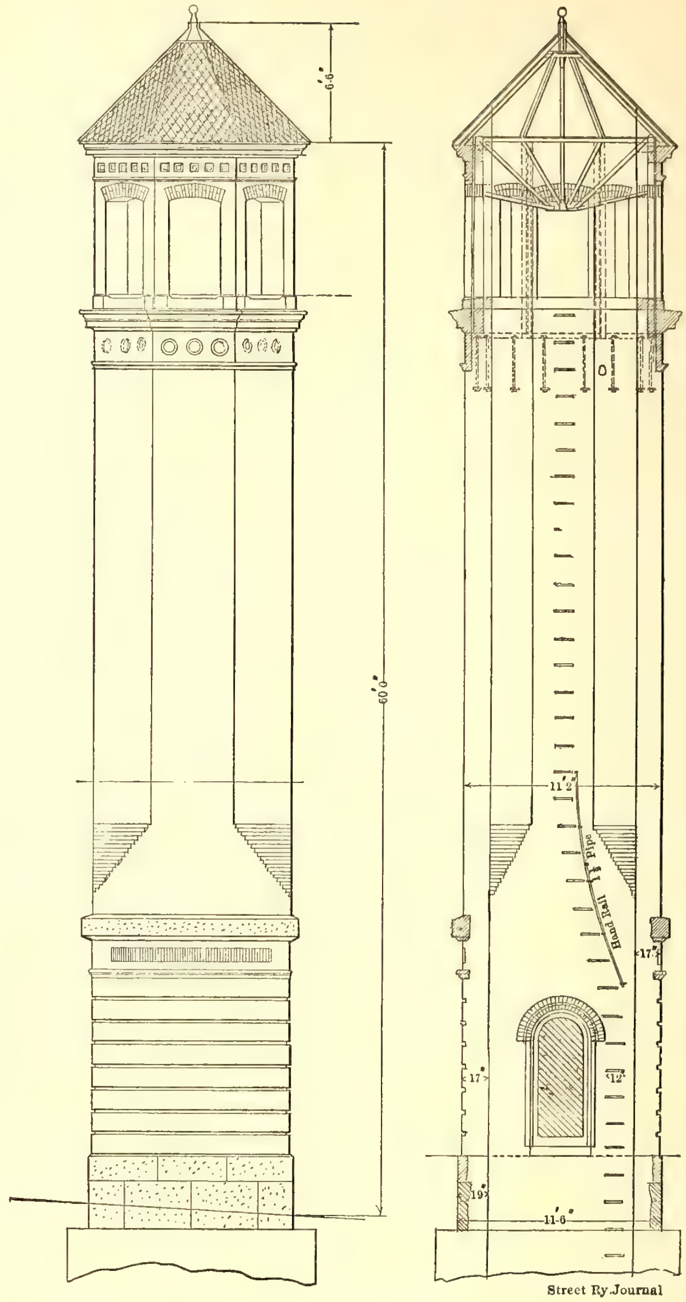
The bridge upon which the subway tracks cross the Schuylkill River called for a design somewhat out of the ordinary, inasmuch as it was necessary to carry the two inner tracks on an ascending grade of about 4 per cent from the east to the west so as to bring



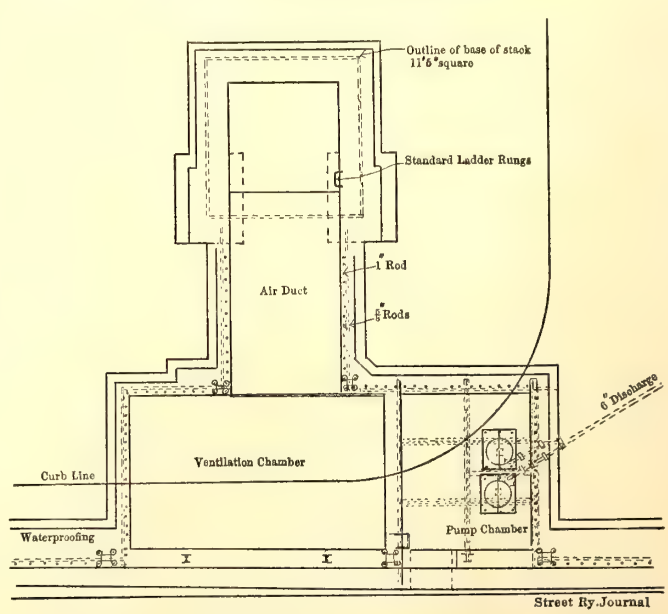
SECTION THROUGH SUBWAY VENTILATING DUCTS ALONG PENNSYLVANIA RAILROAD BUILDINGS

the trains from the subway level on the east bank to the level of the elevated structure on the west bank; and to carry the two outer tracks on a descending grade of 2.34 per cent from the west river pier to the ground surface at the west end of the bridge.

Beginning at the easterly approach, the superstructure consists of a plate girder approach span; a 98-ft. through Pratt truss; a 214-ft. truss with curved top, which is the main river span; a 90-ft. Pratt truss, and an 82-ft. plate girder approach to the west shore. The cross sections of the bridge reproduced on Plate XLIX. show the gradual divergence of the inner tracks and outer tracks at the centers of the respective spans. It will be noticed that the bridge structure begins at the eastern end just beyond the incline leading from the subway portal with the four tracks on the same level, but reaches the west end as practically a double-deck structure with the two inner tracks 22½ ft. above the side tracks designed to carry the surface cars. The piers and abutments of the bridge are of stone founded on bed rock, with the exception

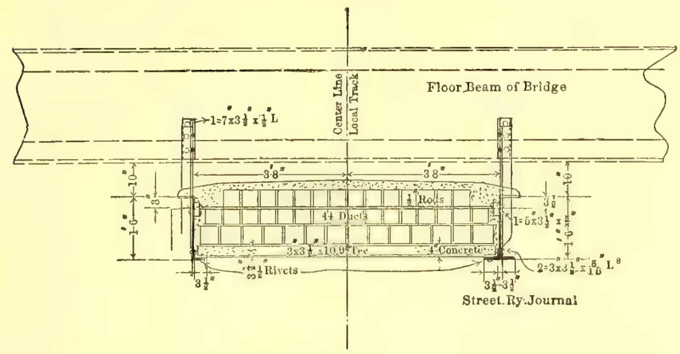


DETAILS OF SUBWAY VENTILATING STACK AT TWENTY-SECOND AND MARKET STREETS



PLAN OF VENTILATION CHAMBER AND BASE OF VENTILATING STACK

of the west abutment which rests on a pile foundation. Five pneumatic caissons were used in founding the piers. The total length of the bridge is 563 ft. and the under clearance at mean



METHOD OF CARRYING CABLE DUCTS ACROSS THE SCHUYLKILL RIVER BRIDGE

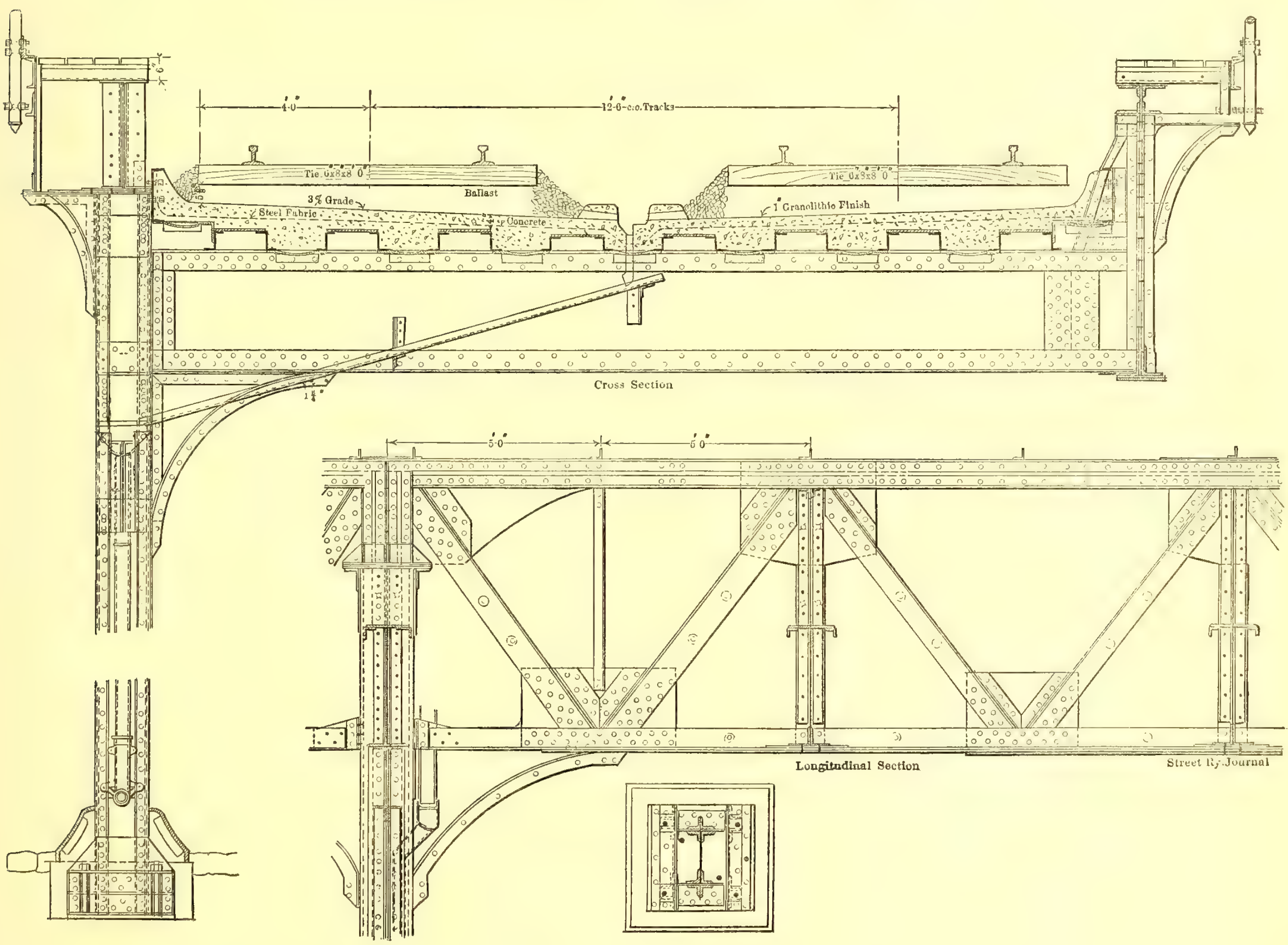
high water is 28½ ft. The bridge was built and erected by the American Bridge Company.

Provision is made for carrying the power and telephone cables across the bridge by continuing the bank of conduits running through the south wall of the subway under the floor system of XLIX., the bank of conduits is carried under the outside tracks to the west end of span No. 3, where the conduits run into a junction house and pass from the outside tracks to the two inner tracks, the conduit for the rest of the way being supported beneath the two inner tracks, at the level of the outer tracks.

ELEVATED STRUCTURE

The ordinance authorizing the elevated railway called for a structure with a closed floor system, so that no drippings would fall from the elevated railway into the street. To meet this requirement, and also to reduce the noise to a minimum, the structure has been designed with a steel deck extending clear across the structure and covered with a bed of concrete under the roadbed. Where the concrete bed is deposited against vertical or inclined surfaces, the concrete is locked to such surfaces by stud bolts upon which wire is wrapped, the intention being to secure the benefit of the protection of the concrete and diminish the liability of its shaking loose and permitting water to percolate through and produce corosion.

Where the railway is on a grade of one per cent or over, there has been placed a longitudinal gutter between the tracks parallel to the grade of the structure. Where the grade is less than 1 per cent, the gutter is provided with a grade of not less than 1 per cent by local inclination between the column bents. The

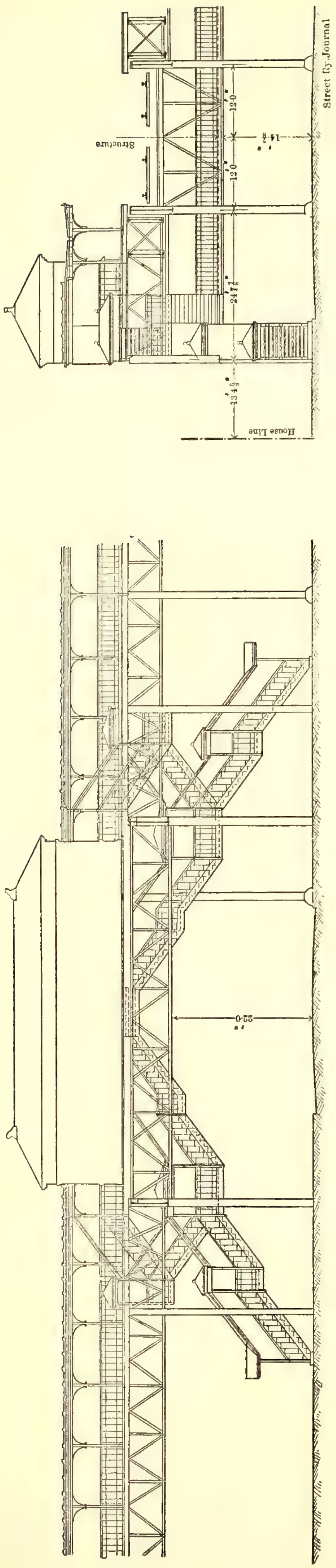


DETAILS OF ELEVATED STRUCTURE ON WEST MARKET STREET ELEVATED RAILWAY

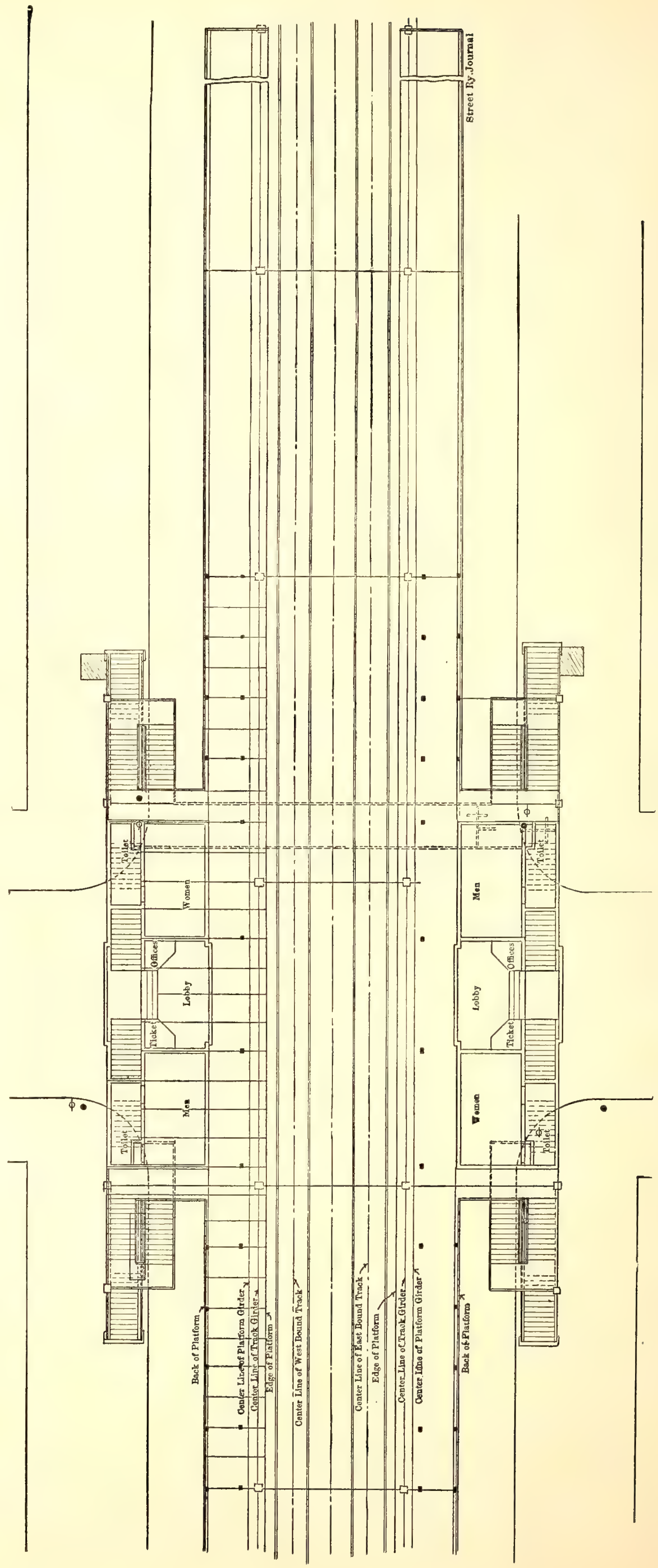
the bridge. The conduits are supported between special steel stringers and are covered with a concrete casing, the entire structure being hung from the bridge floor system by special hangers, as shown in the detail drawing on this page. The concrete floor between the stringers supporting the lines of conduits is reinforced by wire cloth. As will be noticed from the drawings on Plate

drainage water is delivered to collector boxes secured to the columns, from whence it is discharged below. A bed to confine the ballast transversely and maintain alignment is made by a dam between the guard in the center of the structure and the rails, and also by a facia channel on the ouside of the structure.

The tracks comprise the ordinary cross tie construction with a

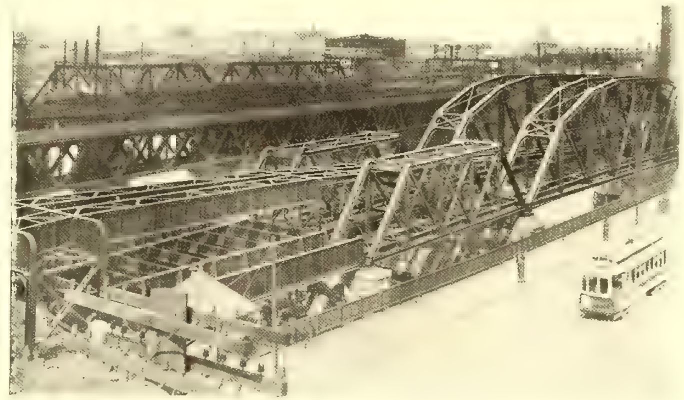


ELEVATION AND SECTION OF TYPICAL STATION ON WEST MARKET STREET ELEVATED RAILWAY

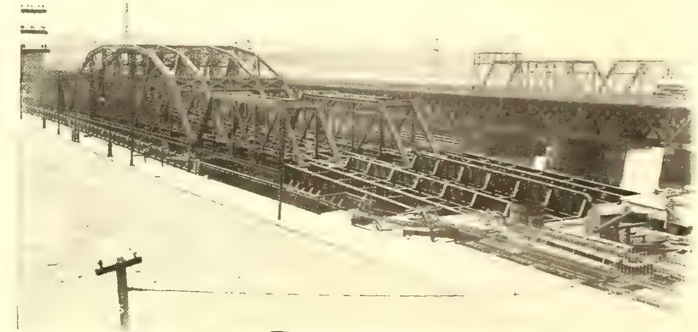


PLAN OF TYPICAL STATION ON WEST MARKET STREET ELEVATED RAILWAY

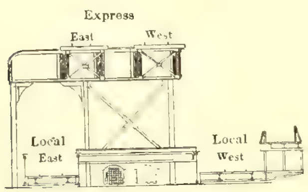
SCHUYLKILL RIVER BRIDGE, LOOKING EAST, SHOWING ELEVATED TRACKS IN CENTER AND SURFACE TRACKS AT SIDE



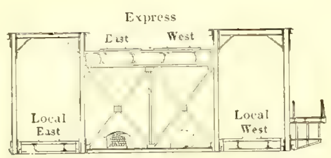
SCHUYLKILL RIVER BRIDGE, LOOKING NORTHEAST



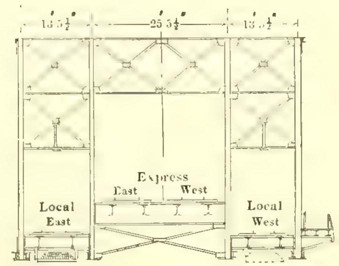
SCHUYLKILL RIVER BRIDGE, LOOKING WEST, SHOWING ELEVATED TRACKS ON INCLINE IN CENTER, AND SURFACE TRACKS AT SIDES



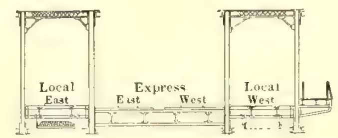
Section at Span 5



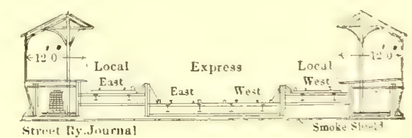
Section at Span 4



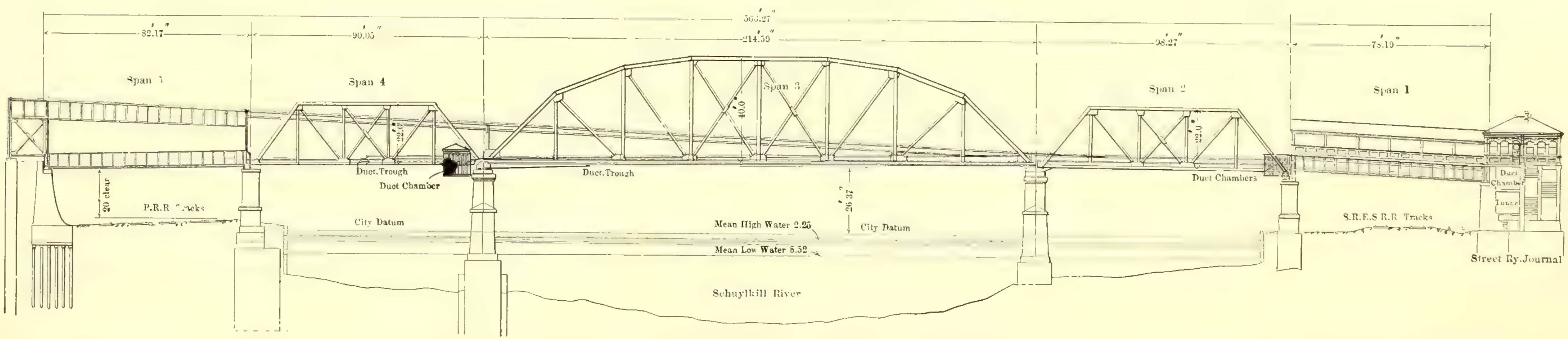
Section at Span 3



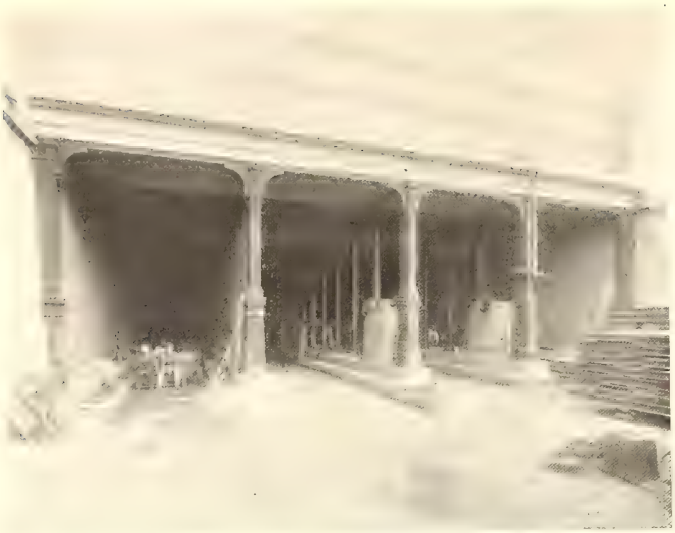
Section at Span 2



Section at Span 1



ELEVATION AND SECTIONS OF NEW SCHUYLKILL RIVER BRIDGE CONNECTING THE SUBWAY ON THE EAST END WITH THE ELEVATED STRUCTURE AND SURFACE TRACKS ON THE WEST END



VIEW OF WEST PORTAL TO SUBWAY

STARTING WORK ON WEST MARKET STREET ELEVATED STRUCTURE

VIEW TAKEN EARLY IN SEPTEMBER OF THIS YEAR, SHOWING FIRST SECTION OF ELEVATED STRUCTURE ON WEST MARKET STREET

minimum of 5 ins. of ballast under the ties, the ballast resting directly on the concrete bed. The third rail will probably be placed between the inside rails and will be fed by feeders passing through pipe apertures extending through the concrete. Where the grade is 2 per cent or over, transverse ridges are placed in the concrete bed at right angles to the track to prevent creeping.

A feature of the deck construction is a special curved plate comprising the bottoms of the steel troughs, by which such water as may percolate through the concrete is delivered to the middle, from whence it escapes through holes punched at intervals of three or four feet through the curved plate. These holes are provided with a specially designed drip on the lower side so that alkaline water will not run along the under side of the deck and destroy the paint.

Another feature of the deck construction is the use of special small angles termed "drip angles," by which such leakage as may occur at the juncture of the steel floor with the cross floor beams will be led to drop clear from the floor beams below.

Along each side of the structure a gangway will be placed supported on curved brackets. Each gangway will be provided with a pipe hand rail, with details arranged so that there will be no rattling of the pipes, the pipes being confined by a specially devised joint.

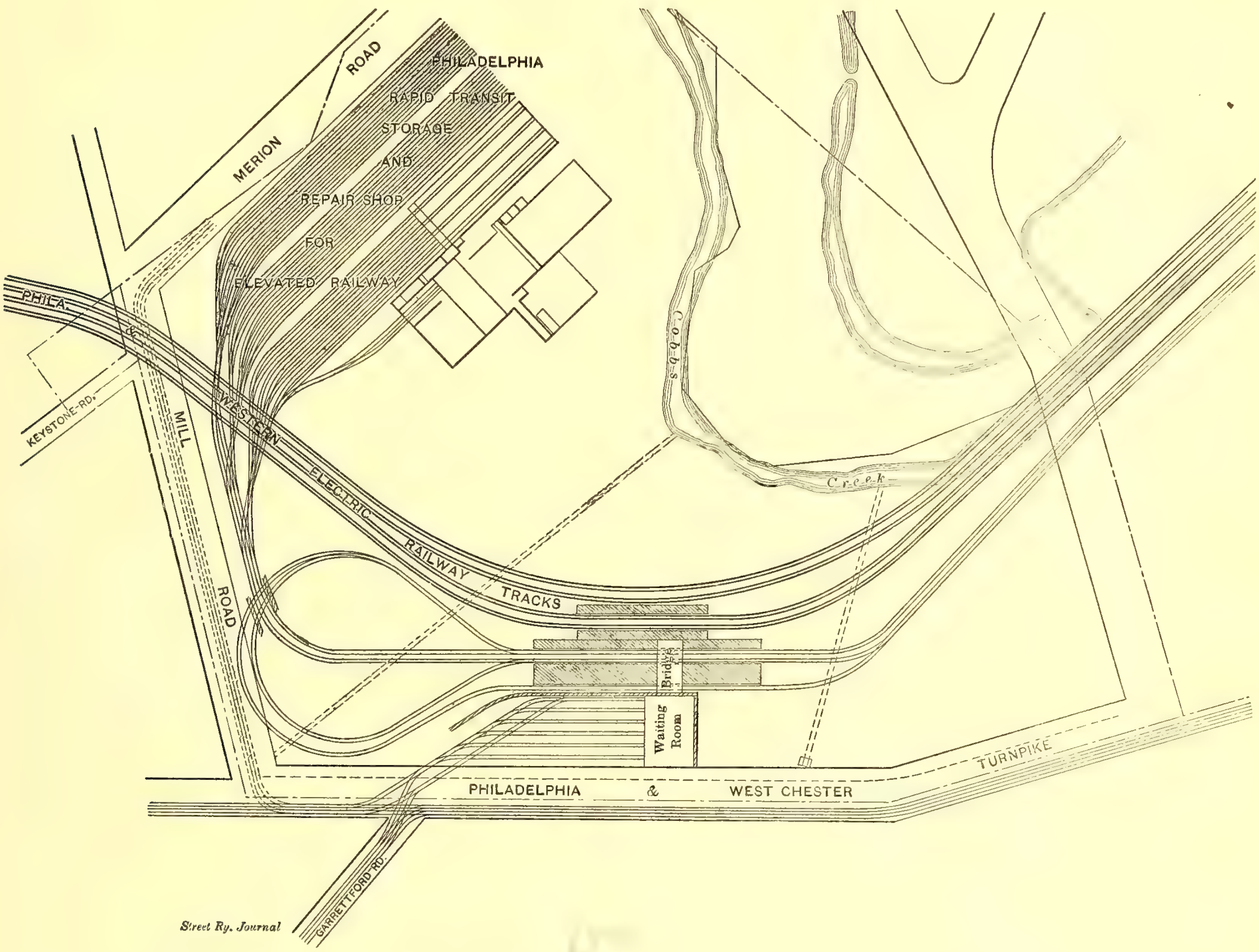
The foundations for the columns are all of concrete, with four angle bolts to each column. At the base of each column is a cast-iron fender filled with concrete, which is finished off on top to a smooth surface to drain water.

In very many cases, special designs for column foundations were necessary, owing to the presence of gas and water pipes so close to the street surface that it was necessary to provide spread footings of reinforced concrete to make the pressure per unit of area sufficiently low on soft ground. In other places it was necessary to provide grillages where pipe mains pass directly through the footings in order to carry the base of the columns around the obstructions and to a sufficient depth to secure ample foundations. All the steel work in grillages of this kind will be encased in concrete, being locked to the vertical surfaces to maintain contact and prevent corosion.

Elevated stations are located at intervals of approximately four blocks from the Schuylkill River to the Sixty-Third Street terminal. Cross passages are providied under the tracks at each station to make connection with the platforms on each side of the railway. This arrangement places the stations higher than the adjacent portions of the lines, producing in some cases accelerating and retarding grades in leaving and approaching the stations. At the stations where the railway is higher than at the other parts of the line, plate cross floor beams are replaced by lattice girders which serve also as transverse bracing to stiffen the structure.

The station platforms are carried on separate girders to avoid vibration, these girders being supported on brackets from the outer side of the columns.

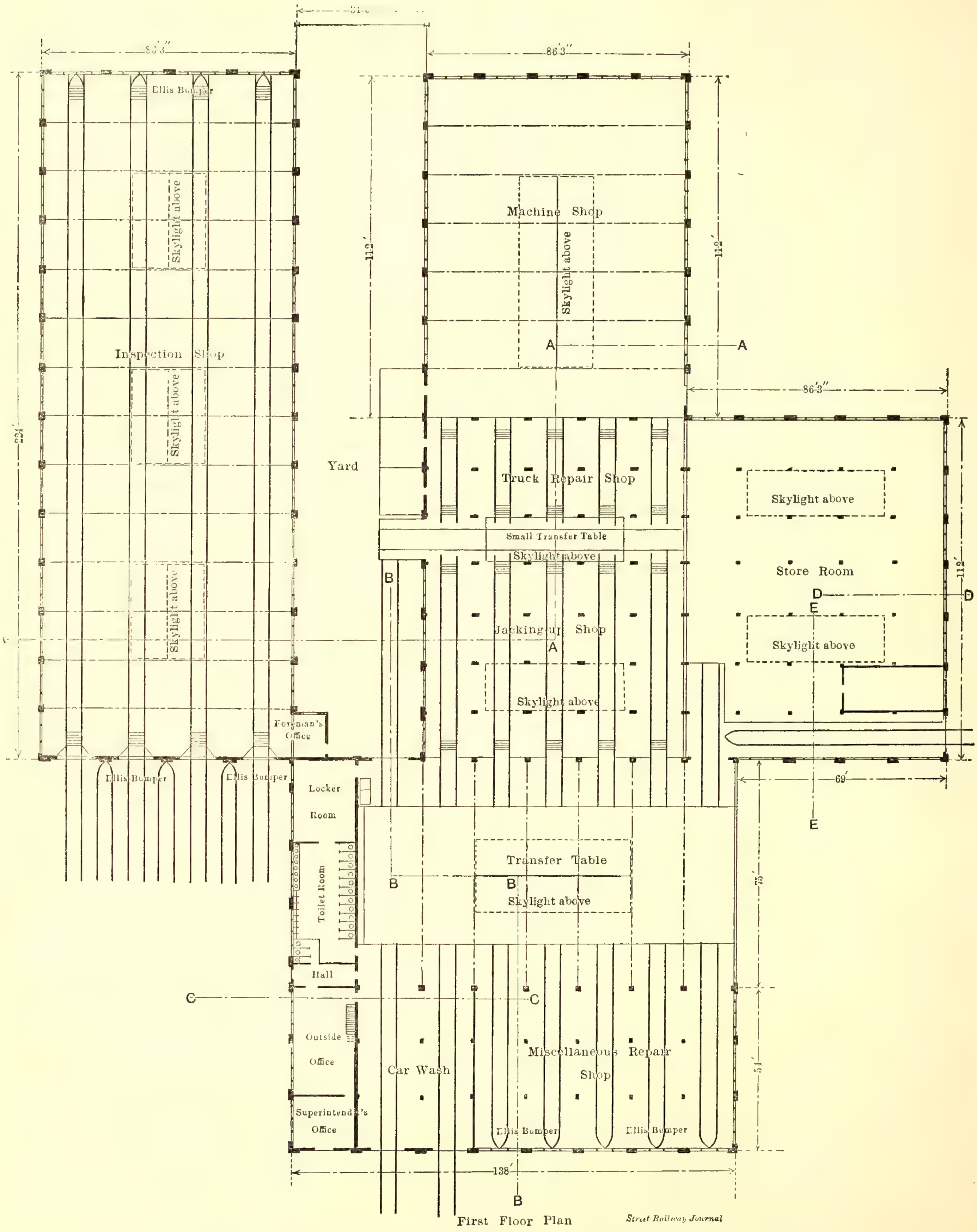
Expansion joints are placed in the elevated structure at intervals of from 200 to 250 ft. At these expansion joints steel dams support the concrete, the concrete being anchored to the vertical surfaces in the manner previously described.



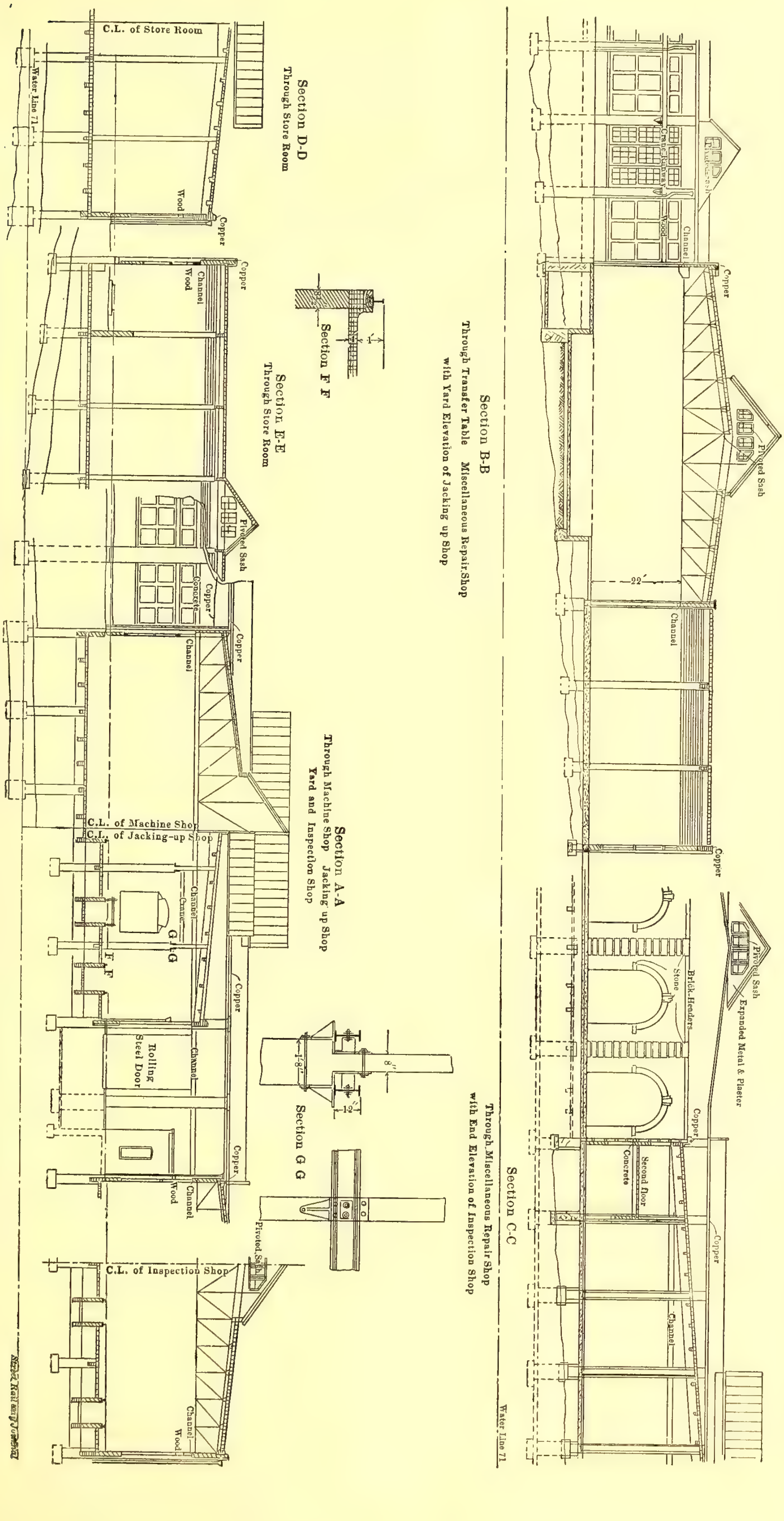
PLAN OF TERMINAL STATION AND SHOPS AT SIXTY-EIGHTH STREET FOR WEST MARKET STREET ELEVATED RAILWAY

SUBWAY AND ELEVATED RAILWAY REPAIR SHOPS

The western terminal of the Market Street elevated line is on the Philadelphia and West Chester Turnpike, less than a mile west of Sixty-Third Street. Here are to be located the repair shops, car houses, terminal station, a building for the accommodation of the employees of the road and a power station. By reason of the right of way of the Philadelphia & Western Road cutting through the center of the property, a somewhat complicated problem was presented. It was necessary to originate a scheme satisfactory to three independent roads which would avoid any crossings at grade. How the problem has been solved is shown clearly by the plan reproduced on page 549.



PLAN OF REPAIR SHOPS FOR ELEVATED RAILWAY AT WEST MARKET STREET TERMINAL



SECTIONS AND ELEVATIONS OF REPAIR SHOPS FOR ELEVATED RAILWAY AT WEST MARKET STREET TERMINAL

THE REPAIR SHOPS

The shop layout, as shown, is only a portion of the ultimate plans, and is intended to take care of the repairs of the rolling stock and equipment necessary for the operation of the first section of the subway and elevated lines. It has been planned with a view to making extensive additions. Briefly, the plan consists of an inspection shop, a jacking-up and truck repair shop, a machine shop, a miscellaneous repair shop, a storeroom with a transfer table, and offices, toilet room, locker room, etc.

In front of the inspection shop, which is the first of three to be erected, are seven storage tracks laid approximately 11 ft. center to center. Four of these are continued into the inspection shop. Into this shop, as the name implies, trains are run at intervals for inspection and for minor repairs which may be necessary. For this purpose a pit is constructed under each track for its entire length, the rails are raised 1 ft. above the floor level and a wide space between tracks has been provided.

For repair work, two entrance tracks to the repair shops proper are provided, leading to a space to be used for washing, and thence to the transfer table. Cars needing repairs to the trucks or motors are shifted to any one of the five tracks in the jacking-up shop, each track accommodating one car, where the car bodies are elevated by means of overhead traveling cranes. The trucks are withdrawn by a small electric locomotive to a small transfer table, by which they are transferred to the truck repair shop, containing five tracks, each track accommodating two trucks. These tracks are provided with overhead traveling cranes and with jib cranes attached to the columns, with air hoists for lifting the motors, etc.

For the sake of convenience, the space back of this shop is reserved for machine-tool work and for wheel work. Outside and immediately adjoining is the wheel platform for the storage of wheels before they are brought into the machine shop. On the opposite side of the

transfer table from these shops is a miscellaneous repair shop, containing five tracks, each accommodating one car, where minor repairs to car bodies, seats, etc., are to be made.

Adjoining the jacking-up and truck repair shop is the storeroom, into which will lead a steam railroad track and a track from the transfer table.

Between the inspection shop on one side and the jacking-up, truck repair and machine shops on the other side, is a yard with an overhead traveling crane. In this yard are to be deposited the scrap iron and refuse material from the shops, which can be taken by the crane to the steam road track at one end, or to the track from the transfer table at the other end.

The shops, as described, take care of all repairs except painting, which will be done on one of the tracks in the inspection shop until such time as the proposed additions are made.

The shops are located on the side of a hill, the grade at one end being about level with the tracks, and at the other end about 18 ft. below them. This made it necessary to support the walls and floors on piers and beams, the construction throughout being of reinforced concrete, except the roofs of the inspection shop, machine shop and transfer table, which are supported on steel trusses. The pit floors are carried on transverse beams, which support the pit floor beams. On these latter beams are built the brick walls of the pits which, with the beams carried by the piers between the pits, support the main floor. The tracks are spiked to wood plates which are bolted to the concrete construction.

In addition to the floors, the roofs of the jacking-up and truck repair shop, of the storeroom and of the miscellaneous repair shop, with their supporting columns, are of reinforced concrete.

The roofs of the inspection shop, machine shop and transfer table are of reinforced concrete slabs supported on the steel trusses.

All reinforced concrete work has been designed on a basis of 16,000 lbs. per square inch as the safe stress on the reinforcing rods, which are circular in section and of medium steel, and 500 lbs. per square inch as the safe extreme fibre stress for the concrete. All concrete is composed of one part Portland cement, three parts sand and five parts trap rock. All centering is surfaced, leaving the exposed face of the concrete comparatively smooth, and the corners of all beams and columns are chamfered by the insertion of a beveled strip in the angle of the centering.

All columns and trusses are spaced, longitudinally, 16 ft. center to center, and the outside walls consist of narrow brick piers at these points, casing the steel and concrete columns, with brick panel walls from floor to sill, the remaining space, which is about 80 per cent of the total, being occupied with windows. In addition to these windows, the inspection shop, machine shop and transfer table are lighted from monitor skylights, and the storeroom and jacking-up and truck repair shops from skylights of the type known as "saw tooth."

A new feature has been introduced in the transfer table. This, instead of the ordinary type running on four or six tracks, as the case may be, has two tracks, and consists of two plate girders of 45-ft. span, carrying the tracks and platform for the motor and controller. To accommodate this table, it is necessary to construct a pit, in which to operate it, 5 ft. deep, at one side of which, below the main floor, is a tunnel for the installation of wires, heating pipes, etc. This tunnel will lead to the power house, the design of which is not definitely decided, located between the shops and the terminal station, both of which buildings will be heated from it by exhaust steam.

SOME OF THE APPARATUS IN USE IN PHILADELPHIA

The Railway Journal Lubricating Company, of Chicago, has its economy lubricators and dust guards in use on two pairs of Peckham No. 25 M. C. B. trucks, operating on the Philadelphia Rapid Transit system.

The Chase-Shawmut Company, of Newburyport, Mass., states that the Philadelphia Rapid Transit Company was one of the first roads to investigate and install soldered rail-bonds, and a considerable quantity of Chase-Shawmut bonds were installed in Philadelphia in the year 1902. This company has also supplied the Philadelphia system with enclosed fuses of all dimensions for different classes of work.

The Albert & J. M. Anderson Manufacturing Company, of Boston, has made a number of shipments of line material and station switches for service in Philadelphia.

The Lagonda Manufacturing Company, of Springfield, Ohio, has installed a number of its power and turbine tube cleaners and reseating machines in the power houses of the Philadelphia Rapid Transit Company, as follows: Thirteenth and Mt. Vernon Streets station, Thirty-Third and Market Streets station, Delaware Avenue station, Beach Street station and South Street station. The Philadelphia office of the Lagonda Manufacturing Company is at 14 South Fourth Street, and is in charge of L. Bancroft Mellor, resident manager.

Williams, Brown & Earle, of Philadelphia, have installed one of their late models of continuous electric blue printing machines in the draughting room of the Philadelphia Rapid Transit Company. This machine is especially valuable for blue printing street plans, for the reason that it makes blue prints in one continuous sheet of any length without piecing.

The American Ferrofix Brazing Company, of Philadelphia, is doing considerable brazing work for the Philadelphia Rapid Transit Company. The conspicuous feature of the Ferrofix process of brazing is the saving effected by repairing broken castings, as truck frames, gear casings, etc. This process has been fully described in the columns of the Street Railway Journal.

The H. P. Cameron Electrical Manufacturing Company, of Ansonia, Conn., has recently filled a number of orders for commutators for Philadelphia, including seventy-five railway commutators and 10,000 bars or segments of the GE-800 type, all of which were made up from hard-drawn copper bars. This concern has also furnished the Philadelphia Rapid Transit Company with a considerable number of Christensen air-brake commutators.

A. O. Schoonmaker, of New York City, has furnished the Philadelphia Rapid Transit Company with amber mica for street railway repair purposes.

The Speer Carbon Company, of St. Marys, Pa., states that the Philadelphia Rapid Transit Company is one of the largest users of Speer carbon brushes in the country.

The Durkin Controller Handle Company, of Philadelphia, has its controller device on a number of cars in Philadelphia.

The Sterling-Meaker Company, of Newark, N. J., has more than 2000 Meaker registers in service in Philadelphia.

The Schoen Steel Wheel Company, of Philadelphia, states that it is now filling an order for 200 rolled-steel wheels for use on the surface lines of Philadelphia.

The Standard Automatic Lubricator Company, of Philadelphia, has sold the Philadelphia Rapid Transit Company a considerable number of its automatic oilers for armature and axle bearings.

The Sterling Varnish Company, of Pittsburg, states that the Philadelphia Rapid Transit Company has for years made liberal use of the Sterling insulating products, particularly of the Sterling black plastic insulating compound.

The Falk Company, of Milwaukee, Wis., reports that it has furnished many thousand motor gears and pinions to the Philadelphia company.

The American Brake-Shoe & Foundry Company has supplied the Philadelphia system with part of its equipment of castings and brake-shoes.

The Star Brass Company, of Kalamazoo, Mich., has a great many of its trolley wheels on the street railways of Philadelphia.

L. A. Sayre & Company, of Newark, N. J., has supplied ticket punches to the Philadelphia Rapid Transit Company for several years.

The Pantasote Company, of New York, reports that "Pantasote" curtain material will be found on most of the cars in Philadelphia.

The Westinghouse Traction Brake Company reports that it has sold its governors for air brake equipments to the Philadelphia Rapid Transit Company, the type used being the Westinghouse standard Form G.

The American Rattan & Reed Manufacturing Company, of Brooklyn, N. Y., has supplied the rattan for many of the track sweepers in Philadelphia.

The Standard Paint Company, of New York, reports that it has regularly furnished the Philadelphia Rapid Transit Company large quantities of P. & B. insulating tape, P. & B. insulating electrical compounds, and S. P. C. armature and field coil varnish.

The Globe Ticket Company, of Philadelphia, has for several years furnished the tickets used for operating the various concessions at Willow Grove Park. These tickets are the Globe consecutively numbered strip tickets, put up in rolls, and are the same form of ticket as used at the St. Louis and Portland World Fairs, and at many of the leading amusement parks in this country. The Globe Ticket Company states that it has supplied the Philadelphia Rapid Transit Company with between 4,000,000 and 5,000,000 tickets each year.

J. R. McCardell & Company state that during the years previous to the formation of the Philadelphia Rapid Transit Company they had sold about thirty Trenton trolley wagons to the different electric railway companies in Philadelphia, and these wagons are still in use.

The Hope Webbing Company, of Providence, R. I., has furnished the Philadelphia Rapid Transit Company for years with tapes, webbing and sleeving for repairs to electrical apparatus. It has also made special material to meet special requirements in Philadelphia.

The Peckham Manufacturing Company, of Kingston, N. Y., reports that the Philadelphia Rapid Transit Company has in service the following Peckham trucks: About 1200 standard single trucks, several extra strong "Metropolitan Special" trucks under sprinkler cars, ten pairs of the Peckham new diamond frame freight car trucks, and two pairs of the Peckham new short-wheel base No. 25 double trucks. The Philadelphia company also has two Ruggles rotary snow-plows, made by the Peckham Manufacturing Company, and in addition has ordered another of these equipments for this fall's delivery.

The Niles-Bement-Pond Company, of New York City, has furnished for use in the shops of the Philadelphia system a car-wheel boring machine, and also one No. 5 single punching machine with interchangeable fixtures for shearing, driven by a 5-hp General Electric motor directly geared.

The Cutter Electrical & Manufacturing Company, of Philadelphia, has furnished specialties to the Philadelphia Rapid Transit Company, as follows: About sixty type "L. L." I. T. E. circuit breakers, especially adapted for street railway service. This form of instrument was developed with the special view of meeting the requirements of the Philadelphia Rapid Transit service, and is characterized by extreme simplicity of construction, yet capable of successfully withstanding severe service all day and every day. Practical use has demonstrated the merits of this device. A large number of Cutter "Reversible" or I. T. E. overhead and reverse current circuit breakers, for the protection of rotary converters, are also in use. These instruments are installed in the direct-current side of the converters for the purpose of preventing the converters from being operated reversely by the direct current, as might occur if the alternating-current supply was interrupted. These instruments are required to be very sensitive to reverse current flow, in order to disconnect the converter on a reverse flow of current equal to that required to run the converter with external load.

The Electro-Dynamic Company, of Bayonne, N. J., has recently shipped to the Philadelphia Rapid Transit Company the following inter-pole variable and constant-speed motors: Two of type "2-S," 3-hp, 550-volt, 700 r. p. m. to 1400 r. p. m. inter-pole variable speed motors, one of which is operating a radial drill. These are located in the Kensington Avenue shops. Two of type "3-S," 10-hp, 575-volt, 1200 r. p. m. inter-pole constant-speed motors, for operating elevators at the Wyoming Avenue shops. One type "3-S," 5-hp, 575-volt, 550 r. p. m. to 1650 r. p. m., inter-pole variable-speed motor. This motor is installed at the Wyoming Avenue shops.

The Electro-Dynamic Company also has on order with the Philadelphia Rapid Transit Company the following apparatus: Three type "15-S," 30-hp, 575-volt, 690 r. p. m. to 1380 r. p. m. inter-pole variable-speed motors. Three type "20-S," 40-hp, 575-volt, 630 r. p. m. to 1260 r. p. m. inter-pole variable-speed motors. Two type "50-S," 120-hp, 575-volt, 600 r. p. m. to 800 r. p. m. inter-pole variable-speed motors.

The Kalamazoo Railway Supply Company has installed the Root track scraper on a number of roads near Philadelphia, including the American Railways Company, Philadelphia, Bristol & Trenton Railway, the Williamsport Passenger Railway Company, Lewistown & Reedsville Railway Company, the Philadelphia & Easton Railway Company, the Pottsville Union Traction Company, the Camden & Trenton Railway Company and others.

The Hale & Kilburn Manufacturing Company, whose extensive works are located in Philadelphia, has supplied most of the modern seating in the cars of the Philadelphia Rapid Transit Company. Among the earliest experiments in the use of spring seating in street cars were those made on the Second & Third Streets and Fifth & Sixth Streets lines. Nearly all the cars of these two branch lines were originally equipped with Hale & Kilburn high-grade rattan spring seating, when in nearly every other city passengers were riding on the old-style board seats. Philadelphia has always since that time kept well in advance of other cities in this respect. Later on, hundreds of cars were equipped with plush-covered spring seating manufactured by the same company, and nearly all of them have now been recovered with rattan. In recent years all the new cars have been equipped with the Hale & Kilburn reversible type of rattan spring seat of neat and attractive design. There are twelve of these cross-seats in the body of the car, with four long stationary seats running longitudinally in the ends of cars. All of these seats are covered with the Hale & Kilburn canvas-lined rattan. One noticeable feature of these cross-seats is the end plate, which is so designed as to extend a few inches above the cushion, the object being to keep the occupants of the seat from encroaching upon the aisle and interfering with the free and quick movement of passengers entering and leaving the car. The rattan backs of these seats are finished around the edges with a neat bronze band.

The National Electric Company, of Milwaukee, reports that the Philadelphia Rapid Transit Company uses more than 1300 Christensen air brake equipments for the control of its cars. The compressors are of the A-B type, having a capacity of 11 cu. ft. of free air per minute. The National Electric Company has also furnished the Philadelphia system with a number of portable air compressor outfits, which are used to advantage for cleaning, riveting, etc., the compressor, reservoir and governor being mounted on a suitable truck to facilitate handling. These outfits have been found extremely useful when it is not desirable to install expensive system of piping.

The J. G. Brill Company has the following equipments on the traction lines in Philadelphia: Four hundred and seventy-five 28-ft. closed motor bodies, 156 28-ft. semi-convertible motor bodies, 160 12-double-seat cars, 28 shear-board snow-plows, 22 nose snow-plows, 5 snow sweepers, 1106 No. 27-G short-base double trucks, 550 "Eureka" maximum traction trucks.

The B. F. Sturtevant Company, of Boston, Mass., within the last two years has furnished to the Philadelphia Rapid Transit Company the following apparatus: Ten special 90-in. steel plate fans for cooling transformers, two each in the following sub-stations: 125 East Chelton Avenue, Thirteenth Street & Snyder Avenue, Frankford Avenue and Arrott Street, Fifty-Second Street and Lancaster Avenue, Willow Grove. Heating and ventilating equipment for roadway shops, consisting of a 140-in. steel plate fan, one 7000-ft. heater and complete system of galvanized steel distributing ducts with controlling dampers. Forge equipment for roadway shops, consisting of 90-in. steel plate exhauster for removing smoke, and a number of large forges for heavy work, each provided with down-draft hood. One No. 4 steel pressure blower for supplying blast to a large cupola furnace. Extension to forge equipment, Kensington Avenue and Cumberland Street, consisting of one J-1 forge with blast and exhaust connections to the Sturtevant system installed a number of years ago.

The Allis-Chalmers Company advises that in the Thirty-Second and Dauphin Streets station of the Philadelphia Rapid Transit Company are installed two Bullock engine-type railway generators that have been in continuous service since Jan., 1902. These generators have a rated output of 800 kw, but are capable of standing a 25 per cent temporary overload without overheating or harmful sparking. The speed is 85 r. p. m., and the machines are compounded to give 525 volts at no load and 575 volts at full load. The armature, which is 8 ft. in diameter, is provided with a commutator of very liberal dimensions. The brush holder yoke is supported by the magnet frame, being mounted on trunnions, so as to be automatically shifted back and forth through a small distance parallel to the shaft. In engine-type machines there is little or no end play of the armature, and the brush oscillating device is of great advantage in keeping the commutator in good condition. The armature and commutator spiders are of open construction, and the armature core is well provided with air ducts so that the ventilation is unusually good and the temperature increases correspondingly low. The insulation of these machines is very thorough, being formed in place on the armature coils, under pressure in steam-heated moulds. The generators were installed in cold weather, and, when brought into the station, were covered with frost. They were dried out for only two or three hours before being loaded, yet when thrown in parallel with generators of other make already in the station, they took their share of the load and operated with no trouble whatever. The generators are driven by horizontal cross-compound engines, and the station is provided with a storage battery which operates in parallel with the generators.

The Wheeler Condenser & Engineering Company, of New York, state that the condensing apparatus which it installed at the power station at Thirty-Third and Market Streets, Philadelphia, is one of the largest cooling tower installations in this country. The plant consists of a battery of five towers, which are placed on the roof, to each of which battery is attached two 10-ft. fans, operated by 30-hp motors. These towers cool by forced draught in summer and by natural draught in winter about 25,000 gals. of water per hour, to be used for the condensing of about 200,000 lbs. of steam. The condensers installed are of the Wheeler Admiralty rectangular type, of which there are three, to which are connected Edwards triplex suction valveless air pumps, each having three 18-in. cylinders with 12-in. stroke, and which are directly connected on the same base plate with two 40-hp Westinghouse motors. The apparatus maintains from 24 ins. to 26 ins. of vacuum in summer and 26 ins. to 27 ins. in winter.

The Electric Storage Battery Company, of Philadelphia, has installed storage batteries for traction purposes in Philadelphia as follows: First battery installed Sept., 1896, consisting of 250 13-G chloride accumulator elements, in type 13-G lead-lined wooden tanks; this battery has a capacity of 500 amps. for regulating the fluctuations on the railway load. The plant is installed at 8100 Germantown Avenue. Second battery installed Dec., 1899, at the power house at Thirty-Third and Dauphin Streets. This battery consists of 270 41-G chloride accumulator elements, in 41-G lead-lined wooden tanks, battery having a capacity of 1600 amps. for regulation. At present a specially wound motor-driven regulating shunt booster is being installed to operate in connection with this battery. Third battery installed Dec., 1899, at Ninth and Dauphin Streets. This battery consists of 260 25-G chloride accumulator elements in 41-G lead-lined wooden tanks, battery having a capacity of 960 amps. for regulation. Fourth battery installed in April, 1900, at Fifth and Lombard Streets. This battery consists of 260 31-G chloride accumulator elements in 41-G lead-lined wooden tanks, battery having a capacity of 1200 amps. for regulation. Fifth battery installed July, 1900, at Chelten Avenue, this battery consisting of 250 17-G chloride accumulator elements, in 25-G lead-lined wooden tanks, battery having a capacity of 640 amps. for regulation. Sixth battery installed July, 1900, at Erie Avenue, near Broad Street. This battery consists of 250 17-G elements, in 41-G lead-lined wooden tanks, battery having a capacity of 640 amps. for regulation. All of these batteries, with the exception of the one at Thirty-Second and Dauphin Streets, which operates in connection with the power house, were originally installed for the purpose of obtaining high voltage at points distant from the power house. Recently the battery sub-station at Chelten Avenue has had added to it some rotary converters.

The Lorain Steel Company, of Philadelphia, has furnished a large portion of the track layouts and special work in the city of Philadelphia. The company is also rolling the 137-lb. P. R. T. standard rail described elsewhere in this issue. Of special interest

is the complex track layout at the Willow Grove terminal, all of the special work for which was constructed and furnished by the Lorain Steel Company.

The General Electric Company is about to install the following apparatus for the Philadelphia Rapid Transit Company: One 2000-kw, 25-cycle, 13,200-volt a. c. Curtis steam turbine; 30 125-hp GE railway motors for operation with Sprague-General Electric multiple-unit control; 116 four-motor GE 70 equipments with K-28 control; 40 GE 70-railway motors; 260 GE 80-railway motors.

The Philadelphia Rapid Transit Company is about to install two low-pressure Curtis steam turbine units, made by the General Electric Company, and which promise to be an interesting departure in power station engineering. Each of these units consists of a specially designed Curtis steam turbine, adapted to receive steam from the low-pressure side of a non-condensing reciprocating engine, the turbo-generator in each case delivering direct current at 575 volts. No governing mechanism is required, but the turbines, operating in parallel with the engines, will adjust themselves to the load as called upon to do so. Steam will be taken into the turbines at a pressure of 15 lbs. absolute, and exhaust into the condenser at about 1 lb. absolute, passing through the turbine in four stages. The turbo-generators will in effect float on the line automatically, taking care of their part of the load.

The Locke Insulator Manufacturing Company, of Victor, N. Y., supplied the Philadelphia Rapid Transit Company the Locke No. 3 porcelain insulators for the high-voltage overhead transmission line leading from the Glenside sub-station.

The Crocker-Wheeler Company, of Ampere, N. J., sold to the Union Traction Company, predecessor to the Philadelphia Rapid Transit Company, a number of small motors for the company's printing plant, where all the transfers, exchanges, tickets, etc., needed in the operation of the system are printed. There are also in service in Philadelphia several Crocker-Wheeler boosters of the form D, two-unit type with 1000-amp. capacity at 125 volts. It is stated the engineers of the transit company were so well pleased with the brush holders of these machines that the company has purchased a number of the standard parallel type Crocker-Wheeler brush holders for equipping the generators at several of the power houses. A 100-kw form D engine-type Crocker-Wheeler generator has recently been placed in operation as an exciter in connection with Westinghouse steam turbines. The Philadelphia Rapid Transit Company has also purchased motors of the Crocker-Wheeler type to the extent of several hundred horse-power, for use in machine shops and also for driving the various amusement attractions at its parks.

At Kennett Square, in the power plant of the West Chester, Wilmington & Kennett Railway, are two 300-kw standard Crocker-Wheeler railway generators. At Lenape are two 300-kw Crocker-Wheeler generators of the same type in the power plant of the West Chester Railway Company, and a 200-kw Crocker-Wheeler generator is installed in the Downington plant of the same company.

The Alberger Condenser Company, of New York City, has carried out considerable work in connection with the Philadelphia power houses. A very interesting condensing plant will be found at the power station at Second Street and Wyoming Avenue. This consists of one 3500-hp Alberger barometric condenser and auxiliaries in connection with reciprocating engines; four 1500-kw Alberger dry vacuum centrifugal condensers, condensing on Parsons steam turbines with natural water supply, and two 1500-kw Alberger dry vacuum centrifugal condensers working on Parsons steam turbines with water from cooling bay. Another interesting condensing installation will be found at the Thirteenth and Mt. Vernon Streets power station. This plant consists of two Alberger dry vacuum surface condensing equipments working on Curtis low-pressure steam turbines with water from three Alberger double fan-draft cooling towers.

The Consolidated Car Heating Company, of New York City, has installed electric heaters in most of the cars in Philadelphia. The company's standard panel heaters are used in cars with panels, and its new design of cross-seat heaters with lead wires at one end in cross-seat cars.

The Mayer & Englund Company, of Philadelphia, has supplied the Philadelphia Rapid Transit Company with a great many of its well-known specialties. The list includes the following: About 100,000 rail-bonds and four sets of hydraulic bonding outfits; also a considerable amount of overhead line material, including insulated overhead crossings made from designs originated by the traction company. These insulated crossings are built up of sheet steel brazed and riveted together, and having a straight under-run with renewable wearing parts. Acting as agents for the International Register Company, the Mayer & Englund Company has recently taken an order for the entire equipment of the Philadelphia system with Heeren standard enamel badges for employees. This badge is a new design, claimed to be practically indestructible as far as finish and appearance are concerned. The badges are made up from molded composition layers, with german silver face and backing of pure aluminum. The various layers are pressed together under heavy pressure while hot, so as to ensure a complete molding of the layers to form one homogeneous piece. About 10,000 of the badges have been supplied. The Mayer & Englund Company has also furnished for use in Philadelphia about 350 International registers known as type R-7. The transit company is also a large user of Sterling compounds, for which the Mayer & Englund Company is agent.

The Chicago Pneumatic Tool Company, of Chicago, has equipped the repair shops of the Philadelphia Rapid Transit Company with a complete up-to-date pneumatic installation, including a large number of pneumatic tools, such as hammers, riveters, drills, etc., this installation comprising one of the largest and best pneumatic plants in connection with street railway repair work in the country.

The Gem Manufacturing Company has in operation in Philadelphia a number of portable electric plants, each consisting of a motor mounted on a truck with gearing, flexible shaft and attachment. These portable plants are used in track work for drilling, reaming and grinding, especially on crossings, curves and at joints. The resident manager for this company in Philadelphia is L. Bancroft Mellor.

The Curtain Supply Company, of Chicago, states that practically all of the open cars in Philadelphia have been equipped with curtains having this company's Acme open-car cable fixtures, while the closed cars and convertible cars have curtains equipped with the Curtain Supply Company's Acme closed-car cable fixtures and the Keeler eccentric roller top fixtures.

The E. W. Bliss Company, of Brooklyn, N. Y., advises that the Philadelphia Rapid Transit Company has used for a number of years the Bliss high-grade steel gears and pinions. The Bliss gears are made of high-grade open-hearth steel castings, the split gears being held together by eight special bolts of high tensile strength. When very heavy service, combined with high speed, is demanded, solid gears are frequently used. The Bliss high-carbon pressed pinion is the result of extensive experimenting, to produce a pinion very tough and durable that will withstand the heavy wearing strain of electric railway service. The pinions are made of special high-carbon steel, which is solidified and toughened under high pressure.

The Garton-Daniels Company, of Keokuk, Ia., has supplied lightning arresters for practically all of the lines in Philadelphia, it being the practice of the Philadelphia Rapid Transit Company to place an arrester at practically every overhead crossing, of which there are an unusually large number on the system. There are also a number of Garton-Daniels automotoneers in service on cars in Philadelphia and the suburbs.

The Keystone Electrical Instrument Company, of Philadelphia, has for some years attended to the matter of repairing and recalibrating the switchboard and portable indicating instruments in use by the Philadelphia Rapid Transit Company. This concern has also furnished the transit company with semi-portable laboratory instruments for checking alternating-current switchboard and portable instruments, and has also sold a number of switchboard-type alternating-current voltmeters and ammeters.

The George W. Lord Company, of Philadelphia, maker of water-purifying chemicals, has for several years acted as feed-water expert and chemist for the Philadelphia Rapid Transit Company, and has supplied the chemicals for use in the boilers at the various power houses where the feed-water has caused trouble.

William Wharton, Jr., & Company, Inc., has supplied a very large part of the special track work throughout the system of the Philadelphia Rapid Transit Company. Some of this work has been in use a great many years. More recent work furnished by this company can be found on some of the important extensions, like the Allegheny Avenue line, the Northeast division, the Elmwood

Avenue line, in the southwestern part of the city, and others. A number of recently furnished car house special work layouts can be found at the Lancaster Avenue car house, near Forty-Fourth Street, the Girard Avenue car house, the Thirty-First and Dauphin Streets car house, the car house at Arrott Street and Frankford Avenue, and the car house at Third Street and Wyoming Avenue, installed early this year. Among the large number of important layouts furnished by the company, one is located quite close to the convention hall, at Thirty-Third, Spruce and South Streets, at the corner of Franklin Field, the University of Pennsylvania's athletic grounds, only a half block from the street leading to the convention hall and exhibition. This layout was installed about one year ago. Of special interest is the loop at the foot of Market Street, near Delaware Avenue. This loop is of very sharp (24 ft.) radius, at the bottom of a steep grade, so that special provision had to be made to prevent derailment of the cars, by an outside guard for the wheels. To sustain the enormous traffic on this loop the entire curve was made of manganese steel. Three sets of these manganese steel rails have been furnished since Nov., 1898. The present inside rails were installed the latter part of 1903, and the present outside rails were furnished only a few months ago. Prior to 1898, manganese steel flat rails, bolted to cast-iron stringers, were used. Prior to 1895, while cable cars were still operated over the Market Street line, the outside of the curve was made of chilled cast-iron curved sections, which, at the entering end, wore out in three to four weeks. The inside rails were made of Bessemer steel, which lasted from eight to ten weeks at the entrance, and about six months in the rest of the curve. The average life of the manganese steel rails in this loop is three years. Another curve made entirely of manganese steel, installed two years ago, is located at Twelfth Street and Susquehanna Avenue. Of further interest may be the Manganese steel crossings furnished by the Wharton Company, where the Philadelphia Rapid Transit Company's lines cross steam railroad tracks of the Pennsylvania and Philadelphia & Reading roads, particularly all along Washington Avenue, Ninth Street, on the main line of the Philadelphia & Reading Railway from Fairmount Avenue north, and on American Street. In these crossings the steam railroad rails are made entirely of manganese steel, in accordance with the special design and patented construction of H. B. Nichols, engineer of way of the Philadelphia Rapid Transit Company. Several hundred of these crossings, manufactured by the Wharton Company, have been installed throughout the city, some being in use since 1899, and some sixty or more have been furnished within the last two years. At some places, where steam railroad tracks are laid with girder rails, such as at Richmond and Westmoreland Streets, Richmond and Tioga Streets and Second Street and Girard Avenue, manganese steel center crossings, made of heavy 9-in. girder rail throughout, of the latest type, and furnished by the Wharton Company early this year, can be seen. The works of William Wharton, Jr., & Company, Inc., are located in the city of Philadelphia, at Twenty-Fifth Street and Washington Avenue, and are devoted entirely to the manufacture of street railway girder rail special track work. Fourteen miles out of Philadelphia, at Jenkintown, Pa., on the Philadelphia & Reading Railway, are located the second works of the same company, devoted entirely to steam railroad and T-rail special track work.

The American Bridge Company, of New York, has furnished all the structural steel work involved in the construction of the new subway and elevated lines in Philadelphia, including the new Schuylkill River bridge. The company has also supplied the steel work for power houses and other structures erected in recent years by the Philadelphia Rapid Transit Company.

The F. B. Tait Manufacturing Company, of Decatur, Ill., has recently received an order from the Philadelphia Rapid Transit Company for 100 Curtis D-2 trucks. This type is a short wheelbase truck for medium weight cars.

The Westinghouse Machine Company and the Westinghouse Electric & Manufacturing Company received the initial order for generating apparatus in the new Delaware Avenue power station of the Philadelphia Rapid Transit Company, and have now under construction three Westinghouse-Parsons steam turbine units of 6000-kw capacity each, or three times the capacity of the largest generating units at present in operation in the power plants of the Philadelphia system. The new station is designed to accommodate, ultimately, eight units of the same capacity. The Westinghouse companies have already installed six steam turbine units, of an aggregate capacity of 9000 kw, in the remodeled power plant at Second Street and Wyoming Avenue, which plant is now delivering alternating current to the six new rotary converter sub-stations recently completed at 125 East Chelten Avenue, Frankford Avenue and Arrott Street, Thirteenth Street and Snyder Avenue, Fifty-Second Street and Lancaster Avenue, Glenside and Willow Grove. The Westinghouse Electric Company has furnished most of the converters and transformers for these new sub-stations, including thirteen rotary converters, of an aggregate capacity of 11,000 kw, forty-three air-blast transformers of an aggregate capacity of 12,375 kw, and two motor generator sets of 45-kw capacity each. The direct-current generating equipment of the old power stations includes eleven 1500-kw Westinghouse compound-wound generators of recent type, three Westinghouse automatic compound engine units of 400-kw capacity each, and several generators of about 1000-kw capacity each, of early Westinghouse design, which have been in service a dozen years or more. About one-third of the cars in service in Philadelphia are operated by Westinghouse motors.

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Of this issue of the Street Railway Journal 8000 copies are printed. Total circulation for 1905 to date, 319,750 copies, an average of 8204 copies per week.

The Philadelphia Convention

As this paper goes to press, four days of the Philadelphia convention have been completed, and the Accountants are holding their final sessions. In this issue we are presenting a complete report of the events of the first four days, together with an account of the proceedings and technical discussion at the meetings of the Mechanical & Electrical Association and of the American Street Railway Association up to Thursday noon, and all of the papers and reports presented at the meetings of those two bodies. In next week's issue a report will be given of the session of the parent association on Thursday afternoon, an account of the meetings of the Accountants' Association on Sept. 28, 29 and 30, a description of the exhibits at the convention and the Question Box of the American Railway Mechanical & Electrical Association.

The results of the Philadelphia convention were so successful in every respect that we feel confident that every member will look back upon them with satisfaction. In the Mechanical convention, which was the first held, the papers and reports were more complete and extended than any which have ever been previously presented, and they reflect great credit upon the authors, as well as upon the association. The same remark is true of the discussion, which was taken up by the different members with an interest and zest which holds forth a great deal of promise for future meetings of this important body. The principal topics considered were those relating to power stations, track work and controlling apparatus. Our space in this issue makes it possible to comment editorially only on the track papers and on two of the power-station papers, but we expect in an early issue to discuss the facts which were brought out in other portions of the discussion.

The principal feature of the American Street Railway Convention was, of course, the adoption of the new constitution and by-laws by practically a unanimous vote. Previous to the convention, the executive committee considered very carefully all of the objections which had been offered to the proposed constitution. It was found upon examination that these criticisms did not relate to the main features of the proposed plan, but to minor details. A conference, at which all of the associations were represented, was held and a unanimous agreement was reached, and the approved constitution and by-laws, with the changes made since the publication of the constitution in our issue of Sept. 2, appear elsewhere in this issue. The unanimity with which the new constitution was generally received, and which was displayed on the final vote, must have been exceedingly gratifying to the officers and members of the executive committees of the various associations, who have given so much consideration and time to it during the last year.

The re-election of President Ely for a third term was a move which gave universal satisfaction. While all of the members realized that during the coming year this choice would mean that the present president must devote a great deal of time and consideration to the affairs of the association, and that during the past year he has already been required to make a great many sacrifices of both for the common good, it was the universal opinion that the new association should, if possible, have the benefit during the coming year of his broad experience and direction. To its president, more than to anyone else, the association owes the reform which has just been consummated in its organization, and no one is so fully acquainted with the requirements of the hour in this connection as President Ely. In the work of guiding the fortunes of the

new associations during its trial period he will be associated with a particularly strong executive committee, and one which is in hearty sympathy with the new plan.

As already explained, we cannot attempt in this issue to discuss editorially more than a few of the papers and the other features of the convention. It is only proper to refer at this time, however, to the magnificent display of exhibits, which we hope to describe more fully in our next issue, to the admirable arrangements for both the meetings and the entertainments, which were also in charge of the Manufacturers' Association, and to the hospitality extended by the officers of the Philadelphia Rapid Transit Company, who were most assiduous in making the delegates feel at home, and in showing them the interesting features in connection with the Philadelphia Rapid Transit system.

The Report on Way Matters

The report of the committee on way matters before the American Railway Mechanical and Electrical Association this year is the first consideration that association has given to track subjects. It is the compilation of Fred G. Simmons, of Milwaukee, whose efforts to get way matters discussed more fully at national associations resulted in his appointment as chairman of a way committee for this year. The report consists of contributions from various sources on rail-joints, compiled and commented upon by Mr. Simmons. Four kinds of permanent joints receive extended attention by their most active advocates, viz., the cast-welded, the thermit-welded, the electrically-welded and the zinc or composite joint. Two points brought out by the discussion we wish to call special attention to. One of these is that the success of both bolted and permanent joints depends on the care used in their application. It can be stated with perfect confidence at this stage of the game that with any of the welded or permanent joints a track can be laid in pavement, on which the joints will be as good electrically and mechanically as the unbroken rail, and that they will so remain until the rail is worn out, if only the work is properly done in the first place. The evidence is not at hand to yet warrant a similar statement as to bolted joints in pavement where they cannot be got at for tightening of bolts, although on open track there is little doubt but that with proper care, both when the track is laid and subsequently, the life of the joint can be made to approach the life of the rail. Much better results than are common with bolted joints could be secured by following out the suggestions made in the report, namely, that the bolts be tightened, not only once when the track is new, but numerous times, so as to take up the looseness due to the wearing down of the rough surfaces between rails and joint-plates. It is the wearing down of these uneven surfaces that is almost entirely responsible for loose and battered joints. If the joint-plates and rail-ends made a perfect polished fit, one with the other over a large area, there would be no trouble in keeping a bolted joint tight. It is the roughness of rails and plates which makes a limited area of contact that is responsible for the trouble, because with a limited contact area the pressure is so great per square inch that steel cannot stand up under it without wearing down. The most successful types of bolted joints are those providing a large area of contact.

Returning to the welded types of joints, the compilation of costs for these various types made in the report is most interesting, and seems to leave cast-welding in the lead as far as actual cost is concerned. On the other hand, each of the other joints has certain special features which recommends it. All the processes of welding, except the thermit, require a formidable amount of apparatus, and this, rather than the cost of materials and labor, has prevented their more general adoption. The coming year will undoubtedly be a most important one so far as determining the relative value of the different joints is concerned, and at the next convention most valuable light should be available on this important subject.

Economical Power Distribution

It is a great pleasure to read two such practical and valuable papers as those by Messrs. Hile and Crecelius. The former, to summarize very briefly, is a study of how to keep out of power station difficulties, while the latter deals rather with getting out of them. The Boston Elevated system of power distribution is well known as a most effective one, judged by results, and it also stands quite alone in employing low-tension distribution from a group of allied stations instead of undertaking high-tension distribution from a huge central station. Judging from the results given by Mr. Hile, the Boston method is singularly effective. Perhaps the most striking feature of the case is the enormous load factor obtained at all the stations. The lowest figure of the lot is 63.2 per cent for the station as a whole, and 91.5 per cent for the machines in operation. Taking the whole group in fact, the lowest load factor for the machines is 81.7 per cent. Of course, the secret of this extraordinary result is the operation of the stations in parallel, making a network for the entire system, covering an area more than 10 miles in length and from 5 miles to 8 miles wide. Not only are the networks thoroughly interconnected, but the power stations themselves are linked by massive conductors, so that the whole group operates as a single plant.

The immediate result of this policy comes in the very high load factor and an exceptionally uniform distribution of the energy. Bearing in mind the load factors for the machines in use, one easily appreciates that batteries would here be of singularly small use. Also, it is fairly clear that generating sets of fearfully and wonderfully good efficiency when grossly underloaded have no earthly advantage in such a system. What is wanted here is high economy near full load, and to all appearance Mr. Hile has it. It is a very difficult matter to compare generating costs in stations under different managements, for station bookkeeping varies wonderfully in the manner of distributing the items, particularly those relating to maintenance and general expense. The Boston figures are, however, more than usually full, and the results as given may safely be taken as conservative. The mean cost per kw-hour for the whole system is 0.778 cent. This is much higher than figures often quoted, but fuel is relatively dear in Boston, costing for the term of years considered an average of about $3.57 per ton. Reducing the total cost to the basis of coal at, say, $2.50 per ton, the result is almost exactly 0.06 cent per kw-hour at the switchboard. How much allowance should be made for other items in comparison, it is hard to estimate, but it is sufficiently evident that there is precious little margin left for any power transmission scheme to travel upon. Of course, a complete low-tension distribution requires a very large amount of copper for high efficiency, but on the other hand, so long as d. c. railway motors are used, most of this copper can hardly be dispensed with. If the Boston system were organized on so-called "modern" methods it would probably have one central station and about the number of sub-stations at present operated as power stations. The saving in copper would be mostly

confined to the special mains now connecting the stations, and if any central station in Boston could save enough over the present ones to pay for the loss in and upkeep of a high-tension system, we should like to see the plans for it.

The stations described in Mr. Crecelius' paper are in no such happy case as to load as the Boston stations. The factors knock around at 40 per cent to 50 per cent, and only is screwed up to 57 per cent when by interconnecting the stations it becomes possible to work the whole system from one station during part of the day. Part of this difference between the Boston and St. Louis figures can be explained, however, by the fact that Mr. Hile's figures are upon an 18-hour basis, while those of Mr. Crecelius are based upon 24-hour operation. The wholesome effect of even the slight increase of the power factor to 57 per cent, described by Mr. Crecelius and secured by interconnecting the stations, is well evidenced in the bettered costs of operation. From the magnitude of the gain it is altogether probable that if one could draw up a curve showing the improvement of costs with power factor, the knee of the curve would come not far from 50 per cent. Certainly gains hereabouts are worth making. But as the load on the plant becomes more favorable, and the load factor rises, a point is soon reached where a small gain is inconsequential. A system like that in St. Louis presents really very difficult problems for solution, and the one consoling feature of the case is the quickness of the response to remedial efforts. As Mr. Crecelius intimates, the use of batteries in this connection ought to be more carefully investigated than it yet has been. It is well known that in certain cases batteries have been extremely successful in steadying the output, but in other cases they have demonstrably proved a source of expense. Data on the subject are scarce, particularly maintenance data on the batteries themselves, and we hope that some one will take Mr. Crecelius' suggestion up and make a thorough study of the conditions of economy in the use of batteries.

The Gas Engine in Practice

The American Street Railway Association papers by Messrs. Bibbins and West and the resulting discussion will repay more than casual consideration. While the papers themselves may naturally be regarded as somewhat of the nature of special pleading, they are no more so than most other papers on prime movers, and there is no more reason to doubt the data presented than in the case, let us say, of a paper on steam turbines or quadruple expansion engines. As we have many times intimated, the gas engine is coming along rapidly. We are far from decrying the steam engine in its ordinary form—it is and probably will long remain the mainstay of power production. But the gas engine is here and is doing good work at a cost which, in many cases, compares well with other engine costs. This is not saying that a street railway load is the gas engine's long suit or that there will always be economy in using gas engines. The stock arguments against such engines are three: first, that they will not hold their speed well enough for irregular loads; second, that they are, when the producer plant is included, very expensive, so that the fixed charges eat up the possible profits; and third, that they entail an abnormally heavy cost for repairs. Let us take up these in the light of the present papers and see what weight is properly to be attached to them in the existing state of the art.

To begin with, a 4-cycle gas engine is, cylinder for cylinder, at a disadvantage compared with an ordinary steam engine. But, on the other hand, a two-cylinder, double-acting gas engine, such as is now produced for large work, will give the same regularity of impulse as a single-cylinder Corliss engine, while a four-cylinder gas engine will give a cycle like that of a compound steam engine. Thus similar regularity of effort merely means a duplication of cylinders, which appears in the capital and maintenance accounts, but gets there just the same. By the same token, the governing should be, and is, about the same in the two cases. As Mr. West also shows, the overload capacity of either machine depends on its rating, and any less overload capacity of the gas engine consequently appears in the costs to be discussed. It is a matter of record that gas engines can successfully drive alternators in parallel, which means that the governing is actually good. Their rotative speed is also fully up to that of Corliss engines of similar output, which means that in the two cases the generator design is about the same. Now as to cost, it is at the present moment true that a gas power plant is somewhat above a steam plant. This, however, affects the cost of the power produced only in so far as it raises the fixed charges. In the bids on an 8000-kw plant cited by Mr. Bibbins, the excess in cost between the favored gas plant and the favored steam plant was about 8 per cent, which would raise the fixed charge on the latter pro rata to partially offset the fuel economy, which was guaranteed at 1.61 lbs. coal per kw-hour, as estimated from the engine performance. This is not unapproachable by steam engines, but is far better than current steam practice.

Let us now touch upon the much-mooted question of repairs to gas engines. Two actual stations cited by Mr. Bibbins give pertinent data. One case, that of an 800-kw station at Bradford, Pa., operating on a station load factor of only 19.54 per cent, showed a total works cost per kw-hour of 0.825 cent, of which 0.01 cent was due to repairs on engines. This can hardly be rated as excessive. A second plant, belonging to the London Metropolitan Boroughs, on a load factor of 15.2 per cent, gave a total for repairs, including all, of 0.048 cent in a cost per kw-hour of 1.05 cents, the station capacity being 2000 kw. The average of eleven steam generating plants in the same district gave, with an average load factor of 17.25 per cent, a cost per kw-hour of 1.41 cents, of which repairs ran to 0.218 cent. Of course, such comparisons are a bit uncertain, but it is sufficiently clear that the gas engines were not the source of severe repair. The labor cost in these gas stations is relatively higher than in steam stations, the fuel cost being relatively so much reduced. These figures show at least that the gas engine is in the game, and when one considers that they were derived from small units operating at bad load factors, supposably disadvantageous for gas engines, the results are all the more striking. The long and short of it is that when one undertakes with a steam engine to go up against a thermal efficiency of 25 per cent or more, there must be very substantial gains in fixed charges and repairs to come out even. And as to plant efficiency, there is too much difference between less than 25,000 B. T. U. per kw-hour and 40,000 or more to be easily overcome. We believe that the next few years will see considerable gains in the efficiency of both kinds of engines. The gas engine has already proved a valuable stimulant in steam working. The fact that several American electric railway plants are being equipped with gas engines gives promise of livelier competition in the future.

PAPERS READ AT THE PHILADELPHIA CONVENTION OF THE AMERICAN RAILWAY MECHANICAL AND ELECTRICAL ASSOCIATION

THE POWER DISTRIBUTING SYSTEM OF THE BOSTON ELEVATED RAILWAY COMPANY

BY C. H. HILE,
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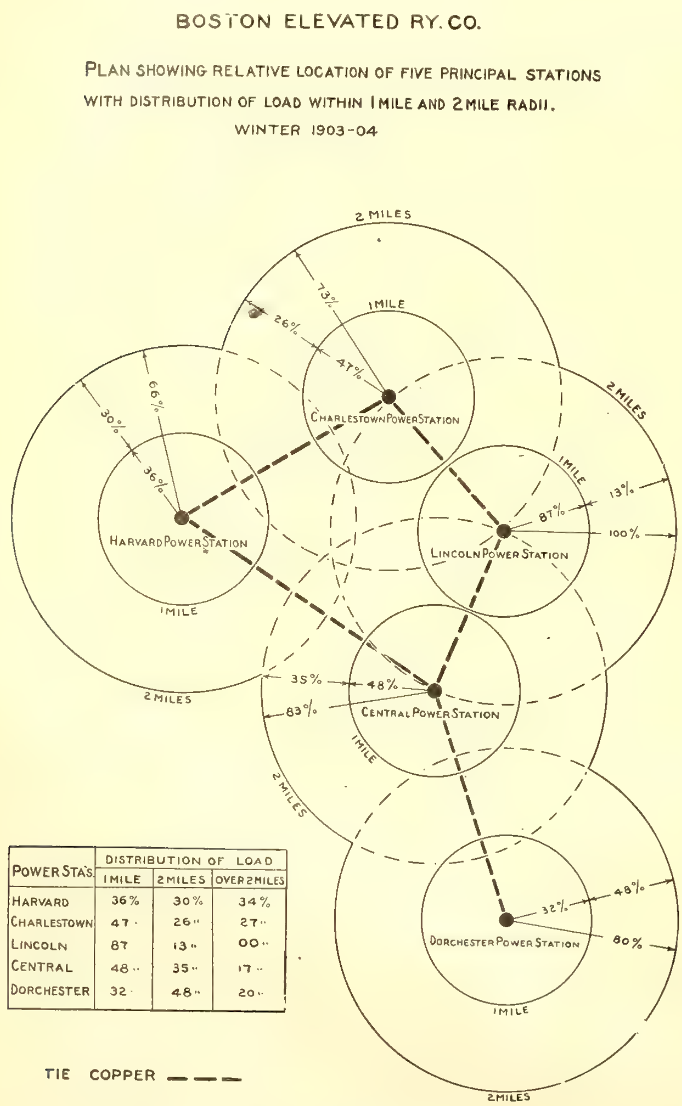
In considering an established power distribution system for the best understanding of its advantages and efficiency, it is essential that one has a knowledge of the conditions and disposition of the power plants in their relation to the territory served.

Among engineers entrusted with the laying out and designing of power plants and transmission systems there are two recognized tendencies in their treatment of such questions. The most prominent, perhaps, because the most radical of these two tendencies of late years, is for large central power stations, correspondingly large power units, and the alternating-current transmission system with sub-station conversions. The development in the science of engine and dynamo construction, in connection with the progress made in high-voltage transmission systems, has made such engineering ventures easily possible as well as practicable. The other tendency, while not necessarily opposite in method and effect, is more the result of a growth and development, based upon conditions as they have presented themselves to the engineer, covering years of progress and expansion of a single or a number of power systems.



POWER STA'S.	DISTRIBUTION OF LOAD		
	1 MILE	2 MILES	OVER 2 MILES
HARVARD	36%	30%	34%
CHARLESTOWN	47 ·	26 "	27 "
LINCOLN	87	13 "	00 "
CENTRAL	48 "	35 "	17 "
DORCHESTER	32 ·	48 "	20 "

FIG. 1.—DISTRIBUTION DIAGRAM

At present writing it cannot be said that the merits and advantages of either practice over the other have been conclusively proven. Each power and transmission problem has its individual conditions, and these in connection with the requirements of good engineering must determine the type and system of power plants and transmission systems.

It is the purpose of this paper to deal with an established system of separate power plants, with their interconnected power distributing systems, and to present facts, results and experiences which may be taken as fairly representative of such engineering practice. To illustrate the practice, its results and possibilities for the purpose of this discussion, only five of the eight stations on the system will be considered (the three stations not considered being of obsolete construction and operated only part of the time, or so situated as to have no bearing upon the main proposition).

The five power stations considered are fairly representative of the modern type of station, and include in their equipment direct-connected d. c. units, varying in size from 800-kw to 2700-kw rated capacity.

The diagrammatic sketch, Fig. 1, with the information contained therein, gives a very fair idea of the relative locations of the several stations with regard to each other, and to the territory each supplies with power.

TABLE I.—POWER-STATION DATA, BOSTON ELEVATED RAILWAY

Power Stations	Boilers						Engines				Generators		
	No	Type	Rated H.P	Method of Firing	Draft	Type Economizer	No	Type	H P	Type Condensers	No	Type	Capacity K W.
Central	24 8	Water-Tube "	250 500	Hand "	Forced "	Green "	1 2 6	Vertical, Cross Compound Condensing Horizontal " " " " Triple Expansion "	4200 2000 1800	Buckley Siphon " " " "	1 2 6	Multipolar " "	2700 1500 1200
Lincoln	8 4	Water-Tube "	450 475	Mechanical Stokers "	Natural "	Green "	3	Vertical, Cross Compound Condensing	4200	Jet	3	Multipolar	2700
Charlestown		Water-Tube				Green	1 2	Vertical, Cross Compound Condensing Horizontal " " "	4200 1000	Buckley Siphon Jet	1 2	Multipolar "	2700 800
Harvard	6	Water-Tube	500	Mechanical Stokers	Natural	Green	3	Horizontal, Cross Compound Condensing	1800	Jet	3	Multipolar	1200
Dorchester	2 2	Water-Tube "	500 500	Hand "	Natural Forced	Green "	2	Horizontal, Cross Compound Condensing	1500	Jet	2	Multipolar	1000

The yearly output of the several stations under consideration during the year 1904 was as follows:

TABLE II.—YEARLY OUTPUT OF SEVERAL STATIONS IN BOSTON

	Kw-Hours
Central power station	51,146,535
Lincoln power station	31,978,676
Charlestown power station	17,449,963
Harvard power station	15,813,669
Dorchester power station	8,487,644
Total	124,876,492

In Fig. 1 is shown how the several stations are tied together and operated in parallel. The tie between stations is accomplished through feeder wires running into so-called feeder sections common to two or more stations. Sufficient copper is run from each station into the common feeder sections, so that in the emergency of a disabled machine, or an unusual load in any one of them, the others immediately respond by taking up more load from the tie feeder sections, either automatically or through an adjustment of the voltage in the stations affected. By thus operating the stations, heavy and extreme fluctuations of load are avoided, and, with the movement of maximum morning and evening loads from the outer to the inner feeder sections and from the inner to the outer feeder sections, the several stations are so located as to materially help each other when the need is most urgent.

While it is true that there is more copper required to thus dis-

tribute the power than if just a sufficient amount were strung to satisfactorily distribute the power output of each station individually, it is a fact that none of the copper is ever idle, and is always contributing to better conditions, both for the stations and for the operation of cars; and it is also believed that the extra expense occasioned by this additional copper is more than compensated for by the smaller surplus generating capacity required than is the case in the single generating station idea.

That which is equally interesting and best brings out the advantage of operating the several stations in parallel (thus practically getting the advantage of the high-load factor obtained in the single large central station) is the data given in Table III. These figures are presented as being fairly representative of the average load factor for machines in service throughout the 18 hours of day-service operation, and also shows the machine-load factor for the same period.

TABLE III.—GIVING THE APPROXIMATE LOAD FACTORS UNDER GIVEN CONDITIONS

STATIONS.	Load Factor for Station in Operation for 18 Hours. 6 A. M. to 12 P. M.	Load Factor for Machines in Operation During 18 Hours. 6 A. M. to 12 P. M.
	%	%
Central	.744	.817
Lincoln	.632	.915
Charlestown	.637	.929
Harvard	.807	.874
Dorchester	.881	.883

The graphic statement given in Fig. 2, and which represents average costs for the four years ending Sept. 30, 1904, is well worth careful consideration, and well illustrates the possibilities in small stations when operated in parallel with other stations. With regard to the costs per kilowatt-hour given in Fig. 2, consideration should

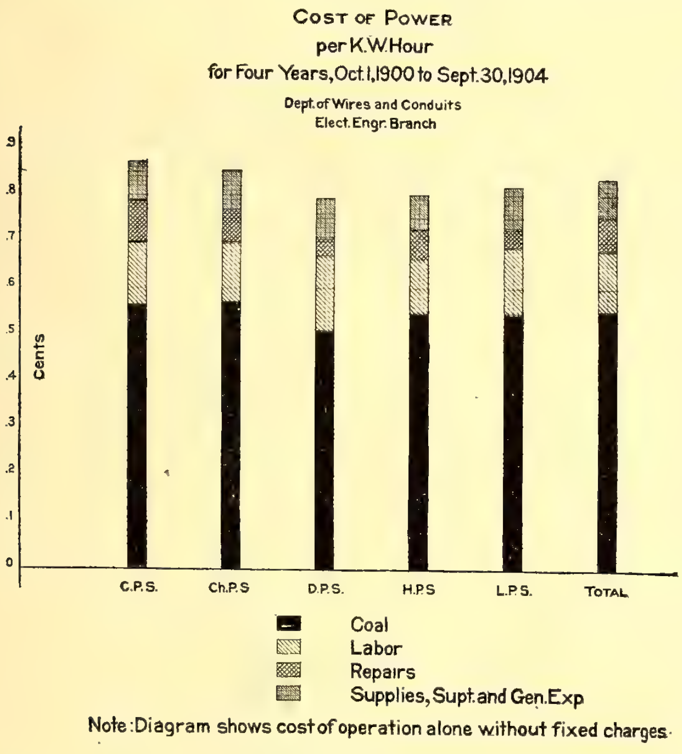


FIG. 2.—DIAGRAM SHOWING COST OF POWER IN BOSTON FOR FOUR YEARS

be given to the fact that the year 1903 is included in the four years taken. During this year, on account of the coal strike, the cost for coal was more than 35 per cent above that paid in normal periods.

It will be a long and difficult task to satisfactorily show in dollars and cents what advantage there may be and what saving is accomplished by having the several stations so nearly located to the load center of their districts, but in considering this fact as offset by the advantage there may be in the reduction in operating and maintenance expenses in the large central station, the costs given in the graphic statement afford interesting figures as a basis for comparison.

As a summarized statement, using the station outputs, cost for coal and power for the fiscal year ending Sept. 30, 1904, we have the following table:

TABLE IV.—SUMMARY OF POWER HOUSE DATA FOR YEAR ENDING SEPT. 30, 1904

STATIONS.	Rated Capacity in Kw.	Output in Kw. Hours, 1904.	Per Cent. of Load Within Miles.	Station Load Factor for 18 Hours.	Machine Load Factor for 18 Hours.	Cost of Coal per Ton at Station.	Cost of Power per Kw.Hr.at Sw.Board
			%	%	%		
Central	12,900	51,146,535	83	74.4	81.7	3.55	.00786+
Lincoln	8,100	31,978,676	100	63.2	91.5	3.50	.00760+
Charlestown	4,300	17,449.968	73	63.7	92.9	3.61	.00803+
Harvard	3,600	15,813,669	66	80.7	87.4	3.63	.00769+
Dorchester	2,000	8,487,644	80	88.1	88.3	3.73	.00759+
Average cost per kw. hour for all stations							.00778+

FEEDER SYSTEM

We may now take up the consideration of the power distributing system in its relation to the districts to which power is supplied from the several power stations just described.

Not taking into consideration the territory served beyond the limits of the railway company's tracks, there are approximately 72 square miles of populated territory included within the limits of twelve cities and towns served by the company's lines. This total territory is divided into sixty-four feeder sections. The smallest feeder section has 1.6 miles of single track. The largest feeder section includes 16.2 miles of single track.

The most heavily loaded section during the hour of greatest travel in the winter months requires, approximately, 2300 amps., which are supplied through five feeders aggregating 4,000,000 circ. mils of copper.

The smallest section with regard to power required during the hour of heaviest travel takes during the winter months approximately 55 amps., supplied through 1,000,000 circ. mils of copper. This large amount of copper capacity is required, since unusual loads may be thrown upon this section, due to temporary changing of routes in case blockades occur on certain streets.

In addition to the subdivision of the territory served by feeder sections there is still further division made by keeping the elevated division feeder system separate from the surface line sections, and the subway and tunnel sections independent of both the elevated and the surface feeder sections.

The general scheme of the distribution system is largely the result of growth with its accompanying experience, and may be said to be a compromise between two extremes of feeder layouts. While it would seem to be an ideal system from the operating point of view to have the feeder sections so disposed and limited that each might be supplied with power through a single feeder, thus giving the most complete control of the feeder system at the switchboard and securing the least disturbance to the general system in case of trouble on any part of a single feeder or its section, it is not believed that these advantages are sufficient to compensate for the extra copper required, and loss of the more efficient use of the copper installed. The other extreme, which is seldom resorted to, is where all feeders supply power to one large common section, which may embrace an entire system. While this scheme has the advantage of securing the most efficient use of the least possible amount of copper, it practically takes all control of the feeder system out of the hands of the operator at the station, and in case of trouble on any part of the system or upon a feeder, the entire feeder system may be seriously affected.

With us the size of the feeder section is determined by the location of the line to be supplied with power, its relation to connecting or cross lines, how heavy the traffic may be, the importance of quick control of any section in case of fire, and the number and size of feeders which the load conditions would seem to justify in running in parallel for the best operation at the switchboard.

By the use of section insulators in the trolley wires in connection with legs leading from the trolley wires to a switch in a box on the pole opposite from where the section insulators are installed, any two sections or number of sections may be tied together and run as one large section. In addition to this means of tying the feeder sections together, at suitable or advantageous locations in the feeder system, switches in pole boxes are installed so that any desired number of feeders may be tied together or thrown from one section to another.

With respect to the "L" division, subway, tunnel and surface feeders, emergency switchboxes, or switching stations, are located at the most advantageous points, so that the feeders of one division can be connected in with those of another, or so that feeders of one division can be disconnected from their regular section and utilized in another. For the manipulation of the feeder system outside the power stations in cases of emergencies, tests, or repairs, 964 section insulators and 1540 switches are maintained as important features

in the feeder system. By the foregoing arrangements any feeder wire or group of feeder wires if disabled may be quickly disconnected from the system and the service still be maintained by the use of feeders from other sections, or by tying sections together.

Considering the distribution system with reference to its physical construction the following amounts, sizes, kinds of material and types of construction enter into its make-up. The standard sizes of conductors used are 500,000 circ. mil, 1,000,000 circ. mil. and 2,000,000 circ. mil overhead wires or underground cables.

About ten years ago, for the purpose of keeping down the number of kinds and sizes of wires to be carried in stock, 500,000 circ. mil was adopted as the standard size for both overhead and underground conductors. Later, as the feeder sections increased in the amount of power required, transmission distances grew, and when general feeder wire adjustments became necessary on account of new power plants being added to the system, it was found desirable to include the 1,000,000 circ. mil conductor as a standard. With the construction and installation for the elevated division to meet the heavy current demands for this new kind of service, 2,000,000 circ. mil was determined upon as a suitable and standard sized conductor.

On Oct. 1, 1904, there were 424.078 miles of trolley wire and 16.015 miles of third rail being served by the following amount of copper conductor:

Total miles of overhead conductor	545.469
Total miles of conductor in conduits or buried	255.743
Total miles of conductor in submarine cables	5.254
Total miles of conductor, not including trolley wire	806.466
Approximate weight of copper in conductor	7,101,542 lbs.
Amount in weight of copper for each kilowatt capacity at stations	195 lbs.

UNDERGROUND CONDUITS AND CABLES

About 32 per cent of the power distributing system is carried underground, all feeder cables and a large portion of the return copper being carried in conduits, and the balance of the return wires buried directly in trenches or just outside the conduits.

The following shows the total amount of underground conduit in service in 1904:

	Miles
Total length of conduit	28.386
Duct length in conduit (cement-lined iron pipe)	76.341
Duct length in conduit (vitrified-clay pipe)	195.360
Duct length in conduit (wrought-iron pipe)	9.106
Total number of manholes	683

The underground conduit system was begun in 1894, and has been added to each year in varying amounts.

Practically the whole of the conduit system has been built by contract under the direction and supervision of the railway company's engineers. It may not be foreign to the purpose of this paper to briefly outline some of our practice and experience with underground conduits.

In the matter of construction our experience has shown that the less a conduit deviates in depth from 3 ft. between the top covering and the surface of the street the more satisfactory will be the conditions for the conduit system. The deeper a conduit is constructed in the street or highway the more likely it is to become a subsurface drain for the surrounding soil, the deeper and more expensive becomes the manhole construction, and the more difficult is the drainage. As more or less water will seek a drainage way in most street subsoils, it is an advantage in all cases where it is practicable to construct a conduit so that in cross section its height is greater than its width, thus having the fewer ducts on the bottom layer, and therefore the fewer wet ducts in the conduit, since any water leaking into a conduit will invariably get to the bottom ducts in any vitrified clay pipe conduit.

Experience has shown that it is desirable to drain manholes wherever practicable, as it is not possible, within reasonable cost of construction, to build them water-tight, nor is it believed practicable to maintain water-tight frames and covers to prevent surface water from getting into the manholes. Where conduits are built in streets containing gas mains and service pipes, it is believed that all danger from gas explosions can be avoided by maintaining perforated covers on the manholes. In so maintaining the covers the necessity as well as the advantage of having the manholes drained is obvious.

In laying out a system of conduits for street railway service, large trunk lines with one set of manholes should be avoided. Any large and important traffic section should be so supplied with power that a burnout or the disabling of any one section of conduit would not seriously interfere with or suspend car service. Cable burnouts or break-downs are due to various causes, and in spite of all precautions will sometimes occur, and in such instances either in the conduits or in the manholes one or more adjoining cables may be injured by the escaping current. It is therefore deemed to be good engineering to divide up trunk line conduits into two or more distinct lines, separated at least by 6 ins. of concrete and having separate systems of manholes.

It is important throughout any conduit system to isolate, so far as practicable, each cable conductor, both for its safety and for the safety of other conductors in case a burnout occurs. For street railway service, where cables are always required to carry their full current capacity, and when it is considered that single conductors as large as 2,000,000 circ. mil may be carrying 1600 to 1800 amperes, the chances for serious damage in case of a break-down in the insulation may be readily appreciated. In view of these considerations it is believed that single duct or pipe sections, built in the conduit, with all joints carefully sealed with cement mortar and well staggered in relation to joints in other ducts, will be found to give the most satisfactory conduit.

For the construction of manholes in city streets where water and gas pipes and other underground constructions are plentiful, it is believed that the use of good sewer brick will give the best satisfaction, since it will be found that the shapes of the manholes will be constantly varying on account of the limiting spaces and obstructions in the street.

An 8-in. wall is considered sufficiently strong for all sizes of manholes up to 6 ft. x 6 ft. x 8 ft.

For ordinary feeder cable transmission, manholes built with brick recesses or with cast iron or other type of hanger will give good satisfaction.

Where conduits and manholes are to be used for carrying high tension cables, it is believed that the importance of each conducting cable is such as to justify taking extra precautions in both conduit and manhole construction in order to secure complete isolation and safety from outside sources of injury.

CABLES

Taking into consideration the fact that our experience with underground cables has extended over a period of nearly eleven years, Table V is interesting as an indication of what may be expected in the life of lead-covered conductors. The installation and maintenance of underground cables is much more expensive than is the case with overhead lines, and the chances for trouble to the transmission system, in our experience, are greatly increased. Faults will develop in the cable from defects in the insulation, injury to the lead covering in handling it in the ducts, or from picks or bars when digging is being done in the streets, and in case of burnouts due to a break-down in the insulation of one cable every cable in the conduit may be more or less injured.

Ever since the underground cables were installed, a regular system of testing for trouble has been maintained. Depending upon the importance of the cables, size of conduit and the condition of insulation, tests are made on every cable varying in frequency from twice a week to once a month.. The insulation resistance test is used in keeping tab on the condition of the cable for the work it has to perform. While this method is somewhat expensive, in our experience it has proven fairly effective, and our records show that nearly 90 per cent of the defects which develop in cables are found by the tests and removed before a break-down and burnout in the insulation occurs.

For convenience and safety in the installation and maintenance of underground cables the following methods and practices have been found to give good results:

Preparatory to the installation of the cables, careful and accurate plans are gotten up showing the size of the conduit, duct, distance between manholes, size and shape of manholes and the relative locations of the conduits entering the manholes. Each manhole is designated by number and each duct entering and leaving a manhole is numbered.

Each individual cable is assigned its proper location in the conduit system, from the switchboard at the station to its terminal where it feeds into the overhead wires, and is diagrammatically shown and located in plan, by its own number and the number of the duct it occupies throughout the conduit system.

The cable lengths are required to be furnished by the manufacturer in proper lengths, according to lists furnished by the railway, each reel being marked with length numbers, number of feet in each length and the section of conduit indicated by the number of the manholes between which the lengths are to be installed. The pulling-in gang is supplied with the diagrammatic plans of the conduit, and also lists giving reel numbers, length numbers, number of feet in each length and the location of each length in the conduit system.

By such precautions there is secured the least amount of waste in cable, in labor of handling and the avoidance of trouble in jointing, testing and the making up of the cable records for future use.

When installed and jointed up ready for service, every cable is

stamped with its number in each manhole throughout its length.

It is important that each cable be as fully individualized as possible from the switchboard to its street terminal, so as to give the least possible chance for a mistake occurring in case of handling it as a feeder, testing it, or making repairs.

The following figures are believed to represent a fair average cost per foot for complete installation ready for service:

	Cents per Foot
500,000 circ. mil conductor; average weight per foot, 6.6 lbs. Cost of installing	2
1,000,000 circ. mil conductor; average weight per foot, 7 lbs. Cost of installing	2.5
2,000,000 circ. mil conductor; average weight per foot, 11.5 lbs. Cost of installing	3.25

The cost of maintenance per foot per year, which includes testing, inspection, repairs and changes, will amount to from 1 cent to 1¼ cents.

To date there is little conclusive evidence upon which to base a prediction regarding the life of an underground cable. With proper usage and care the life of a first-class cable would seem to be limited only by the period during which the lead covering remained intact. Under fair conduit conditions and with proper care and usage, I cannot see why an average life of from twenty-five to thirty years should not be experienced.

With regard to the question of type or kind of insulated cable which may be expected to give the best satisfaction, I would say that while our experience has included fibre, rubber and paper-insulated cables, covering a period of nearly eleven years, to date there has not developed sufficient conclusive information to allow of a statement which would show how much better one type of cable is than another.

In a few instances in recent years, consideration has been given to the possibility of using in underground conduits, rubber-insulated, heavily-braided and waterproofed cables without lead covering. As yet the experience with this type of cable has not extended over a sufficient period to prove its advantage over the lead-covered type, but if the manufacturer can cover the insulation with a waterproof braiding and compound having good lasting qualities, there is much to commend such a type of cable over the lead-covered type. The chance of break-down in the insulation would certainly be reduced to a minimum. If a burnout or break-down in the insulation should occur, the chances of the trouble spreading would be very small. The testing which is so important and desirable in the maintenance of lead-covered cables could practically be dispensed with.

In conclusion and in general, since the function of any power-distributing system is to supply adequate power whenever and wherever needed for the continuous and uninterrupted service as scheduled, the engineer has performed only a part of his duty when he has determined the amount and general layout of the copper required for carrying power for street car traffic in thickly populated sections, such as we have in Boston and vicinity. In the event of fire, streets are blocked, cars must be sent over roundabout routes, all power in wires within the sphere of the fire-fighting force must be quickly cut off, and at the same time the least disturbance to the general traffic be secured. The blockade of any track may occur, due to various causes. In such event cars must be diverted to other streets, and the feeder system must meet this new condition at any time and with practically no delay to the service. Burnouts on underground cables or the breaking down of overhead wires are occurrences which must be met, and the inconvenience which such interruptions may cause to traffic must be reduced to the smallest practicable degree. A good working system for power distribution must, therefore, be studied and perfected with the view of securing the least interruption to service within reasonable provision and cost, and having laid out and constructed such a system, its best use and successful operation is no small part of the consideration which must be given to secure desired results.

The construction and maintenance of the distributing system of the railway company is carried on through the department of wires and conduits, organized under a superintendant. The operation or use of the system is directly in charge of an official with the title of superintendent of power distribution. The switchboard operators are directly responsible to this official for the distribution of the power delivered at the switchboard and the best use of the system of feeders with their connections. Complete plans of the distribution system, showing details of every feeder, with their switches and connections, are kept at every station for the use of the operators.

Seven emergency crews are maintained, conveniently located in the several districts into which the territory served by the railway company is divided. These crews respond to all trouble calls and to all fire calls which may affect the lines and property of the railway company. These crews and also the entire organization of the department of wires and conduits are at the call of the power station operators at all times in case of trouble, or if the need arises for changes in the feeder system outside the stations.

In review of the power distribution system herein treated, considering it as a whole, the cardinal features distinguishing its construction, maintenance and operation are:

1. The construction and operation of several power stations conveniently located with respect to the territory served.

2. The operation of all stations in parallel, their bus-bars being tied together through feeder conductors which supply power to feeder sections common to two or more stations.

3. The great flexibility of the power distributing systems which enables the operators to quickly meet all possible contingencies either in power stations or in elevated, subway, tunnel or surface feeder sections.

4. The organization for the operation and maintenance of the distributing system.

5. The systematic testing, inspection and care of all underground cables and structures.

TABLE V.—SHOWING QUANTITIES OF CABLE IN CONDUITS EACH YEAR FOR A PERIOD OF TEN YEARS, AND THE AMOUNTS OF CABLE REMOVED EACH YEAR ON ACCOUNT OF DEFECTS DISCOVERED BY TESTING, AND ON ACCOUNT OF BURN-OUTS:

YEAR.	Total Amount in all Conduits.	Total Amount Removed Acct. Repairs.	Per Cent of Total Removed.	Total Amount Removed Account Burn-outs Due to Breakdown of Insulation.	Per cent of Total Removed.
1895	135,593′	2,969′	2.19	......	....
1896	224,404′	1,009′	.45	700′	.31
1897	339,245′	1,290′	.38	3.765′	1.11
1898	431,733′	1,671′	.39	......	....
1899	480,111′	2,587′	.54	16,708′	3.48
1900	599,229′	3,402′	.57	1,742′	.29
1901	657,979′	9,712′	1.48	1,815′	.27
1902	687,932′	6,770′	1.00	2,847′	.41
1903	698,361′	4,699′	.67	1,747′	.25
1904	777,406′	5,759′	.74	6,878′	.88
	......	3,868′	.841	36,202′	.70

AVERAGE PER CENT PER YEAR FOR TEN YEARS

Account repairs .... 0.841—Average feet per year, 3,986.8
Account burn-outs .... 0.7 —Average feet per year, 3,620.2

Total average 1.541

THE POWER STATION LOAD FACTOR AS A FACTOR IN THE COST OF OPERATION

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Chief Electrician United Railways Company, of St. Louis, Mo.

The question of keeping proper load charts of the power station loads has already been given much attention, and its value has long been recognized. The irregularities of the power station load diagram of a railway system depend entirely upon the nature of the travel on that system.

In urban railway systems the load curve is double peaked, having the characteristic morning and evening peaks of city travel when the people go to and from work. The breadth, magnitude and duration of these peaks depend, of course, upon local conditions, such as the size and layout of a town, and upon its sociology. In a manufacturing center the peaks are often remarkably symmetrical, and are little affected by climatic conditions, as the people usually go to work at about the same time in the morning and leave to go home at nearly the same time in the evening. In the larger cities, where it becomes necessary to transport a mixed community consisting of factory employees, merchants, clerks, shoppers, theater-goers, etc., the peaks lose their symmetry and the morning peak becomes lower and not so sharp as the evening peak. This is accounted for by the fact that in these cities the morning travel generally extends over a period from 6 a. m. to 11 a. m., while in the evening the homeward-bound passengers leave the business districts at about the same hour. Here also the condition of the weather and the season of the year become governing factors in the shaping of load curves.

Any method that will tend to smooth up the load curve is indeed worthy of consideration, as an increase in the load factor means a corresponding decrease in the cost of power per car-mile. This becomes very apparent when we compare the amount of station apparatus which is required to carry the peaks with that which is required to carry the average, and the manifest inefficiency of this

arrangement when the load factor is small. The load factor is the ratio between the average load and the maximum, and, therefore, represents the ratio between the amount of station apparatus required for the average and that required to carry the peaks. Further, since the morning and evening peaks are both 3 and 4 hours respectively in duration, we find that from 45 per cent to 60 per cent of the station apparatus of a system is idle for 17 hours or more.

Since there are so many causes, depending upon local conditions, which become governing factors in the shaping of a power station load diagram, and therefore determine the load factor of a system, it would be very presumptuous on my part to attempt to describe to you a certain fixed method by which the load factor of a system might be brought up and the advantages derived thereby. Each and every system has its own peculiarities, which have to be met, and which prohibit the application of a general method, hence they must necessarily be dealt with separately. I shall, therefore, confine myself to outlining a method employed by the United Railways Company, of St. Louis, in increasing the load factors of the main power stations, and showing how the load factor in this case plays a prominent part in the cost of power per car-mile.

A good many of the larger railway systems are the result of consolidations of the different independent companies in a locality, each having its own power stations, some of which it becomes necessary (for various reasons) to continue in service. In the majority of cases, this seldom constitutes the most economical arrangement of power stations for the consolidation. The power station layout of the United Railways Company, of St. Louis, is of this order. It would be a real treat, indeed, to have charge of a layout where the necessary central station or stations are located at a point where both fuel and water can be conveniently handled, together with enough sub-stations sensibly located, containing storage batteries, to cap off the peaks, etc., as in that event it would be possible to generate power at the lowest price without any apparent effort on the part of the power superintendent.

The United Railways system, of St. Louis, has in operation four power stations at the time of writing. Two of the larger stations, one of 13,950-kw and one of 7000-kw capacity, are kept in operation continuously, and constitute the main central stations. The two smaller stations are operated on swing watches on week days, that is, operated during the peak hours only. But bus wires have been run from the larger stations to both of the smaller ones and are there connected through circuit breakers and double-throw switches to either one of the two feeder busses, with which the smaller stations have been supplied. The installation of double-throw switches on both the feeders and bus wires in these stations makes it possible to operate them on one bus to which any number of feeder sections can be connected, and at the same time to operate the bus wires independently of the station on the other bus to which the rest of the feeder sections can be connected. During the rush hours the bus wires are connected to the same bus on which the stations are operated, thereby becoming equalizer wires. The amount of copper in the bus wires is just sufficient to carry the load of the smaller stations during the lighter part of the day, allowing a reasonable drop in potential.

The resulting economy of operation in this case more than justifies the expenditure of a good many dollars and cents in the bus wires, and also the resulting increase in the cost per kilowatt-hour of the power generated under this arrangement in the smaller stations, as may be seen by referring to the load curves.

In the accompanying load diagrams on Fig. 1 are shown two curves. The upper curve represents the total load of all the power stations for a period of 24 hours. The second curve represents the load on

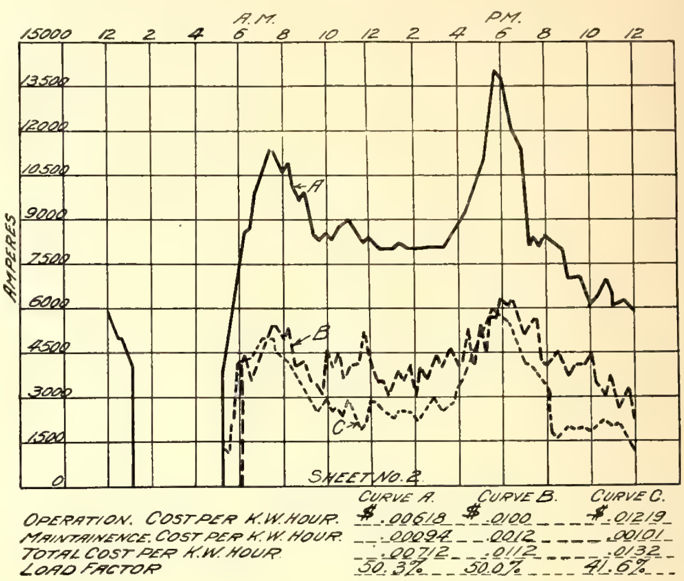


FIG. 2

the 13,950-kw station before the installation of the bus wires. Under the curves are shown the cost of operation and maintenance per kilowatt-hour, the cost per car-mile, the kilowatt-hours per car-mile and the load factor. Fig. 2 represents the performances of the other stations on the same day. Figs. 3 and 4 are carried out on the same order, and represent the output of each of the stations under the new arrangement, after the installation of the bus wires. The summary of the above is as follows: By plotting a curve which is the sum of the load of both the main stations, we can arrive at a curve, the load factor of which is nearly the correct factor to work by, as obviously the effect of the load factors of the smaller stations will have little bearing upon the total cost of operation as compared with that of the larger stations. Nevertheless the shutting down of these stations during the lighter part of the day, thus operating them at an absolute disregard toward economy, does influence the load factor of the main station curves very materially, and ultimately effects a saving. This is clearly shown by the curves in Fig. 5. This curve sheet gives the sum curves of the two main stations when working under both conditions. Curve

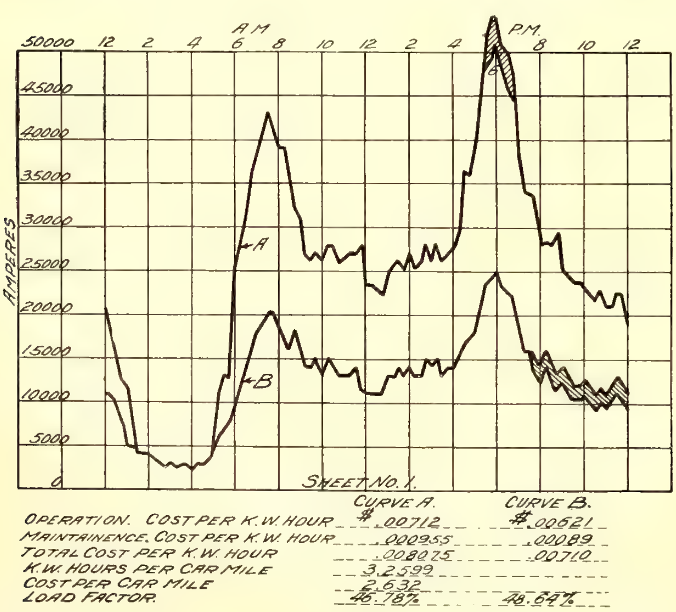


FIG. 1

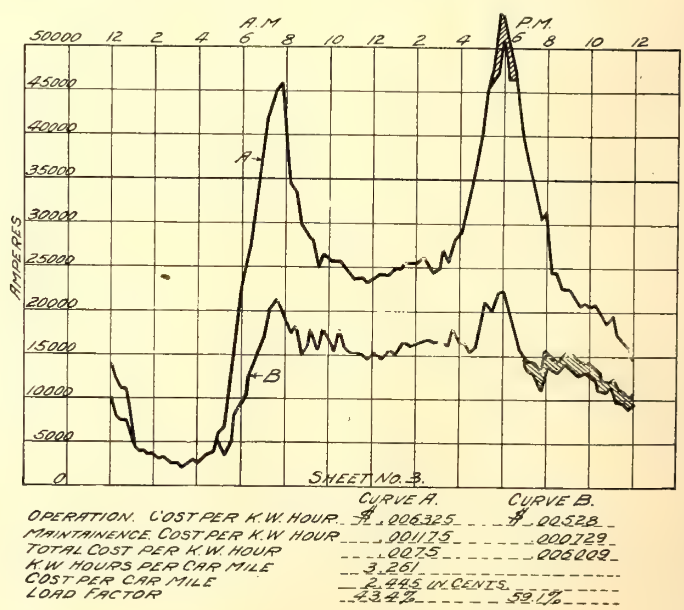


FIG. 3

"A" represents the load of the main stations for the same day on which all four stations were in operation all day. Curve "B" represents the load of the same stations when taking the load of the smaller stations during the lighter part of the day. Thus it is found that in bringing up the load factor of the sum curves of the main stations from 50.23 per cent, in the first case, to 57.7 per cent in the second, that a saving of .000575 of a cent per kilowatt-hour has been made on the total power cost. And on a basis of 310,000-kw hours per day, which is about the average output of the stations of this system during the summer months, this would represent a saving of $178.00 per day when operating under these conditions. All of the above figures, giving the cost of operation and maintenance per kilowatt-hour, were taken from a report received monthly

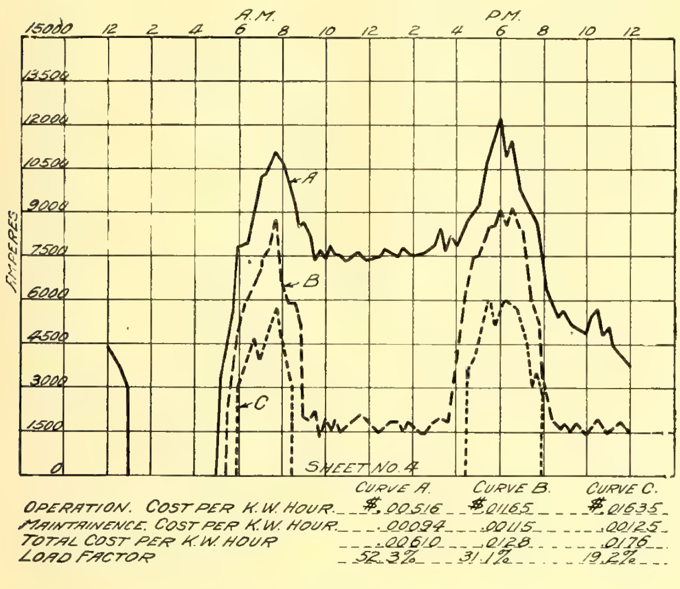


FIG. 4

from the auditing department, while the curves were plotted from readings taken daily. It is, therefore, possible that the cost of power per kilowatt-hour for the specific days shown on the curve sheets may have been a trifle more or less than given.

The curve sheets show the use of a storage battery to level the evening peak. The charge and discharge of the battery are shown

FIG. 5

by shaded areas above and below the load line. It has been found that since the installation of the battery, which is located in the business district of the city where the traffic is very congested, the service has been increased to a marked degree during the rush hours. A large reduction in the amount of copper required to handle the sections located in this district from the four stations has also been effected. This, and the fact that a battery can always be called upon in cases of emergency to take hold of the load point to the advantages to be derived in using storage batteries to smooth up the load curve when conditions warrant their use.

There is still a tendency among power men to regard batteries with suspicion and distrust, owing partly to the enormous cost of a complete battery installation, and partly to the rapid depreciation of a battery when overloaded. Nevertheless, the use of storage batteries abroad, with their attendant economical results by leveling load curves, has gradually led to the adoption of them here, until now we find that in every modern installation they form an integral part of the power equipment.

It is not my intention to take up the effects of storage batteries on power-station load diagrams in detail in this paper, as the same is getting rather lengthy. But from the resulting economy, as pointed out above by the crude and uneconomical arrangement of operating power stations in swing watches to bring up the load factor, it would seem that the question of employing batteries for that purpose should be given some attention and might be made the subject of a paper which would prove of considerable value to the members of the association.

PAPERS PREPARED BY THE COMMITTEE ON CONTROLLING APPARATUS

ASSEMBLED BY J. S. DOYLE,
Master Mechanic, Interborough Rapid Transit Co., New York, Chairman

MULTIPLE UNIT SYSTEMS OF TRAIN CONTROL

BY HUGH HAZELTON,
Electrical Engineer, New York

Electric motor power found its first application on single motor cars, and when its use was extended to train operation the single motor idea was for a time retained. Placing all the electrical apparatus on one car has the obvious advantage of simplicity and lowest first cost, and the use of a single motor car system was the natural and only feasible thing to do in the early development of the art. The first application of electricity to train operation was made at the World's Fair, Chicago, in 1893. The trains were made up of one motor car and three trailers. This installation was followed in 1895 by that of the Metropolitan West Side Elevated Railway, in Chicago, where similar equipment was used. The experience of these two roads demonstrated that electric traction was fully as reliable as steam, and more economical for this class of service. A single motor car pulling trains of several cars has, however, many of the limitations of the steam locomotive, and some of the pioneers in the art saw that important improvements could be made with electric traction, if the motors were placed on each car in the train and a suitable method devised for their simultaneous operation from the forward car. By such an arrangement the weight of the motive power equipment is distributed, and there is effective for traction as great a percentage of the total train weight as desired. The demand for more rapid acceleration and increased speed had forced steam roads to build successively heavier locomotives, which in turn required stronger bridges, heavier rails and better roadbed.

With an electric locomotive or a single motor car the problem of providing the necessary weight for traction is the same as with a steam locomotive, and an equipment designed for a specific service has the same limitations when increased service is desired. Frank J. Sprague was the first to point out the advantage made possible by equipping each car with its own motors and providing for their simultaneous control, and in 1885 he made the first concrete suggestion of such a "multiple unit system," with special application to the Manhattan Elevated Railway, in New York. The advantages enumerated by Mr. Sprague were as follows:

(1) The number of cars in the train may be increased at will, thus increasing the carrying capacity of the road.

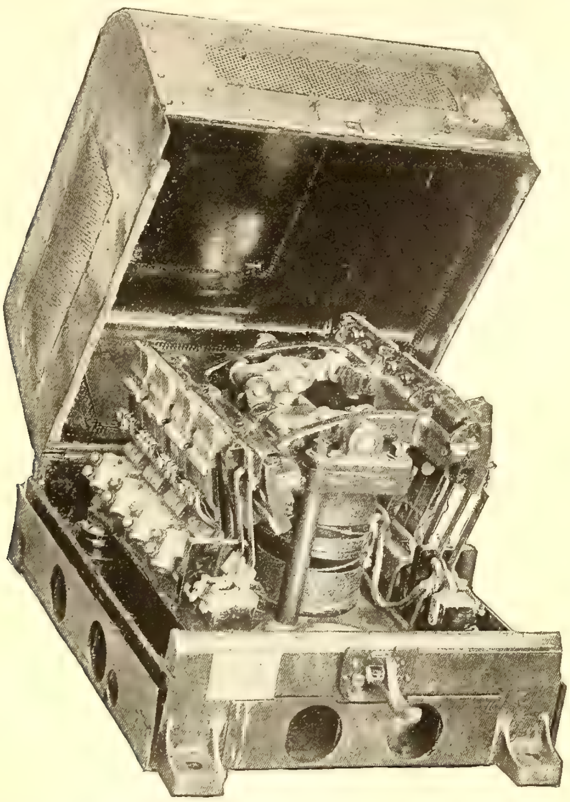
(2) The speed of the trains may be increased, thus improving the service and also increasing the carrying capacity.

(3) Long trains may be run at the same speed as single motor cars and with equal facility.

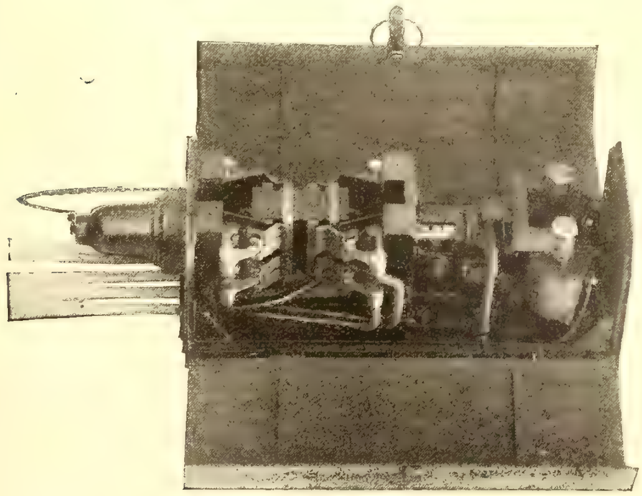
These claims are now fully established, and all of the elevated and subway lines in this country and Europe, which have been installed within the past five years, have adopted some type of multiple unit control, and the earlier roads which adopted the single motor cars are already replacing them by multiple unit equipments.

Although multiple unit control apparatus found its first application on elevated railways for passenger service, it is now coming

into use on interurban roads, and it may be of interest to consider its claims in this more extended field. The necessity for rapid acceleration on interurban roads is not as great as on elevated or subway roads, where the station distances are shorter, and the traffic demands on many interurban road may be supplied at first by single motor cars, but as the traffic increases it may become desirable to run trains of two or more cars. Unusual local conditions, such as fairs and ball games, also frequently make it desirable to run a number of cars together in a train. If the motive power equipment is designed for propelling a single car, the addition of trailer cars is sometimes impossible, if the road has steep grades, and it is always unsatisfactory, for it results in overloaded motors, reduced speed and unreliable service. If the cars have been equipped with multiple control apparatus it is possible to couple together as many cars as desired without increasing the load on the motors, or reducing the schedule, and the train of cars has the same ability to climb grades or start on a slippery rail as a single car. By adopting multiple control apparatus, therefore, no limitations are imposed which may restrict future increase of service.



SPRAGUE-GENERAL ELECTRIC REVERSER D. B. 26

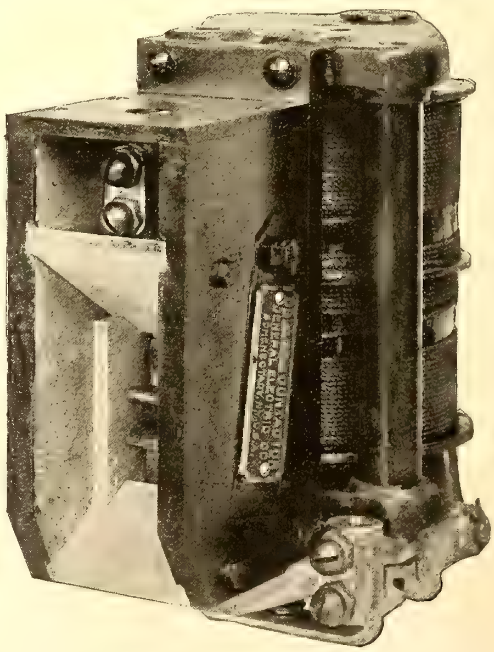


WESTINGHOUSE REVERSER, SWITCH TYPE 176C

The first operative system of multiple control was installed on the South Side Elevated Railway, in Chicago, and put into operation in 1898. The Boston Elevated Railway also adopted the Sprague control, of a somewhat modified type, and began the operation of its cars in 1901. The General Electric Company and the Westinghouse Electric & Manufacturing Company also developed multiple control apparatus, and sample equipments of the three types were put into competitive operation on the Boston Elevated and on the Brooklyn Elevated Railway.

In the original Sprague system a drum-controller placed on each motor car was operated by a pilot motor so attached as to give a step by step motion to the drum. A current-limiting relay was provided on each car to regulate the speed at which the drum controller was advanced through the resistance positions. The current operating the pilot motors on the several motor cars throughout the train was supplied through a control cable in circuit with the master controller, which was turned on or off by the motorman. The early form of Westinghouse control made use of a drum controller operated by an air cylinder with a ratchet arrangement. The air cylinder was provided with electrically-operated valves, and these valves were simultaneously operated throughout the train by control wires in the circuit from the master controller. A current limit relay on the forward cars provided automatic acceleration. In the original type of General Electric control a radical departure from the drum type of controller was made by substituting independent electrically-operated switches or "contactors;" each contactor consisting of a main switch with blow-out coil and a solenoid, wound for line potential at 600 volts. Similar contactors on the motor cars in the train are simultaneously operated by the control cable in circuit with the master controller. By the successive operation of the different contactors the resistance units are cut out until the motors are in full series; then the multiple connection is made and the resistance units again cut out until the motors are in full multiple. The original type of General Electric Control was adopted for the 800 motor cars of the Manhattan Elevated Railway, in New York, and put into operation in 1902. The control equipment supplied on this road does not include the current limiting relay, which accomplishes automatic acceleration, but this feature was included on the 430 motor cars of the Interborough Rapid Transit Subway, which were put into operation in New York in 1904.

There are at present on the market two types of multiple-control apparatus, known respectively as the Sprague-General Electric Control and the Westinghouse Electric Pneumatic Control. By the combination of the Sprague and General Electric Companies, the best features of the apparatus of both systems are brought together.



SPRAGUE-GENERAL ELECTRIC CONTRACTOR D. B.-41-A1

The "contactors" of the General Electric Company have proved greatly superior to the drum type of controller, and the Sprague-General Electric system now has the General Electric type of contactor switch and receiver, and the Sprague current limit relay and master controller.

The Westinghouse Company has also adopted in its present electro-pneumatic control a "unit switch," or contactor, in place of the original drum controller, and this switch is operated by means of an air cylinder with electrically-controlled valves. It is

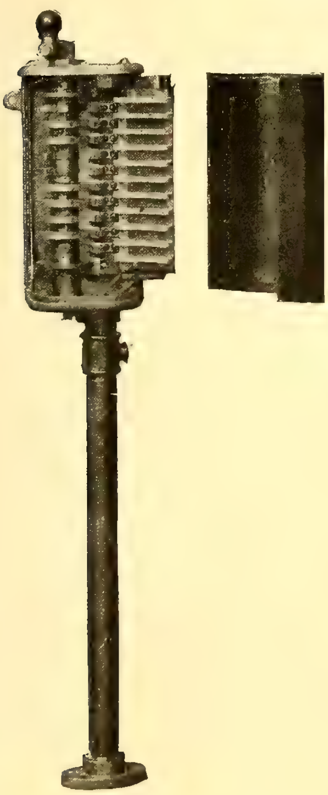
worthy of note that while the design of the mechanism has been radically changed and materially improved, the fundamental principles of operation, defined by Mr. Sprague and incorporated in his original apparatus, have finally been adopted almost unchanged by all manufacturers of control apparatus to-day. As a practical uniformity of results is obtained by the control apparatus of both systems now on the market, some attention will be given to the advantages common to both, and a comparison of the more important features of difference in the design of the apparatus supplied by each company.

CONTACTORS

In both systems independent switches, or contactors, are now used for closing and opening the main motor circuits. With these independent switches large current values may be handled with greater safety and certainty than was possible with the drum type of controller, for a wider air-gap and stronger magnetic blow-out is provided, and the contacts of the independent switches open more quickly than was possible with the revolving drum controller.

In the General Electric contactor the contact fingers are closed and opened by a solenoid wound for line potential, which is operative between the limits of 300 and 750 volts. The advantages claimed for this design are simplicity and low cost of maintenance, by reason of the small number of working parts.

The Westinghouse contactor consists of a similar switch and blow-out coil, but an air cylinder is provided for opening and closing the contact fingers of the switch, and electro-pneumatic valves for controlling the admission of air to the cylinder. The valve magnets are energized by current at 14 volts potential, supplied by a duplicate equipment of storage batteries. In the present design the Westinghouse contactor provides a wider air-gap between the contact fingers when open, and greater pressure to the contacts when they are closed, than in the General Electric design. The amount of air-gap and pressure necessary for satisfactory operation is, however, capable of definite determination, and with either solenoid or air cylinder operation, results equally satisfactory may be secured. The rapidity of closing the contacts is less with air operation, and the wear resulting from the hammer blow correspondingly less. While the use of 14 volts potential for the operating circuits makes it necessary to install and maintain duplicate storage batteries on each motor car, there are compensating advantages, for the operation of the contactors is made independent of line voltage and of interruptions of current on the forward car. Another advantage of the independent operating circuit is the possibility of stopping the train, even in the unusual event of simultaneous failure of brakes and power supply, by reversing the master controller handle to multiple so that the motors are made to act as generators.

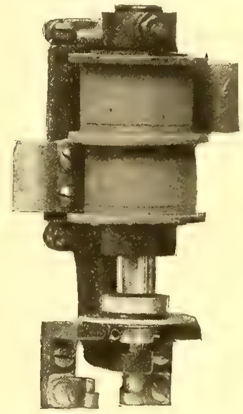


SPRAGUE-GENERAL ELECTRIC MASTER CONTROLLER

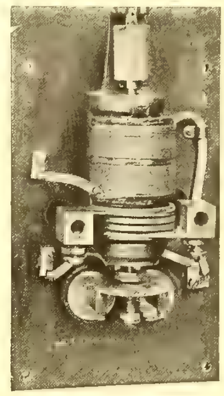
WESTINGHOUSE NO. 12 MASTER CONTROLLER

CURRENT-LIMITING RELAY

The current-limiting relay, common to both systems, consists of a solenoid placed on each motor car through which the current of one motor passes. The armature of this solenoid is attached to a contact disc which opens and closes the operating circuit for the main contactors. The operation of the current-limiting relay may be described as follows: In starting the train the motorman usually turns his master controller to the full multiple position. The current is first completed to the contactors that connect the motors in series with all resistance in circuit. This connection is maintained, and the armature of the current-limiting relay is drawn up until the counter e. m. f., due to the increasing speed of the motor armatures, causes the current in the motor circuit to drop to a value which no longer holds up the armature of the current-limiting relay. This armature then drops and makes connection to the operating circuit of the next resistance unit. The contactors are thus interrupted in their progression at each successive step, so that a nearly constant amount of current is allowed to the motors during the period of acceleration until the motors are in full multiple without resistance. The current-limiting relay is now recognized as an important, if not a necessary, feature of multiple control systems, and its use provides operating advantages which are not obtained in any system of hand control. With the hand controller the motorman starts his car as quickly or as slowly as his judgment or caprice may dictate, and the slipping of the driving wheels is the only limitation to the amount of current imposed upon the motors in starting. For heavy electric service it is specially desirable that the current used in starting trains shall be kept within certain well defined limits. Consideration of speed requirements and economical use of power, fix the minimum rate of acceleration and the corresponding minimum starting current, while the maximum allowable acceleration and starting current is defined by the following considerations:



WESTINGHOUSE CURRENT-LIMITING RELAY



SPRAGUE-GENERAL ELECTRIC CURRENT-LIMITING RELAY

(1) Excessive starting current results in violently fluctuating loads at the power house, and in order to meet these demands, the power equipment must be increased in output and the line equipment in carrying capacity. On interurban roads, where the number of trains on the line is small, the fluctuations due to heavy starting currents is especially objectionable.

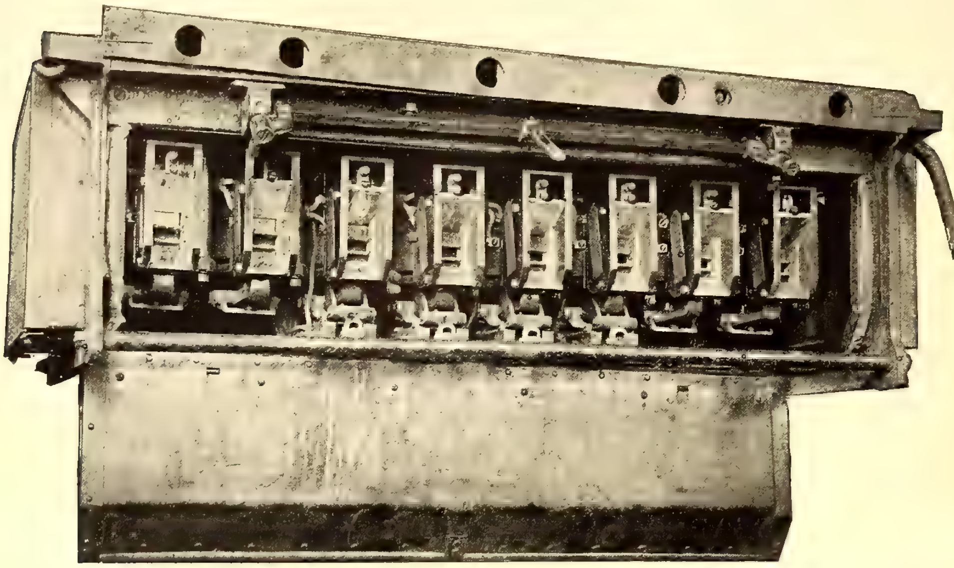
(2) Excessive current applied to the motors results in destructive mechanical strains which materially increase the maintenance charges on gears, pinions, armature shafts and bearings. On an elevated road which has recently discarded hand control for multiple control with automatic current input, the number of motors laid up in the shop for repairs is now only four, where formerly it was fourteen. With the current limit relay on each motor car, each motor does its share of the work, irrespective of possible differences in wheel diameter or variation in the electrical characteristics of the different motors.

MASTER CONTROLLER

The provision made in the master controller, of both systems of control, for opening the main circuit and applying the air brakes whenever the motorman releases the controller handle, is considered a valuable safety feature, and its application is so simple as to well warrant its use. The master controller on both systems is very small and compact, as it handles only the small currents of the operating wires. In the Sprague-General Electric system the control circuits require not over 2½ amps. at 600 volts, with two 125-hp motors, and in the Westinghouse system not over 10 amps. at 14 volts for a ten-car train.

LINE RELAY

In both systems a potential or line relay is provided which opens the main circuit whenever the supply of current from the line is interrupted. When the current is again restored to the line the contactors are closed through successive resistance steps before returning to their former positions. This device obviates the shock which would otherwise occur in passing over road crossings or turnouts where the continuity of the third rail is broken.



GROUP OF SPRAGUE-GENERAL ELECTRIC CONTACTORS IN CASE WITH COVER OPEN

BUS LINE

In connection with multiple systems of control, it is often advisable to install a bus line cable throughout the train connecting the several contact shoes, so that in case the shoes of one car are not in contact with the third rail, the motors of this car may receive current through the bus line from the other cars. The bus line greatly facilitates operation where it is necessary to interrupt the continuity of the third rail at street crossings or yards, and at such points a continuous supply of current for motors and for car lighting is thereby maintained. The bus line also serves to eliminate motor flash-overs, which sometimes occur when the cars are running at high speed, and the supply of current is suddenly interrupted and restored, as is the case when the contact shoes on one car momentarily lose contact by striking a high joint or an approach incline. In the case of snow or sleet on the third rail, the bus line serves to distribute current to all cars in the train from any car which may secure contact with the third rail.

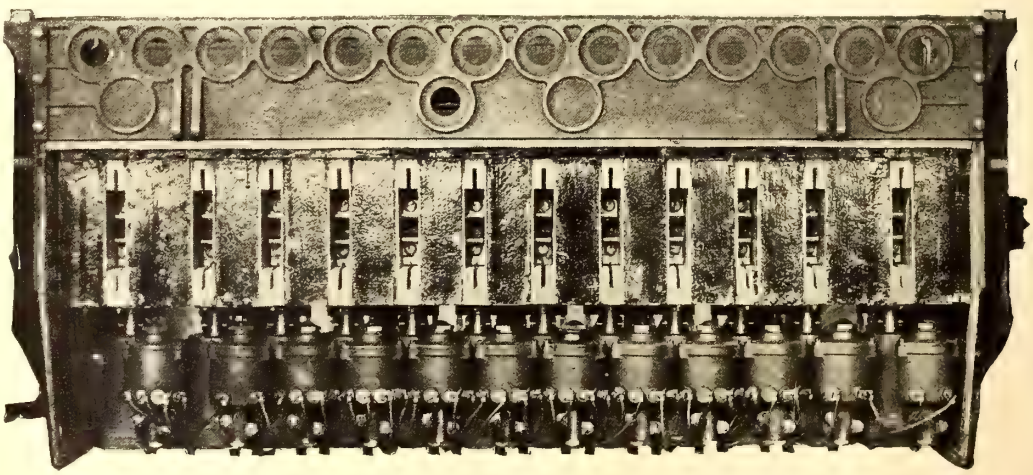
CIRCUIT BREAKERS AND FUSES

For the protection of circuits against excessive current, circuit breakers and fuses are used in connection with multiple control apparatus. Fuses are usually placed in the circuit from each contact shoe, and a common form of shoe fuse consists of two copper wires, about No. 9 B. & S., connected in multiple with suitable terminals and placed on the wood beam that supports the contact shoe. Some of the large roads are using enclosed fuses of 400 amps continuous-carrying capacity in place of the copper wire fuses. For protecting the main motor circuit some roads are using fuses and some circuit breakers. The type of fuse most widely used for the purpose consists of a copper ribbon 10 mils in thickness and 1¼ ins. wide, placed in a fireproof box with magnetic blowout. A hole ½ in. in diameter is made at the center of the ribbon, so that the fuse will begin to melt at the center. A copper ribbon of this size will carry 400 amps. continuously. For larger capacity the number of copper ribbons is increased. These fuses will open an overload or short-circuit with entire safety, and the cost of renewals is small. They do not open a short-circuit with as little noise and flash as the enclosed type of fuse, however. When a circuit breaker is placed in the main motor circuit it is arranged with a tripping device, placed in the motorman's cab, and in some cases the circuit breaker may be reset from the cab also. There is some doubt about the advisability of resetting the circuit breaker until an examination of the cause of its opening is made, and the trouble remedied.

In equipping cars with multiple control the practice of placing all the apparatus under the car has now become standard. The main motor circuits are all kept below the car, and the wiring is done in iron conduit pipes, and the bottom of the car is thoroughly protected by fireproof material. These precautions have greatly reduced the risk of fire, and on one of the elevated roads in Chicago, which has recently replaced its original hand control by multiple control apparatus, the underwriters have voluntarily reduced the fire insurance rate. The reduced fire risk is also given as the controlling reason for the installation of multiple control apparatus on single-motor cars on one of the street railway lines recently opened in Boston.

Before leaving the subject of multiple control, a word should be said concerning the reliability of the apparatus in service—for this is the final measure of merit.

During the first years of its introduction, the most serious obstacle against the adoption of multiple control was the apparent complication of the system, which suggested a doubt as to whether it could ever be operated with as few failures as the simpler apparatus of hand control. The experimental stage is now past, however, and in the more modern types of multiple control it is safe to say that the apparatus is fully as reliable in operation as hand control, and it has the ability of handling much larger current values. On the Manhattan Elevated Railway, in New York, where there are over 800 motor cars in daily service, the number of delays to service chargeable to failure of control apparatus averages only about five per month. It is the practice to inspect the control apparatus on this road once every three days, and except for occasional cleaning, little work is necessary.



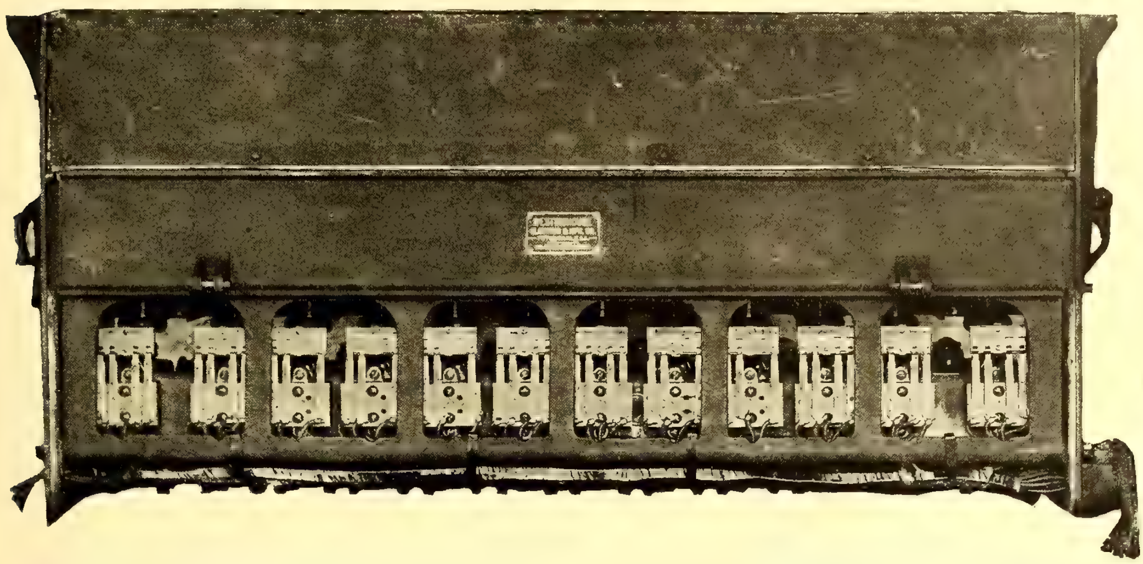
WESTINGHOUSE UNIT SWITCH GROUP TYPE 253, REAR VIEW, COVER REMOVED

In conclusion, the writer would express the hope that this paper may serve to emphasize the merits of the multiple control system for many interurban and street railway lines where the limitations of hand control have stood in the way of the best service and most complete development of the property. The ability to run cars in trains of any desired length, without reduction in speed, and without overloading the motors; the advantage of limiting the current during acceleration to a predetermined value, and the decreased fire risk by placing the control apparatus under the car, are features of the multiple control system which warrant the attention of all progressive railway men.

THE SERIES-PARALLEL RAILWAY CONTROLLER

BY W. A. PEARSON
Electrical Engineer, New York City Railway Company

When the first electric railways were put into operation one small motor was considered sufficient to propel a car. On some of these early equipments in which shunt motors were used, the brushes were designed to be moved around the commutator for the purpose of reversing the direction of rotation, it being considered impossible to provide the same neutral commutating points for both directions. In developing the series motor it was found that common neutral points for both directions of rotation could be produced, permitting the use of a double pole, double-throw switch for reversing the connections of the armature leads.



WESTINGHOUSE UNIT SWITCH GROUP, TYPE 253, FRONT VIEW, COVER REMOVED. (SEE PAGE 568)

The simplest way to start and control the speed of the single motor was to use a dead resistance in series with it. This method, which was adopted, has been successfully used for single motor equipments since the earliest days of the art. To meet the increased requirements of heavier cars and higher speeds, a second motor was added to the equipment. As the rheostatic control had proved sufficiently satisfactory for one motor equipment, it was also considered suitable for two motors permanently connected in parallel. Consequently a heavier rheostat was used with two motors connected in this manner.

At first a reversing switch similar to that used for a single motor was employed, the armature leads from the two motors being connected in parallel. This connection was soon found to be impracticable owing to the unbalancing of the load on the two motors, and necessitated the use of separate reversing switches.

In order to obtain an efficient running speed at somewhat less than the full speed of the motor, several methods of varying the field strength were tried with different degrees of success. Some motors were provided with field taps, or "loops," the full field being intended for use in starting and in ascending heavy grades. The field strength was weakened by cutting out a portion of the winding by means of the tap, thereby allowing more current to pass through the armature, increasing accordingly the speed of the motor. Another method consisted in connecting sections of the field coils, first in series and then in parallel, to produce different field strengths. These two methods were used for a few years, and finally abandoned owing to troubles resulting from the burning out of field coils. In the next field variation method that was used, a resistance was placed in shunt around the fields of each motor, thereby accomplishing the same result, but in a somewhat different manner. This also led to complications, as motors were operated under such varying conditions. In some cases the full field point was used excessively by the motorman, the coils becoming overheated, and in other cases the shunt point was used too much on heavy grades, resulting in armature and commutator troubles. Field variation for obtaining speed control was abandoned by the manufacturers of railway motors about nine years ago, and since that time but two speeds have been provided without series resistance in controllers supplied with two-motor equipments.

About fourteen years ago the attention and energies of manufacturers of railway apparatus were applied to the development of a control for two motors, which, when starting or running slowly, would waste less power than the rheostat and would permit running efficiently at half speed. The method which seemed to promise the best result was to start the motors in series, and after they had reached their full speed for this position, reconnect them in parallel. Many different experimental controllers were constructed in the attempt to produce a satisfactory piece of apparatus. Nearly all original electrical apparatus was crude as viewed from our present standpoint, to which view these early series-parallel controllers formed no exception.

One of the forms was fan-shaped with a stationary slate board to which were secured the motor, resistance and other contacts, with a movable arm, pivoted at its lower end, and adapted to move from side to side of the slate board, thereby making the necessary circuit combinations. This form was defective for two reasons. The circuits made were not suitable for giving proper speed variations, and no adequate means were provided for breaking the arcs formed at the contacts. Several different manufacturers attempted to design controllers of this shape, both for single motors and two motors, but without success.

A more successful series-parallel controller was brought out in 1892, which was located beneath the car and operated by means of rods and bevel gears from either platform. This controller was used in conjunction with the same reverse switch as was used with the rheostatic control. It was expected to fill the great want, but after several hundred had been put into service it was found that improvements were necessary. The starting of the car with this form of controller was jerky, as an insufficient number of points had been provided, while the impossibility of properly installing the controller under the car, so that lost motion in the gears would not be excessive, produced serious burning at the contacts. This controller contained a magnetic blow-out for disrupting arcs, which was very much superior to anything made previously and which served its purpose in proving the value of the magnetic blow-out. It was also the first controller which shunted one motor in passing from series to parallel.

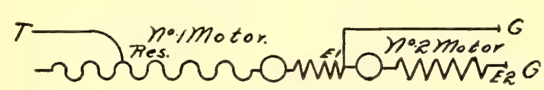


FIG. 1

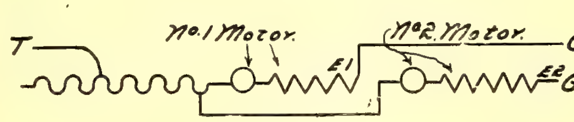


FIG. 2

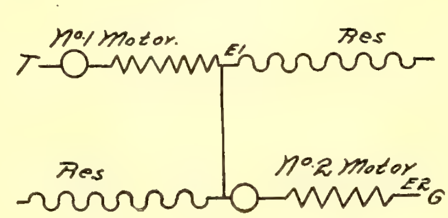


FIG. 3

At about the same time another form of series-parallel controller was brought out by another manufacturer, in which a cylinder was used in conjunction with stationary contacts, or fingers, for producing the different resistance and motor combinations. As

it was installed on the car platform it did not require operating mechanisms and was in consequence simpler in construction and not liable to the troubles due to lost motions in transmitting the turning effort from the operating handle. This controller also met with partial success, although the arcing at contacts was considerable, which, in the absence of a magnetic blowout, caused the principal trouble. These two forms of controllers clearly demonstrated the practicability of series-parallel control, and demonstrated that the magnetic blowout to take care of arcing, and the cylinder for compactness and simplicity, were necessities in the design of a controller for operating two motors of the capacity about 30-hp, then used.

The final outcome of the series-parallel controller for street car service was the present well-known K-type, which has been practically standard for about twelve years. This controller owes its success very largely to the form of magnetic blowout employed for extinguishing the arcs formed in opening the circuits and the method of making the transmission from series to parallel. Other forms of magnetic blowouts differing in detail have since been designed which have operated satisfactorily, but the form used in the K-type of controllers was the first to be made commercially successful.

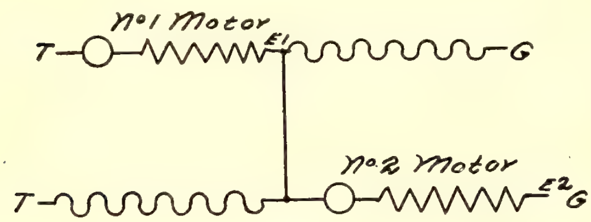


FIG. 4

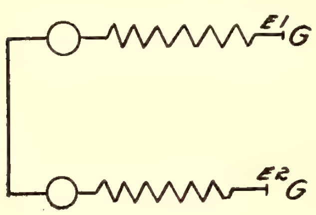


FIG. 5

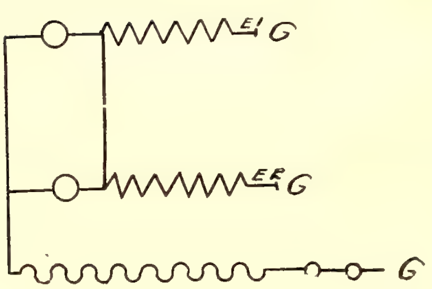


FIG. 6

In this type of controller, after the motors have reached the full series position, a portion of the starting resistance is quickly reinserted in the circuit and a shunt is put around the No. 2 motor by connecting E-1 to ground, thereby eliminating that motor from the circuit, as shown in Fig. 1. Immediately after this circuit has been established the connection between No. 1 and No. 2 motors is broken, and the positive lead to armature of No. 2 motor is connected to the rheostat, while the line current then passes to No. 2 motor, and the motors are in parallel, as shown in Fig. 2.

In the L type of series-parallel controllers, instead of maintaining the current through one motor during the transition, the circuits of both motors are broken. This method of passing from series to parallel was adopted in railway controllers for motors of a total of over 250 hp. It was found that the arcing in the controller when using the K-type of connections was too great to permit their use in large controllers.

In the development of multiple-unit control it was found that a better method of making the change from series to parallel, which had been proposed before the first K-type of controller was made, was possible with separately actuated switches or contactors. This is what is known as the "bridge method," and consists in keeping the current on both motors during the transition. Each motor is provided with a separate resistance, and when full series has been reached the connections are as shown in Fig. 3. When passing from series to parallel the first transition step is with resistance for No. 1 motor connected to the ground, and resistance for No. 2 motor connected to trolley, as shown in Fig. 4. It will be seen that this last step has put the two motors in multiple with an equalizing connection between E-1 and the positive side of the armature of No. 2 motor. This equalizer is next open circuited, and the motors are in the first parallel position. This method of making the series to parallel change permits a somewhat smoother acceleration than with the K-type of connections, but it is not essential for light equipments where great smoothness is not such an important consideration, as on heavy cars operating with multiple-unit control.

Several attempts have been made to produce a control which would be still more economical in use of power than the series-parallel method now in use. One of these, on which a considerable amount of ingenuity has been expended by different inventors without producing satisfactory results, consisted in providing a "counter electromotive force generator" in series with the motors, so that they should not require any resistance to consume energy in starting. This scheme proved complicated and expensive, and in actual service the proportionate time consumed in operating motors at below half speed, or between half and full speed, was so inconsiderable that there was no saving in power of consequence. Another method, somewhat attractive to those unacqainted with the excessive complications involved, consisted in the use of shunt field motors with control connections arranged for generating current and returning it to the line when stopping the car or descending grades. A number of patents have been taken out for different means of accomplishing this result, and various attempts have been made to produce a satisfactory motor and control. It is very attractive in theory to be able to make the motors on a car generate useful current, but there are a number of obstacles which have thus far prevented practical realization. The motor must be provided with a shunt field with apparatus for varying its strength, dependent upon the speed while braking, and apparatus must also be provided for giving practically a straight series field for starting. In addition, it is necessary to connect the armatures in parallel and series relation for braking, according to the speed of the car. When the armatures are in series, and the field strength is at a maximum, the minimum car speed at which current at line potential may be generated is obtained. It is obvious that when the car is moving at a speed less than this critical speed, the motors will be taking current from the line instead of furnishing it.

On a K-10 controller, or similar two-motor equipment, it is a well-known fact that in an emergency the car may be stopped when the trolley is off, or main fuse blown, by throwing the reversing handle to its backward position and turning the controlling handle around to multiple. The connections made are such that the two motors are really connected in series, as shown in Fig. 5, but in such a manner that the voltages of the two armatures oppose each other. If these voltages were exactly the same there would be no flow of current, and consequently no braking. As a matter of fact no two motors are identical, and the slight difference in initial voltage gives one motor predominance over the other and determines the direction of the flow of current, one being obliged to reverse its polarity. This can be readily accomplished, as the changing motor is operating as a series generator. If the car is moving at any more than a very moderate speed the current generated by the two motors will almost instantly reach an amount sufficient to slip the wheels. As the momentum of the car tends to throw more than the normal weight upon the front wheels, and relieve the rear wheels of a corresponding weight, it is to be expected that the rear wheels should slip first. The instant the wheels slip the motor on the same axle naturally ceases to generate current, but as current from the other motor is flowing through it, it is rotated in the reverse direction as a motor. It is well for motormen to know that an effective braking can be accomplished in an emergency by this method.

On four-motor equipments where two motors are permanently connected in multiple, it is only necessary to throw the reverse handle to cause the motors to generate, as the circuits are already made, and it is only necessary to reverse the relation of armature and fields. With a four-motor equipment, care should be taken that the car is brought to rest before the reversing handle is returned to its forward position, otherwise the contacts are liable to be burned. A recent controller, known as the K-28, has been provided with extra air space in the vicinity of the reversing contacts, while barriers are located between them, so that the chance of injuring the reversing switch when "bucking" the motors has been removed

When motors have been used with electric brakes the controller made connections somewhat different from the foregoing, as it was necessary to vary the quantity of current taken and divide the load equally. Fig. 6 shows the connections.

Electric brakes have not proved very satisfactory, principally for the reason that their action was too irregular, and they could not always be depended upon. In order to generate current satisfactorily it was essential that the commutator should be in good condition. A comparatively slight increase in the resistance of the circuit, caused by a dirty commutator or loose connection, would prevent a motor from building up at a certain speed. Due to this irregular action in the motor it was sometimes difficult to make a smooth stop with electric brakes. It was also found that the high voltage and additional duty imposed upon the motor was productive of commutator trouble and overheating.

The duty required of a street car controller has gradually increased. Instead of two 30-hp motors as formerly, four larger motors are now controlled in the same space. Voltages have been increased and the capacity of the line also raised, so that when an extraordinary arc occurs in a controller from any cause the damage is greater than formerly. For this reason it is especially necessary to keep fingers properly adjusted, segments renewed and connections tightened to avoid troubles on the road.

There is a growing tendency to place controlling apparatus for large and medium size motors under the car. It removes the heavy capacity parts from the platforms and not only leaves a greater passenger space but also eliminates all possibility of danger from controller "blow ups."

PAPERS PREPARED BY THE COMMITTEE ON TRACK

ASSEMBLED BY FRED G. SIMMONS,
Superintendent of Construction and Maintenance of Way, the Milwaukee Electric Railway & Light Company

THE TREATMENT OF RAIL-JOINTS

BY FRED G. SIMMONS

The treatment of rail-joints is undoubtedly one of the most important matters concerning both construction and maintenance which obtrudes itself upon the consideration of the "way" engineer, and its more or less successful solution interests in an almost if not quite equal degree the superintendent of transportation and superintendent of rolling stock, who are responsible for the cars operating over the joints; and the power house man and electrician, whose current efficiency depends largely upon their condition. Allowing the unquestioned interest of the financial and managerial representatives, we find the subject to be one in which practically the entire staff is vitally concerned. It is, therefore, impressed upon us that a fairly successful method of treatment constitutes information which it becomes the duty of this association to place before the electric railway world.

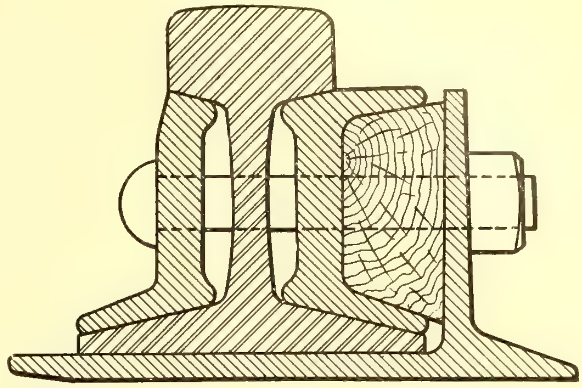
It would probably be a hopeless task to ask any body of men to establish a standard or uniform method of treating the rail-joints, as several methods may approximate in point of efficiency and the local conditions influence each particular individual in forming a preference for his own method, provided that method has rendered a fair degree of satisfaction in the past. The idea of the writer, however, in taking up this broad subject has been to set before the electric railway interests as nearly as possible exact data as to the most successful methods now employed in bringing about the maximum of efficiency in the treatment of rail-joints with regard to both electrical conductivity and surface and alignment.

It is undoubtedly a fact that many roads, particularly the smaller ones, are continuing to use some inferior and inefficient type of joint, solely because they have been unable to obtain comprehensive information as to some more reliable and more satisfactory type. The failure of one person or system to obtain proper results has often unjustly condemned some type of joint in the minds of many persons, when the reason for such failure may have been, absolutely, a lack of proper knowledge and proper workmanship in the application thereof.

The present most accepted methods are divided into two exact types: (First) the mechanical joint, bolted, riveted or wedged, and connected by means of a metal bond for the passage of electricity with the least possible resistance. (Second) The various kinds of welded joints (thermit, zinc, electrical or cast). The first type applies more particularly to interurban or exposed track, the second type to urban or buried track.

In Milwaukee the Weber joint has been in use nearly eight years, the first joints applied have been entirely undisturbed up to the present time, no work has been done on them, and not one low or battered joint has developed. With constant use on a double track for a period approaching eight years the writer considers this a first-class showing. The joints are used on a 56 lb. section of ordinary T-rail, and the summer traffic particularly is very heavy. Accompanying engravings show the latest improved type of both the Weber and the Continuous joints.

Information received through correspondence would indicate that many consider the Continuous joint a very satisfactory one. The

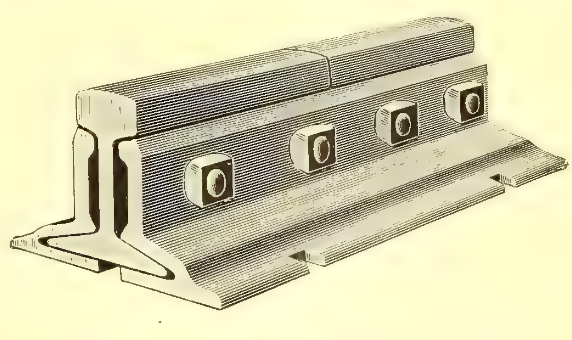


WEBER RAIL-JOINT

following letter, received from H. S. Cooper, general manager of the Galveston City Railway Company, of Galveston, Texas, is an interesting one, and is a fair expression of the sentiment of the country in this matter as nearly as the writer has been able to ascertain:

Dear Sir—We are in receipt of your letter of March 3, enclosing by-laws, etc., of the A. R. M. E. A., and note your inquiries in regard to Continuous rail-joints. In our work here we absolutely could not do without a Continuous rail-joint, or one fully as good. We have in use quite a number of miles of 40-lb. and 45-lb. T-rail, left over from the horse-car days; also our standard for unpaved work—60-lb. A. S. C. E., and in our paved portions a 6-in. 60-lb. T-rail, on all of which we use the Continuous rail-joint. Owing to the saltness and dampness of the atmosphere and soil of this place, exposed rails rust very rapidly, and, with ordinary fish-plate or angle-bar, we find it impossible to get a suitable joint after the rail has started thoroughly rusting, whereas, by using a Continuous rail-joint, we are able to maintain our joints in nearly as good condition as the balance of the rail.

Of course, we have to use great care in the application of the joint,



CONTINUOUS JOINT

making positive that we get a good fit by cleaning the roughness from the rail, by seeing that the joint is thoroughly in contact its whole length and well driven up, and by making certain that the bolts are completely and permanently tightened. On new rail, especially where it is put in paving, we keep on tightening the bolts and slowly driving up the joint as long as it is possible to do so, and until the paving is put in, as we find that, similarly to any joint we have tried, no matter how tight the bolts and plate are made when first put on, there are a number of small "lumps" or inequalities" in both joint and rail, which prevent it being made absolutely tight, and with the running of the cars over the joints for a few days, it seems to cause a motion between the plate and joint that rubs down these inequalities to a certain extent, and allows both joints and bolts to be tightened a little more. In practice, we clean both rail and joint thoroughly and swab the rail surface with some cheap oil, apply the joints with bolts, driving up the joints all that is possible, hammering up the bolts and tightening with from an 18-inch to 24-inch wrench, one man. After a few days we send a man over with a light hammer and wrench, and have him tighten up every bolt by hammering the head lightly while he puts his weight on the nut, and, if there

is an opportunity to repeat this operation before the track is closed up by paving or otherwise, we do so.

We have quite an amount of 6-inch rail laid in brick, on all of which these joints have been used, and have had but very little trouble from loose joints in this rail, some of which has been down two or three years. In all, I do not believe that we have had to take up or retighten more than fifteen or twenty joints out of quite a number of hundreds. As stated above, we think it is very largely on account of proper and thorough application of the joint, and the writer personally knows, from a large experience in other places, that where complaints have been made as to Continuous joints, or of the Weber or Atlas types, the trouble has been largely due to imperfect application in the beginning, and to lack of proper inspection afterward.

Properly applied and in proper location, I think there is very little choice between the three types of joints above mentioned, so far as the practical results of keeping joints in good shape are concerned.

H. S. COOPER,
General Manager, Galveston City Railway Company, Galveston, Tex.

The question of electrical conductivity in relation to the mechanical joint affects them all in relatively the same proportion. The method of bonding the rail ends so as to secure the necessary degree of effectiveness is a subject of such importance that we have decided to assign it for consideration in a paper by itself. The writer believes, however, that either of the two types of joint mentioned heretofore lends itself equally to any of the more approved methods of bonding.

The study of the various methods of welding the rail ends is, we believe, more particularly interesting to all those roads which have a large proportion of urban trackage, the rail of which is buried in the dirt, macadam or paving of a public road or street, accommodating itself more thoroughly to the somewhat unusual conditions imposed by the formation of a practically continuous and unbroken stretch of steel.

The writer is aware that the officials of many roads are outspoken in their opposition to any rail-welding process, and in numerous cases claim a more or less disastrous experience either on their own part or within the range of their observation as sufficient reason to warrant their adverse opinion. We believe that all these unsuccessful experiments in rail welding are due either to unusual local conditions, which in no way affect the general proposition, or to a failure to thoroughly appreciate the requirements necessary to a proper and efficient handling of the work; these requirements varying, of course, with the various methods. The correspondence carried on relative to these matters has convinced the writer that each of the four methods mentioned earlier in this article, viz.: thermit welding, zinc welding, electrical welding and cast welding, is capable of successful demonstration, and that track so treated can be made in each case more efficient both as to mechanical strains and electrical conductivity than by any other known methods.

In order that a more general knowledge of the practical application of the welding of joints may be spread broadcast over the country, we have had papers prepared treating on these four approved methods and have been able to secure in each case an engineer whose experience has been such as to insure an article prepared from certain knowledge. These papers follow:

COMPLETE WELDING OUTFIT FOR THE THERMIT RAIL-WELDING PROCESS

THERMIT RAIL WELDING

BY G. E. PELLISSIER,
Civil Engineer, Holyoke Street Railway Company

The "Thermit" process of welding steel rails dates from the year 1899, and is the discovery of Dr. Hans Goldschmidt, of Essen, Germany.

Thermit, as described by the discoverer, consists of a mixture of powdered aluminum and iron oxide, and its application to welding depends upon the following fact: If the mixture is ignited at a single point by means of a special ignition powder, peroxide of barium and aluminum, combustion proceeds without further supply of external heat and without any combination with the oxygen of the air, at the same time developing a temperature estimated at 3000 degs. C. By the reaction the iron oxide is reduced to nearly chemically pure iron, the oxygen of the iron oxide combining with the aluminum to form aluminum oxide or artificial corundum, the reaction being chemically expressed by the equation $Fe_2O_3 + 2Al = Al_2O_3 + 2Fe$.

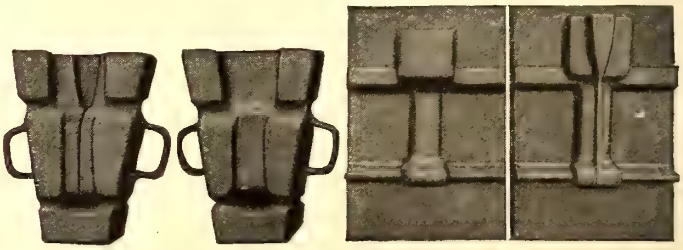
The aluminum oxide, having the lower specific gravity, separates from the iron, rising to the top, where it may be decanted off or the pure iron drawn from beneath. This iron, when poured upon metals to be repaired or welded, has the property of uniting intimately with them, due to the very high temperature to which it is raised. When used for welding, steel or other ingredients, such as carbon, manganese, etc., are added to the thermit mixture to give the resultant metal more or less the properties of the steel with which it unites.

The reaction is carried on in a special crucible made of sheet iron lined with some very refractory material, usually magnesia or aluminum oxide the by-product of the reaction itself.

RAIL WELDING

The complete outfit for welding steel rails consists of the crucible just described, a pair of molds made to fit the section of rail to be welded, a pair of clamps to hold the molds in place, a wire brush to clean off the dirt from the ends of the rails, a small gasoline torch to dry off any moisture which may be present on the parts to be welded and to take the chill out of the metal, and a portion of thermit weighing from 15 lbs. to 25 lbs., depending on the section of rail to be welded. If an absolute butt weld of the ball of the rail is desired, a pair of heavy clamps for upsetting the rails while hot is also necessary. The whole outfit is easily transportable in an ordinary wheelbarrow.

The molds are easily made, being simply sheet-iron flasks filled with a mixture of clay and sand, or any other material suitable for steel casting. The only precaution necessary in making the molds is that they should be well vented and thoroughly dried. The flasks may be used repeatedly, of course, but have to be refilled each time after using. One man can fill from fifteen to twenty pairs per day.



PATTERNS AND MOLDS

In making a weld, the ends of the rails are first cleaned with the wire brush (this simply to get the dirt off, as rust makes no difference), and heated to dispel the moisture. The rails are then brought into exact alignment and the molds put on and fastened with clamps.

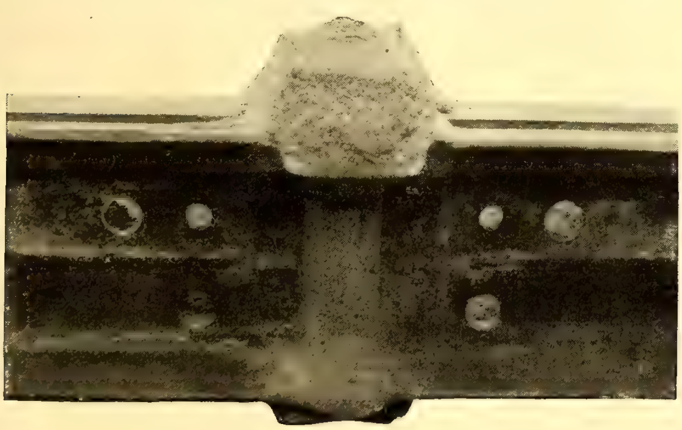
All contact lines between the mold parts and the rail are then luted with moist clay. The top of the rail is also painted with a thin paste of clay and water, which, when dry, prevents the slag and iron from adhering to the top of the rail. When a butt weld is desired, a pair of clamps is next adjusted to the ends of the rail so that they may be upset while hot. These are not deemed necessary, however, and are not generally used, as it has been found sufficient to simply weld the base and web of the rail. The molds are then backed up with sand. The crucible, which is set

on a tripod, is next placed over the molds, with the tapping hole directly over the gate in the mold. A tapping rod is then placed in the hole, which is then stopped up by means of a couple of asbestos washers, a small iron disc, and finally a little refractory sand. The charge of thermit is then added and a little of the ignition powder placed on top, which is set off with an ordinary storm match. The reaction when once started proceeds rapidly, usually taking about 10 seconds, the molten mass boiling furiously. At the end of about 20 seconds more the boiling has ceased and the iron is separated from the slag. The crucible is then tapped and the metal flows into the molds, followed by the slag, and in less

TAPPING CRUCIBLE

than a minute the joint is made. The joint is then allowed to cool about 15 minutes before the molds are taken off. This can be done three or four minutes after pouring, if necessary, as when welding while the cars are running. Two or three taps of a hammer will separate the slag from the joint, and the work is completed, no chipping or grinding being necessary except when welding old rails where the joints are battered, when, of course, the rails have to be ground down to an even surface. In case the two rails do not come together closely, a shim of steel may be inserted and welded in, completely filling the gap. The writer has made many joints in this manner with perfect success.

Four men constitute a welding gang, and eighteen or twenty



JOINT ON T-RAIL BEFORE REMOVING SLAG

joints can be made in a day of 10 hours. No skilled labor is necessary.

The first place to experiment with this process was Essen, Germany, the home of the inventor. Owing to the importance of the rail-joint question, however, other European cities were not slow in investigating its merits. In 1900 about 1200 joints were made in various cities on the Continent. The results obtained from these were considered so satisfactory that the use of this method of welding increased very rapidly, some cities introducing it on an extensive scale, notably Leeds, England; Dresden, Austria, and Singapore, India. Twenty-six hundred joints were made in 1902, and 20,000 in 1903. In 1904 a company was formed in the United States to introduce the process here, and at the suggestion of the writer, who had followed the development of the process with considerable interest, the Holyoke Street Railway Company decided to use it on a mile of track about to be reconstructed.

WORK DONE AT HOLYOKE

The rail welded was new 9-in. 107-lb. grooved Sec. P. S. Co., 228, known as Trilby section, the rails averaging about 55 ft. in length, The total number of joints made was 170. All joints were welded except those on the special work. Three joints were also made on the special work as an experiment, two being at the P. C. of a curve of 40-ft. radius, the other at the end of a frog. The longest piece welded continuously was about 2500 ft., both ends being bolted tightly to the special work. The welding was done when

POURING JOINT

the temperature was between 80 degs. and 90 degs. F. in the shade. Of the total number of joints made, but two were imperfect, and these were immediately repoured. The cost per joint was about $6.23, divided as follows:

Thermit	$4.98
Molds per pair	.35
Labor and supervision	.60
Crucibles per joint	.25
Incidentals (shims, gasoline, etc.)	.05
Total	$6.23

This work has been down nearly a year now, and not a break

JOINT WITH SLAG REMOVED

has occurred, although the temperature has been as low as 10 degs. below zero. Many of the joints can hardly be detected at the present time, and the wear throughout the rail is perfectly uniform, showing that the rail at the joint has not been softened or injured in any way by the heat to which it was subjected. The alignment of the track has remained perfect both on tangent and on a curve of 300-ft. radius, which was also welded. A prominent street railway official, who has been connected with street railway work for

many years, made the remark in the hearing of the writer that there was not a better piece of track in the United States.

As this work proved thoroughly successful, the company decided to weld about 1000 joints this summer. Of these, 400 are on 9-in. 107-lb. grooved rail which has been down about four years, 150 on 7-in. 70-lb. T-rail which has been down about six years, 100 on 6-in. 60-lb. T-rail which has been down about five years, and 350 on new 7-in. 90-lb. grooved rail. As nearly all of the rails to be welded are about 60 ft. in length, this will represent about 5 miles of track, all of which is in paved streets.

The work on the 9-in. rail has already been completed. Owing to the heavy traffic over some of the lines, about 200 joints had to be made between the hours of 12 and 5 in the morning,

GRINDER FOR SMOOTHING JOINT

three men being able to weld from twelve to fourteen joints in this length of time. Where the time between cars was 10 minutes or over the work was done in the daytime, as the joints can easily be made while the cars are running without interfering with traffic. Of the total number of joints made, three (or less than 1 per cent) were imperfect, and had to be repoured. No breaks have yet occurred. The cost of joints on 9-in. rail made this year has been \$5.25, divided as follows:

Thermit	\$4.25
Labor	.50
Molds	.20
Crucibles, per joint	.25
Incidentals	.05
Total	\$5.25

Data on the other sections of rails are not yet available, as the work is not yet completed, but as the charges for labor, molds, etc., remain practically constant, irrespective of the section of rail, it

TRACK AFTER WELDING

will be safe to say that the cost of joints will lay between \$3.50 for 4¼-in. 60-lb. T-rail, and \$5.25 for 9-in. 107-lb. grooved rail, these figures being based on present quotations for thermit. To this must be added \$1.25 per joint for removing and replacing pavement when welding rails already laid.

Tests of the joint with a Conant bond tester which compares the resistance of 3 ft. of rail with a joint with that of 3 ft. of rail without a joint, show the conductivity of the joint to be practically equal to that of an equal length of rail. Tests of individual joints by determining the drop in voltage at the joints confirm these results. Tests of the joints made last year show no deterioration in conductivity. Mechanically the joint seems to be perfect. The following test will give an idea of the strength of the joint: A section of 9 in. 107-lb. rail 13 ft. in length, with the joint in the middle, was placed in the track on two ties, distance center to center of bearing 12 ft. 6 ins., and loaded double-truck cars weighing about 20 tons allowed to pass over it. The rail cracked through the bolt holes, but no harm was done to the joint.

The fact that we did not have a single break during the past winter shows pretty conclusively that the joint is, when properly made, sufficiently strong to withstand all stresses due to changes in temperature and those due to traffic. Joints sawed through the middle show that perfect amalgamation of the metals has taken place.

From what experience the writer has had with this process of welding, it seems to him to possess the following advantages: Simplicity, no skilled labor being necessary; lack of expensive apparatus, the whole outfit costing less than \$100; adaptability to repairs and construction on moderate sized systems where the amount of work done at one time does not warrant the expense of maintaining an extensive apparatus and retention of skilled laborers, the possibility of welding on track already laid without interfering with traffic where the headway is 10 minutes or over, and last, but not least, the excellent results obtained both mechanically and electrically. Another point which has not been mentioned is the ease with which compromise joints of almost any description may be made by simply changing the form of molds.

JOINTS AND TRACK CONSTRUCTION IN PHILADELPHIA

BY H. B. NICHOLS,
Engineer of Way, Philadelphia Rapid Transit Company,
and
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Rail-joints, especially those used in street railway tracks, may be divided into two distinct classes—those which we will call ordinary joints, where the parts comprising them may be assembled and taken apart with ease and comparatively small expense; and those which we will call permanent joints, where the parts are permanently embodied in the joint and cannot be taken apart. The first class comprises practically all of the joints at present in use, and are those that consist of fish or joint-plates of various forms held by bolts or keys. The permanent joints represent a very small percentage of those in use, as they have been introduced comparatively recently, and consist of so-called cast-welded and the electrically-welded joints.

The different kinds of fish or joint-plates used for connecting ends of rails are well known. The principle involved in all of them, is two wedge-shaped plates, that are, by means of bolts or keys, forced on to the rails, the latter having a similar outline; and upon the thorough, continuous and tight contact of these inclined surfaces the solidity and permanence of the joint depends. In any form of rolled steel exact uniformity of section is never obtained; one end is invariably larger in cross-section than the other, even when new rolls are used. This is due largely to the difference of temperature between the ends of the steel when on its final pass through the finishing rolls; and, further, as the rolls wear down, the rolled section becomes larger. This is true even with the simplest section, as a square or round bar, and it is considerably more pronounced in the deep rail sections that are used in street construction. In consequence, when joint-plates and rails are assembled, while theoretically true and exact in their complementary design, in practice they vary greatly—sometimes as much as 1-16 in. But, assuming that the section of plates and rail are correct, as per design, rolled surfaces of steel are not continuous or perfectly smooth planes, but consist of minute elevations and depressions. Therefore, when the two joint-plates are forced by the bolts into the fishing sections of the rail, continuous contact is not obtained, but only an intermittent or point contact. In other words, only the protuberances of the surface of the joint-plate come in contact with those in the surface of the rail. The object of a rail-joint is to bridge over the ends of the rails and hold them against vertical and lateral movements under the load. Were it only for those movements, we believe, joint-plates would be effective for a considerably longer period than they are in practice, for the protuberances mentioned above would hold out considerably longer against

flattening under the weight of the load. But, besides the vertical and lateral movement, there is a longitudinal or bodily movement of the rails, due, principally, to contraction and expansion, and also on account of the wave motion of the rail under traffic. This movement acts like a file on the minute irregularities of the surfaces. Although this linear movement is small, maximum ¼ in. to ⅜ in. in severe changes of temperature, yet those point contacts are so small, as compared with the extent of the movement of the rails, that this movement acts upon them like a long-drawn file. The result is that, no matter how tightly the plates were adjusted originally, in a very short time they become loose, and the ends of the rails begin to hammer under the passing wheels. Moisture percolating between the contact surfaces, due to capillary attraction, or otherwise, oxidizes those surfaces and greatly facilitates this filing effect. In steam roads this necessitates constant, almost daily, tightening of the bolts.

We have not mentioned here the loosening of the plates caused by the nuts being jarred loose from vibration, the reason being that we wish to present the fact to you that a joint, even under ideal conditions of fit and construction, could not be maintained in perfect condition very long. In street railway track construction the movement of the rails, due to changes of temperature, is not as great as in steam tracks, because the rails are buried in the pavement; yet it is large enough to cause the same filing effect. On the other hand, this burying of the rails in the pavement entirely precludes the constant tightening of the bolts, for the expense of the constant digging up and replacing of pavements would be prohibitive. The consequence is that the joints are allowed to remain loose a considerable length of time before they are uncovered and bolts tightened. Moreover, the constant hammering of the loose ends of the rails on the plates causes a depression on the surface of the plate and rail to such an extent that the tightening of the bolts does not avail; and the plates first, and very soon the rails themselves, are in such a condition that a renewal is the only remedy. Even before the ends of the rails and the plates have become damaged, the loose joints cause the ends of the rails to droop, and in connection with the rolling action of traffic, which elongates the upper surface of tread, bend the entire rail in a vertical curve by forcing up the spikes or ties in the midlle of the rail. This makes the track a continuous succession of waves, which necessitates, at intervals, the digging up of the entire pavement for the purpose of retamping and respiking it. When once these vertical curves are formed the track can never be restored to good condition. As a matter of fact, rails, after they have been removed for renewal, could in many cases have been used for several years more, as far as the middle part is concerned, were it not for the battered ends. In other words, the life of the track is mainly dependent upon the life of its joints. We shall not discuss here the loss involved in the maintenance of the rolling stock and pavement, but anyone taking a ride on old track will feel the effect on himself of low joints.

Street railway track construction being a development of that of the steam roads, the idea prevalent in that branch was necessarily embodied in it, although there are radical differences between the two. The steam railroads, consisting of vast stretches in the

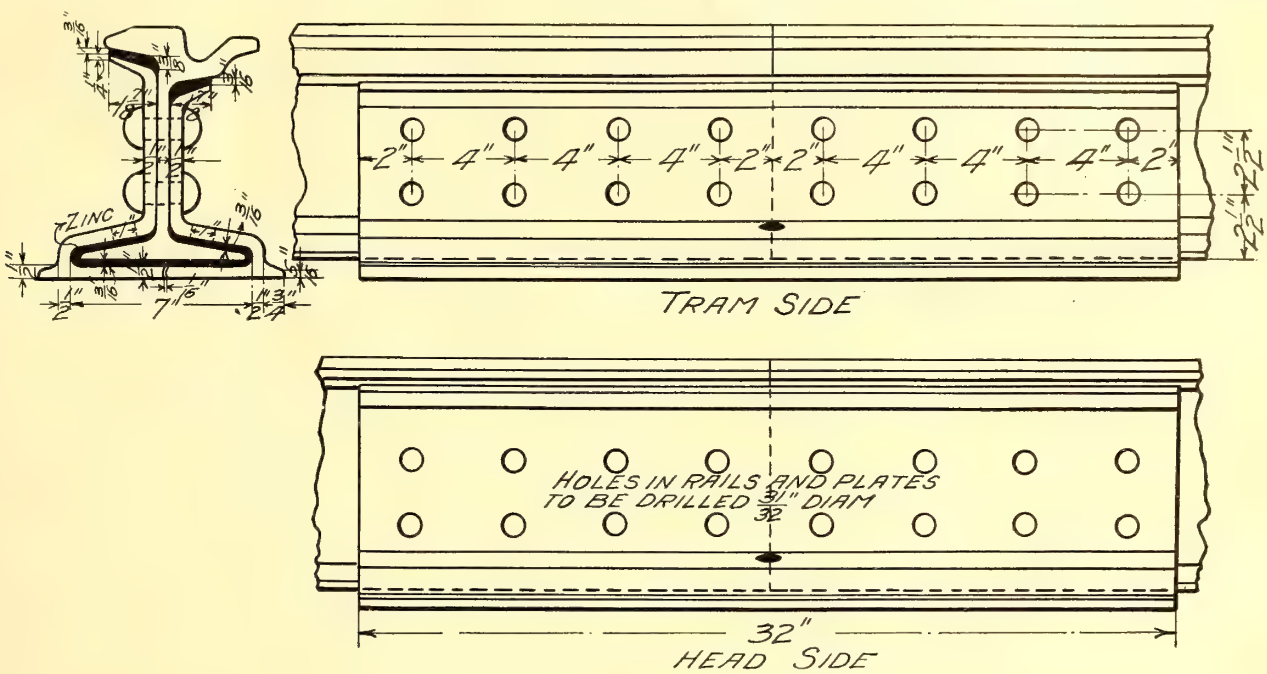


FIG. 1.—COMPOSITE JOINT

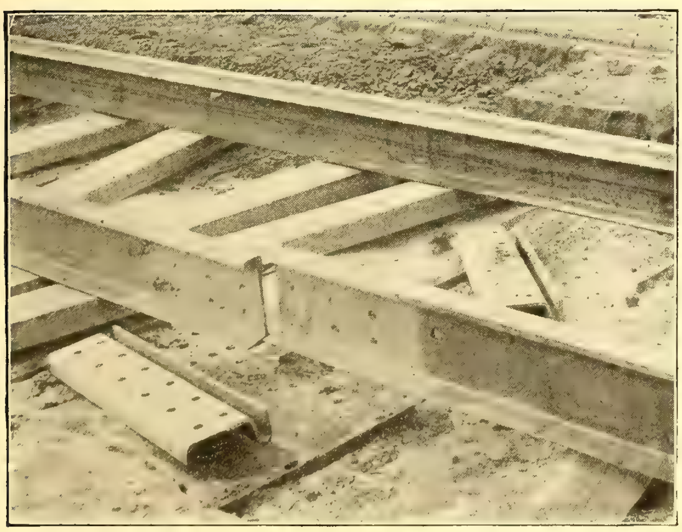


FIG. 2.—JOINT AFTER BEING CLEANED

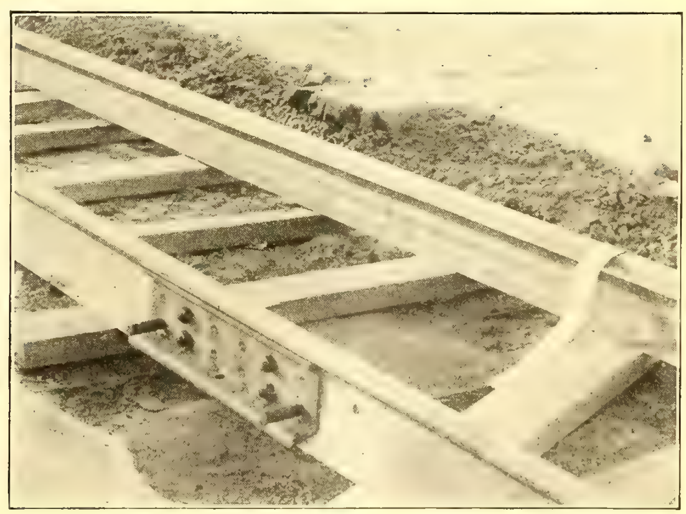


FIG. 4.—PLATES IN POSITION

open country, naturally do not require paving. The rails being entirely exposed on all sides, and therefore directly influenced by changes of temperature, great care must be taken that the expansion in the rails does not distort the alignment of the track. To prevent this, the rails are laid in short lengths, the joint holes in the rails are made considerably larger than the bolts, and spaces are left between the ends of the rails to allow free movement. This was also embodied in street track construction. But it has been

FIG. 5.—REAMING HOLES

gradually acknowledged that in street railways, where the rails are buried in paving, the changes of temperature in the atmosphere do not affect the rail proportionately; the friction between the paving and the rail exerts upon the latter such a force as to a great extent counteract the force of the stress due to expansion. Again, the material of the paving enclosing the rail on both sides helps to keep the rail in permanent alignment and surface. This has involved what we have called permanent joints, viz., the cast-welded joint, which is formed by pouring a mass of molten cast iron around the abutting ends of the rails and the electrically-welded joints, which are made by electrically welding two strips of steel plates to the sides of the webs at three or more points. While these joints have seemingly given better results, they also embody either defects or disadvantages which are quite important. In the cast-welded joint the comparatively large mass of molten metal anneals or otherwise affects, whether physically or chemically we do not know, the texture of the rail ends. This makes the track of an intermittent hardness, which is very soon shown in the difference in wear between the middle of the rail and at the joint. Moreover, on account of the sudden high temperature the rail ends expand vertically, and in cooling do not come back to their original cross-section. This causes either elevations or depressions at the joints. The elevations can be overcome by grinding or filing, but the depressions cannot be remedied, and they remain as permanent defects in the track. We are not as familiar with the electrically-welded joints, and therefore cannot give you the results that have been obtained with them. But the disadvantage that we know of is the fact that the transportation of the machinery and other expenses involved in placing them is considerable. The cast-welded joint does not give a perfect electrical connection, and we know of a railway in the neighborhood of this city where the management is judiciously using large copper plates in connection with this joint. Both of these joints have the further disadvantage that in case of changes in the track layout the joints can only be cut out and thrown in the scrap pile.

The joints that are at present used in Philadelphia are supposed to remedy the above-mentioned defects and disadvantages. This will be seen from the following descriptions. The joint consists of what may be called two Z or special bars (Fig. 1), which are riveted on to the webs of the rail. These plates are not made to fit the fishing section of the rail; on the contrary, spaces are left under the head, tram and around the foot of the rail. These spaces are filled with molten zinc, which enters into and fills out all the irregularities of the rolled surfaces, thus giving an absolutely continuous and perfect bearing throughout the whole length and width of the flanges of the plates. It is obvious that such a continuous contact could not be obtained by the most laborious machining or milling of those surfaces. The adhesion of the molten zinc to the rails and plates, together with the body-bound rivets, hold the joint permanently tight, and at the same time prevent expansion, thus making the rails continuous.

The method of constructing the joint is as follows: After the material has been distributed and the rails placed on ties, but before the latter are spiked, both plates and rails are thoroughly cleaned (Fig. 2) by a portable sand blast (Fig. 3). The plates are next placed on the rail ends and held in place by steel drift-pins, placed one in each end of the plate (Fig. 4). A steel straight-edge is laid on the head of the rail, and the tread brought to a uniform surface by inserting wedges between the plates and the trams, or the plates and the head of the rail. The wedges are then driven in with a light hammer until the straight-edge has a continuous bearing.

FIG. 3.—PORTABLE SAND BLAST

While the plates are held in place by four temporary bolts (Fig. 4), the rivet holes are reamed to 1 1-32 in. diameter (Fig. 5) by a portable pneumatic reamer (Fig. 6). The 12 1-in. steel rivets are then driven by a portable pneumatic riveter (Figs. 7 and 8). This insures the filling up of the holes by the rivets. The next step is to put in place the iron clamps for holding the asbestos cloth pads and clay on the bottom and at the ends of plate and above the base of rail. The spaces between the head and tram and plate are temporarily caulked with asbestos cloth. The plates are then

warmed by fuel-oil burners, operated by a portable compressor, to a temperature of about 300 degs. to 400 degs., after which the molten zinc is immediately introduced through a 1-in. hole located in the center of the lower portion of plate, the remaining space underneath head and tram of rail being filled by the aid of dams.

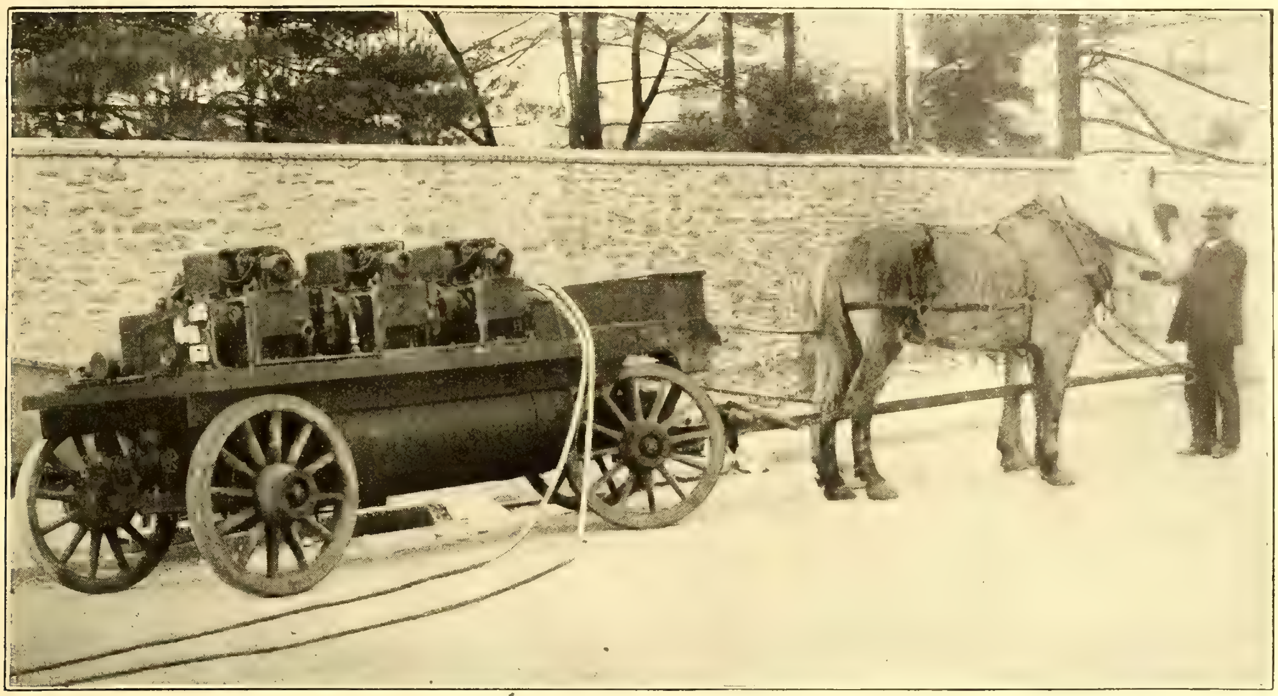


FIG. 6.—PORTABLE PNEUMATIC REAMER

These dams consist of aluminum castings padded with asbestos cloth.

From the above description it will be seen that this joint combines the characteristics and advantages of both classes of joints mentioned above, obviating their defects. While it is a permanent joint, in that it holds the ends of the rails permanently together, it

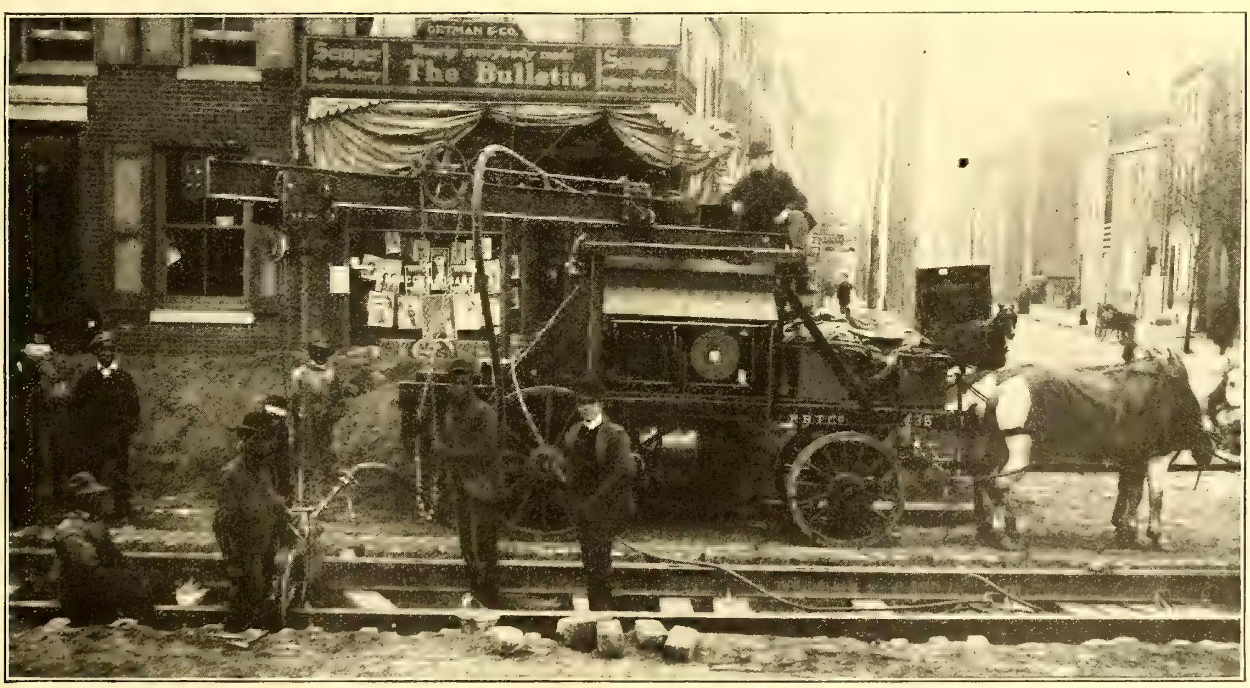


FIG. 7.—PORTABLE PNEUMATIC RIVETER

can be easily taken apart and the parts replaced at a comparatively small expense. It does not distort the original cross-section of the rail, nor does it effect the physical or chemical nature of the metal. It not only obviates the initial defects in the fit of the rolled section, but also the aggravating cause—that of linear movement, due to expansion. As the plates and rails are thoroughly cleaned and heated before the molten zinc is poured in, the latter galvanizes on to the steel (this was proved on joints that were purposely opened for investigation after having been in the ground for over two years), and, therefore, gives a thorough and continuous electrical connection. We know of very interesting data about the electrical bonding quality of this joint, but as these data are the property of the Franklin Institute, we are not at liberty to divulge them at present. We will only say that, after a thorough test by an electrical expert of this city of joints that had been in the ground over two years, and under the heaviest traffic, the resistance was found to be less than the rails themselves. Another, and we think a very important, feature of this joint is the fact that its initial cost is practically a permanent investment. From the nature of its construction, having an intermediate soft metal between the surface of the steel, the plates cannot be affected by wear, and, therefore, practically the entire material that enters into the construction of the joint—that is, the plates and zinc—can be used over again after the rails have been worn out, only necessitating new rivets.

Before describing the other improvements in track construction, we think that it will be interesting to mention the novel idea involved in the construction of this joint. It seems, at first glance,

rather an anomaly that malleable iron, cast iron and even rolled steel plates of a high percentage of carbon have been used, or, in other words, different hard metal substances have been used as a support or foundation for certain vibrating loads, and they all proved more or less a failure. Yet, in face of these known failures, it was proposed to support the same loads by means of a comparatively soft metal, zinc. The fact is that this metal does form a better support. There is a well-known engineering principle which has a similar and close relation to this, and which will explain the seeming ambiguity. Foundations of large and important structures are known to have been built on sand and even quicksand. It is only necessary to dam around the loose material under the foundations and make the area of the latter large enough. The configuration of the plates forming wedge-shaped spaces under the head and tram of the rail, and the enclosed space around the foot is the damming, and the filling in under the entire width of base of rail, and of all the irregularities of the rolled surfaces, is the enlarged area of the foundation.

ELECTRICAL RAIL WELDING

EXTRACTS FROM AN ARTICLE UPON TRACK CONSTRUCTION

BY T. W. WILSON,
of Buffalo

Published in the "Street Railway Review" of March and April, 1903
(Used by Special Permission.)

The electrically-welded joint was adopted as a standard in 1899, and since that time 30,216 joints (representing 106½ miles of track) have been welded. Numerous descriptions of the process have been published, so all that is necessary here is to give a statement of results obtained and the number and cause of breakages. In this connection the question is still asked as to "what we do with expansion." Probably the best answer is that we "forget it," the same as we do the joint after it is welded. Scientifically it may be said that the rail is held in every infinitesimal part of its length by the concrete base, which covers about 1 in. of the base of the rail, and by the paving, and the track cannot expand or contract. The force is taken up in internal strain in the metal of the rail. When the strain becomes greater than the ultimate tensile strength, the rail breaks.

A tabulated statement follows which explains itself:

Kind of Rail	First Year Joints Welded in 1899	Number Broken
Old, 6-in.	4,787	18
Old, 7-in.	8	0
Old, J. Co., 9-in.	2,658	49
Old, P. S. Co., 9-in.	74	3
New, 6-in.	0	0
New, 9-in.	3,882	45
	11,349	115

Kind of Rail	Second Year 1900	Joints Welded in 1899-1900	Number Broken
Old, 6-in.	11,973	16,760	127
Old, 7-in.	566	574	7
Old, J. Co., 9-in.	1,894	4,552	25
Old, P. S. Co., 9-in.	146	220	6
New, 6-in.	619	619	2
New, 9-in.	2,234	6,056	16
	17,432	28,781	183

Kind of Rail	Third Year 1901	Joints Welded in 1899-1900-1901	Number Broken
Old, 6-in.	482	17,242	8
Old, 7-in.	0	574	1
Old, J. Co., 9-in.	356	4,908	7
Old, P. S. Co., 9-in.	0	220	1
New, 6-in.	0	619	0
New, 9-in.	597	6,653	3
	1,435	30,216	20

Of the 183 broken joints, winter of 1900-01, twenty-three were on welding done in 1899 and 160 were on welding done in 1900 (17,432 joints were welded in 1900). The joints which broke have all been carefully inspected, and in no case did the break occur through the weld, nor did the weld pull off. The break almost invariably occurred at the end of a welding bar, the rail breaking usually through old bolt or bond holes beyond the bar. By welding with bars long enough to cover and reach over all such holes, this source of breakage has been eliminated since 1900. The forty-nine breaks in 1899 and the twenty-five in 1900 in old Johnson Company 9-in., as shown above, were directly due to this cause. The large number of breaks in 1900 old 6-in. (127) we could only account for by attributing them to some quality in the chemical composition of the rail which did not lend itself readily to the weld. They nearly all occurred in the same street—viz.: East Ferry Street—and this would seem to help that hypothesis.

FIG. 8.—SECOND TYPE OF PNEUMATIC RIVETER, PHILADELPHIA

Referring again to the table, we note 183 broken joints at the end of 1901 winter. These were all rewelded in the summer of 1901, so that to-day the number of broken joints is twenty. These have been cut out and a piece of rail 10 ft. long inserted, full bolted and bonded. Next summer these plates will be taken off and the rails rewelded. It has been found that it is not always necessary to cut in a piece of rail in place of a broken joint, as a very neat patch can be welded in a great many cases which gives very satisfactory results.

As an average, therefore, on all welding done in Buffalo, the breakage has been about 1 per cent. The welding done in 1901 and 1902 in Rochester and other cities shows even better results, and of 5308 joints welded in Rochester in 1901, there were but six broken rails in the spring of 1902. When it is considered that the quality of each weld depends entirely upon the personal equation of

the welder (since it is by a cherry-red color alone that the proper point of fusion is known), it seems wonderful that such remarkable results are achieved.

In addition to welding our joints, the ground return around special work has been taken care of by welding or electrically brazing copper ground cables to the rails. For this purpose a copper block, 1½ ins. thick, with a suitable groove across one face to pass over the cable, is provided. The cable is placed against the rail-web and the copper block over the cable.

The welder is then brought into position, a Bessemer steel plate about ⅜ in. thick is interposed between the copper block and the contact of the welder. This acts as a heat insulation and enables the copper block to be brought up to proper heat for brazing. Hard spelter is used. By this means a 500,000-circ. mil cable can be attached to a rail so that the full carrying capacity of the cable is realized, the area of union between the copper and the steel being ample to allow for the difference in carrying capacity of the two metals.

ELECTRIC WELDING OF RAIL-JOINTS

(From the "Iron Age")

A DESCRIPTION OF THE MACHINES USED AND METHOD OF OPERATION

The process of electrically welding rail-joints, as applied by the track-welding department of the Lorain Steel Company, Lorain, Ohio, comprises three distinct operations. The machinery is mounted on trolley cars of suitable design, the running gear of which is provided with threaded axles so that the machines can be used to weld track of different gages. New rail is welded either before or after the paving is in place, space being left at the joints to permit the entrance of the welder. In old rail the paving is removed around the joint, and the old plates and bond wires are removed. The rail ends are then brought up to the proper grade.

In the welding process the first operation is that of sand blasting, by means of which all dirt, rust and foreign matter is removed from the rails at the points where the welds are to be made and from the bars used in making the joint. The apparatus for this work consists of a 10-hp motor driving an air compressor, a tank for the storage of air and a bin for holding a supply of sand. A sand mixer of the Tilghman type is also provided. By means of a hose and nozzle the operator directs the blast of air carrying the sand against the rail until all foreign matter has been removed. The bars are similarly treated and the joint is ready for the actual operation of welding.

The apparatus for welding is carried in two cars coupled together by a special form of slip coupling, which permits of sufficient range of movement for the car carrying the welder proper to be moved from one weld to another of the three welds necessary in making a joint without the necessity of moving the second car. The welder itself is hung from a bail on a crane extendnig out beyond the end of the car. This crane permits of lowering and raising, so that the jaws of the welder can engage the sides of the rail and also to shift the welder from one side to the other to engage both rails of the track. The crane is operated by friction clutches from a shaft in the car, which is kept running continuously by a 5-hp motor. This motor also drives a small rotary pump for circulating water through the welding transformer and the faces of the contacts to keep them cool. After the water has passed through the welder it goes to a cooling tank on top of the car, is forced under the false bottom and made to blow in from the middle and passes around and around until the outer circumference of the tank is reached. A false bottom is provided, and air, from a blower in the car, is forced under the false bottom and made to blow up through numerous holes. The hot water from the welder passes into the outer portion of the serpentine and gradually finds its way to the center. From there it is conducted to one of the tanks in the car. In this passage along the serpentine path the air is forced up through the water and forms a most efficient method of cooling, depending somewhat on the humidity of the atmosphere, being most efficient when the atmosphere is dryest.

The welder itself is an alternating-current transformer, the primary winding of which consists of two coils in parallel of forty-four turns each. The secondary coil is a single loop of copper of large cross-section, the terminals of which form the contacts, or jaws, which engage each side of the rail and between which the weld is made. The secondary winding is so made as to entirely inclose the primary coils, which are insulated in oil. On each side of this transformer and supporting it, but insulated from it, are the two large levers, hinged together at about two-thirds the distance from the top, for transmitting the necessary pressure to the weld.

These levers are connected at the top by an hydraulic jack. A hand pump for forcing water into the jack is bolted to one of the levers. A pressure of 4100 lbs. per square inch is obtained on the 3⅞-in. diameter rams of the jack, the leverage on the arms increasing this so that about 37 tons pressure is developed at the weld.

In making a joint, flat-rolled steel bars are used, having at each end a boss, or projection, on one side, which form the contact points between the bars and the web of the rail and confine the welded area to these sections. A flat strip of steel ⅛ in. thick by 1 in. wide is placed across the middle of the bars on the same side with the bosses. The bars are supported on small blocks and placed across the joint so that the middle strip engages the web of both rails. The middle weld is a vertical one and made the full width of the bar; the end welds are horizontal.

The welding train of two cars is moved up to a joint. The welder is swung into place and the jaws made to press against the bars on each side of the rail. The current is then turned on, and flows from contact to contact through the bars and the rail web. By altering the pressure on the jaws the resistance of the several junctures is increased, and the whole is soon brought up to a welding heat. As soon as this point is reached the current is cut off and simultaneously the pressure is brought up to the full

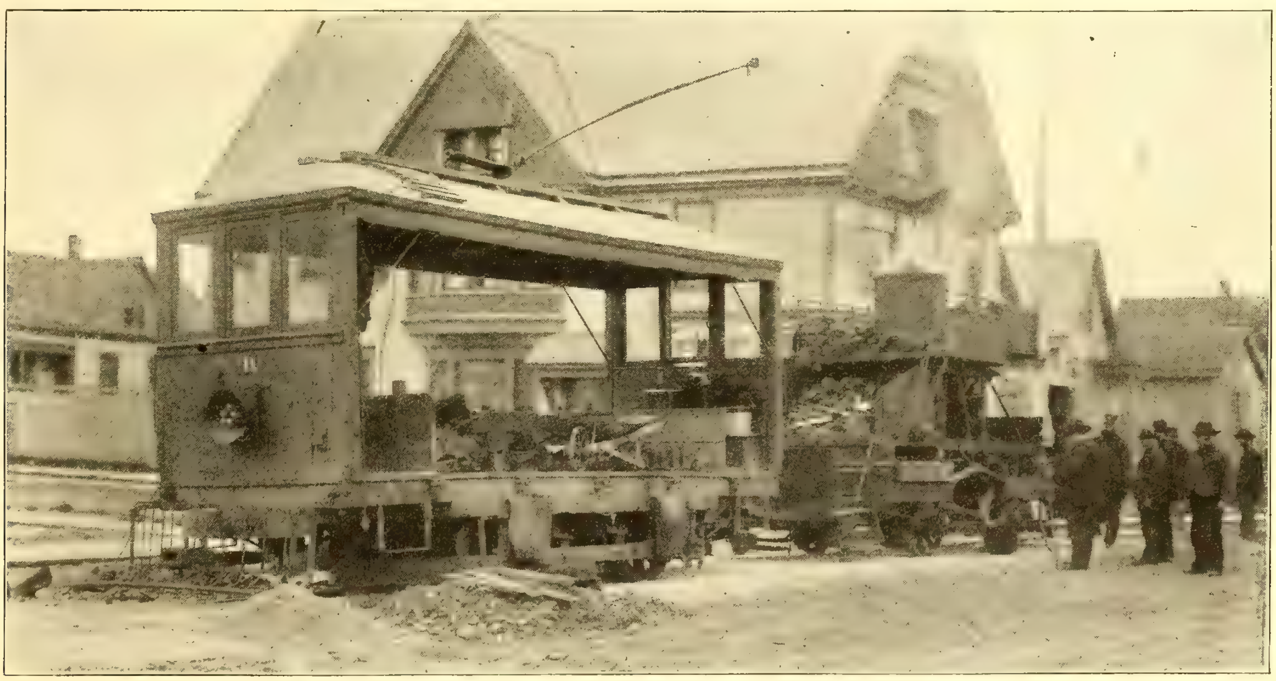


FIG. 1.—UTILITY CAR, CAST WELDING IN MILWAUKEE

amount. The pressure is then loosened and the welder car moved back to bring the jaws opposite the extremity of the bars. The same process is again followed here, except that when the final pressure has been applied it is held there and the weld permitted to cool under pressure until the metal has cooled sufficiently not to and exert a powerful pull to bring the abutting rail ends together, thus closing the slightest opening and leaving practically no joint at all. This is an important point in the manufacture of a continuous rail, for if the abutting rail ends are not brought firmly together, the metal in the head of the rail will have a chance to

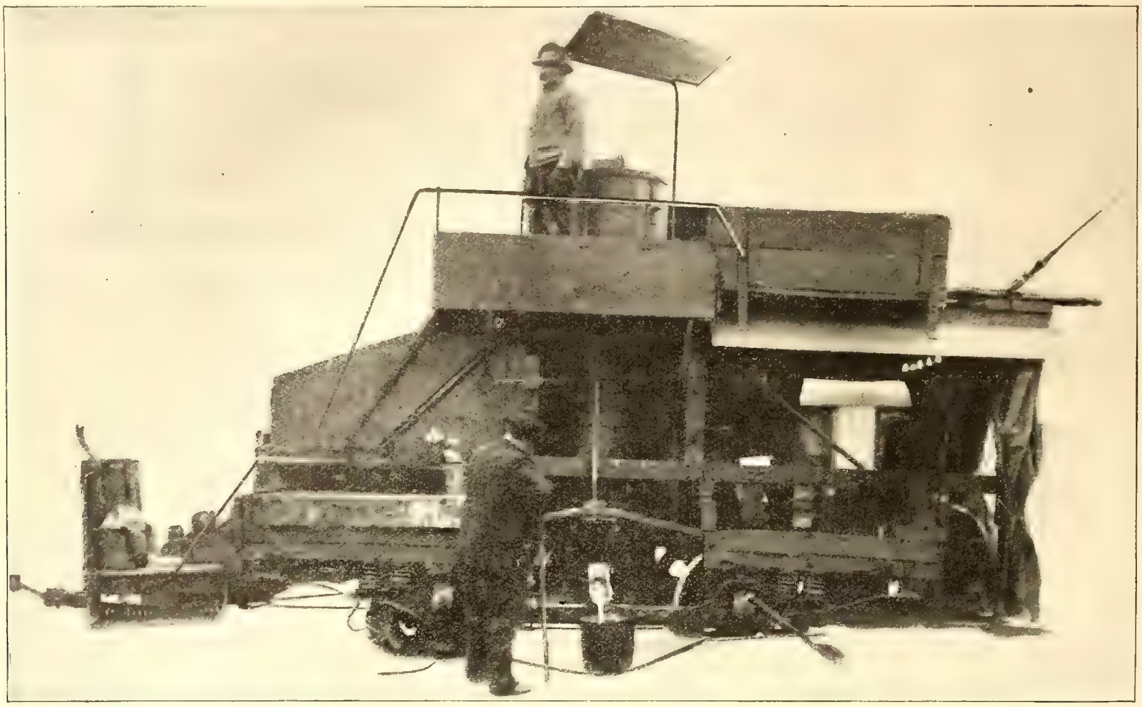


FIG. 2.—CUPOLA CAR, CAST WELDING IN MILWAUKEE

show any glow. The welder is then moved forward to the other end of the bar and the process repeated, after which the welder is raised and moved to the other side of the car to engage the opposite joint.

By holding the pressure after the weld is made a remarkably flow into the opening between the rails, and this in time will cause a low spot in the head of the rail. As the bars are always in a state of tension, it follows that the rail itself, inclosed between the bars, is in a state of compression. Any contraction of the rail itself between the joints will be transmitted to the end welds, and it is

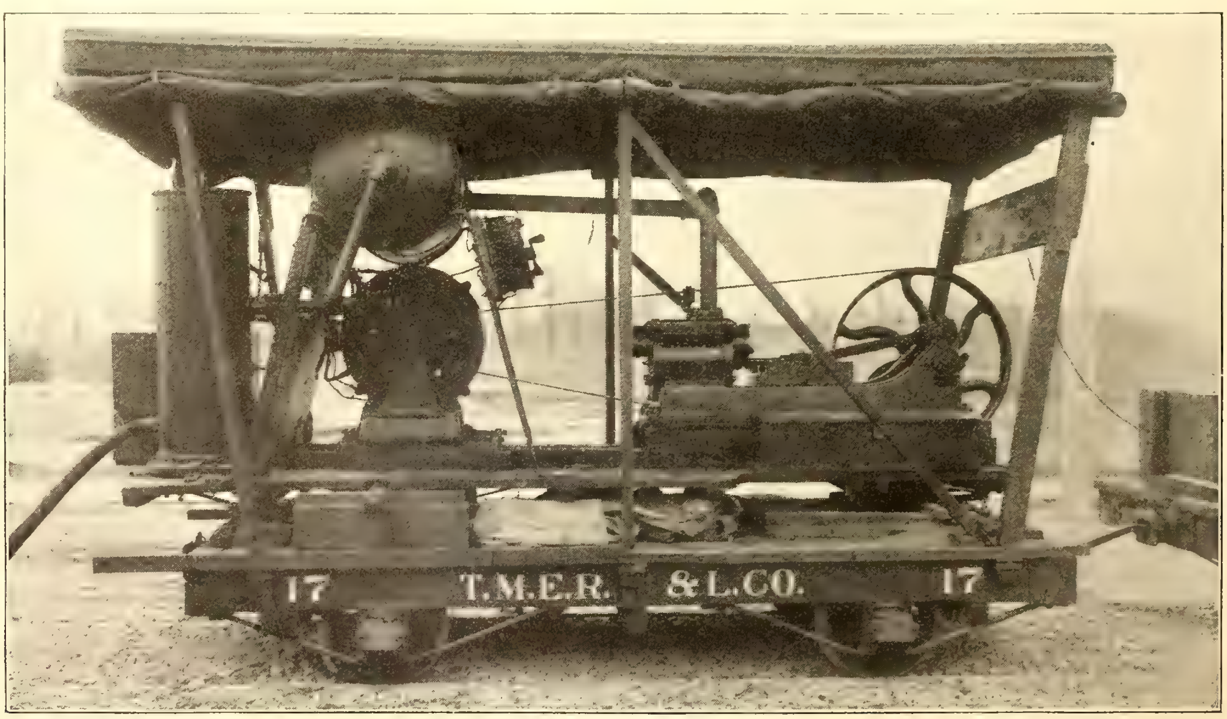


FIG. 3.—SAND-BLAST CAR, CAST WELDING IN MILWAUKEE

tough weld is secured. It will be noted that only the end welds are thus treated. As the center weld is not subjected to any strain, it is not essential to have toughness there. It has been found desirable to weld the ends of the bars while the bars are in an expanded state. By making the center weld first and not stopping to cool it under pressure, the greatest elongation of the bars is secured. After the ends are welded and the bars cool off they shrink therefore necessary to have these welds exceedingly tough to withstand the strain. The object of the center weld is simply for vertical stiffness and to prevent any movement of the rail ends. The actual current used in welding is about 7 volts and from 25,000 to 30,000 amps.

In the car coupled to the welder is carried a rotary converter for changing the direct current from the trolley to an alternating

current. The current in the primary coils of the welder is 300 alternating, 40 cycles. The direct current side of the rotary will take current from 325 to 600 volts from the trolley, and by means of suitable regulating apparatus the output on the alternating side, to the welder, is kept practically constant at 300 volts, without regard to the fluctuations on the line. On a line voltage of 500, about 225 amps. are required, or it takes about 125-kw to make a weld, the current being on about two and a half minutes to each weld.

The third and last operation in the process consists in grinding the head of the rail to a true surface. In welding new rail there is little need for this tool. In old track, where the rail ends have been battered, the receiving rail is purposely welded higher than the other. The grinder is then used to grind out the inequalities in the rail head and bring it back to a true surface. The grinder

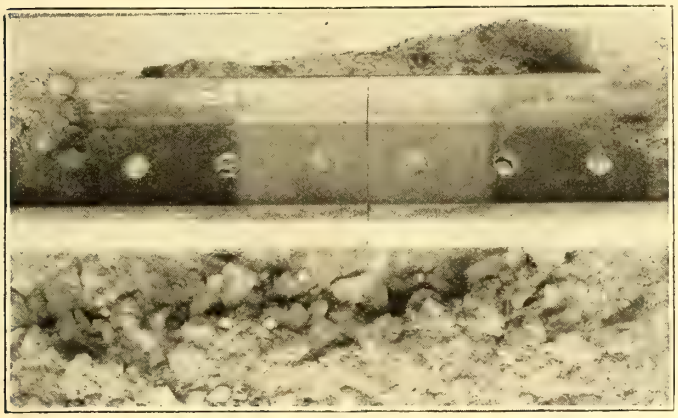


FIG. 4.—JOINT AFTER BEING CLEANED, MILWAUKEE

consists of an emery wheel mounted on a carriage having two rollers, which are about 4 ft. apart. This carriage is let down on the rail so that the rollers roll along the head of the rail, the emery wheel being over the uneven portion at the joint. The carriage is connected with a motor on the car by a swing frame, thus enabling the operator to move the emery wheel back and forth over the joint while the car remains stationary. By means of a hand wheel the emery wheel is gradually fed down, and as it is moved forward and back grinds off the high places until the whole joint is brought to a true surface. The principle is very much the same as a carpenter's plane. With the final operation of grinding the joint is left complete.

Carried on as a continuous process, it takes from 12 to 15 minutes to complete a joint. The work is carried on day and night,

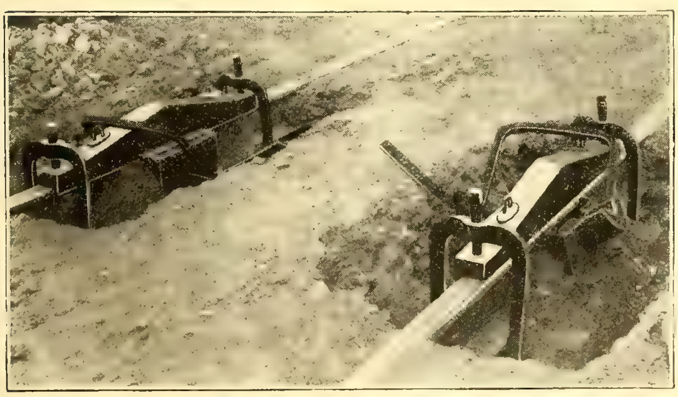


FIG. 6.—JOINT READY FOR POURING, MILWAUKEE

about 80 joints in 24 hours being a fair average. The bars used are 1 in. x 3½ ins. and 1⅛ in. x 3 ins., the length varying with the form of joint previously used. On new rail, where the ends are left blank especially for welding, the length is 18 ins. On old rail the bars must be long enough to reach back of the old bolt and bond holes, in some cases requiring bars as long as 48 ins.

In addition to welding joints the same apparatus is made use of in welding or electrically brazing copper ground cables to the rails. For this purpose a copper block, about 4 ins. square and about 1½ ins. thick, with a suitable groove across one face to pass over the cable, is provided. The cable is placed against the rail web and the copper block over the cable. The welder is then brought into position. A Bessemer steel plate, about ⅜-in. thick, is interposed between the copper block and the contact of the welder. This acts as a "heat insulator," and enables the copper block to be brought up to a proper heat for brazing. Hard spelter is used. By this means a 500,000 circ. mil cable can be attached to the rail so that the full carrying capacity of the cable is realized, the area of union between the copper and the steel being ample to allow for the difference in carrying capacity of the two metals.

The improved process of electrically welding rail joints and bonds has been in use since 1897. Further improvements were made in the winter of 1900, and the welding done the following season amply demonstrated the value of these improvements. While the breakage on all welding done had not exceeded 1 per cent, the breakage on welding done in 1901 was hardly one-tenth as great as before. Of 5308 joints welded in Rochester, N. Y., in 1901, there were but six broken rails in the spring of 1902. In no case has a joint broken through the bars or a weld pulled off; nearly all breaks have occurred through old bolt or bond holes beyond the

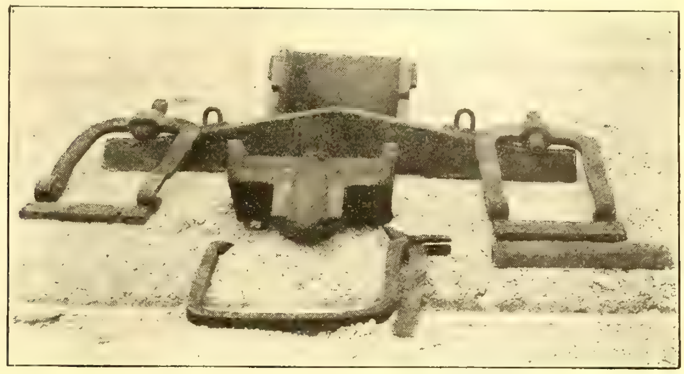


FIG. 5.—MOLDS AND CLAMPS, MILWAUKEE

bars. By welding bars long enough to reach over the holes, this source of breakage has been avoided since 1900. The excellent showing made at Rochester, N. Y., on last year's welding proves to what a remarkable state of perfection the process has finally been brought. When it is considered that each weld depends on the judgment of the man making it, and that every bad weld must necessarily remain in the track, to be subsequently revealed when the strain of winter comes on it, and that but about one out of a

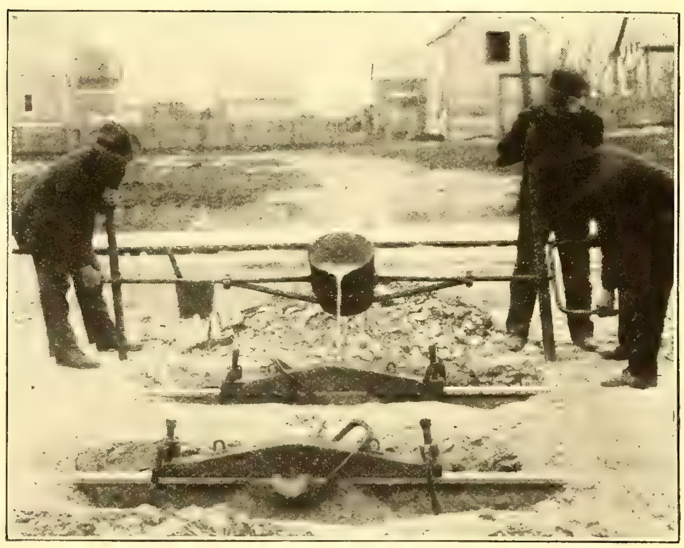


FIG. 7.—POURING JOINT, MILWAUKEE

thousand is a bad weld, it proves that by no other method of welding can such uniformity of results be attained. In the last three years the Lorain Steel Company have welded at Buffalo, N. Y., alone, over 100 miles of track.

THE CAST-WELDING OF RAIL-JOINTS

BY FRED G. SIMMONS,
Superintendent of Construction and Maintenance of Way, the Milwaukee Electric Railway & Light Company

Among the first joints cast-welded under contract were those on Chippewa Street, St. Louis, on the lines of the Southwestern Railway, during the months of Oct. and Nov., 1894. The first 744 joints applied at this time were very satisfactory, less than one-half of 1

per cent breaking. During the following year the work of cast-welding joints on the street railway lines of Milwaukee was commenced, and some of the track welded at that time, consisting of a 5-in. 58-lb. tram-girder rail, is still in place, and in first-class condition after continual service for ten years. It is not the intention of the writer to claim superiority in point of efficiency for the cast-welded joints, as compared with several other methods of accomplishing the same result.

We do, however, believe that many engineers and managers have avoided the use of the cast-welding process on account of the numerous erroneous arguments advanced against it, and it is the purpose of this article to lay before the public a simple description of the results obtained in the cast-welding of rail-joints by the Milwaukee Electric Railway & Light Company, within the personal experience of the writer and under his supervision. This description and the results obtained, we believe, conclusively show the possibility of cast-welding the rail-joints in a manner absolutely satisfactory both as to efficiency and economy.

FIG. 8.—COMPLETED JOINT

It is claimed that the mass of molten iron poured around the rail ends effects either a chemical or molecular change in the metal of the ball of the rail, which makes this section of the rail softer than the remainder, the inference being that the carbon is burned out. With over 150 miles of cast-welded track, some of which has been in service ten years, and with many miles replaced on account of the entire wearing out of the rail, no instance of a low cast-welded joint has been encountered. In fact, when the work was properly and thoroughly handled, absolutely reversing this claim, we have found that as our old girder rail wore out the cast-welded joint became the highest point in the rail, the thin metal on each side of it ironing down into depressions, leaving the rigidly supported metal of the joint high. The picture herewith is from a photograph of such a joint, clearly showing the conditions as stated.

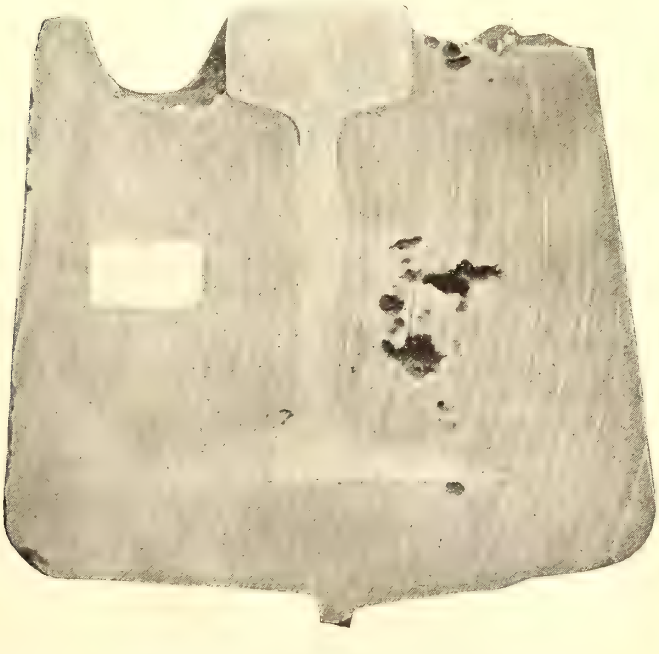


FIG. 10.—SECTION OF JOINT

The entire process of pouring a cast-welded joint is illustrated in the accompanying cuts, made from photographs taken during the actual progress of the work.

Fig. 1 (page 579) shows the utility motor car used in transporting the apparatus and material, and the cupola, with the molten iron flowing, is attached behind this car. The thin stream of white, hot iron may be plainly seen on close inspection of the picture.

Fig. 2 (page 580) is an enlarged view of the cupola, showing this piece of apparatus in greater detail.

Fig. 3 (page 580) gives a very comprehensive view of the car containing the sand blast apparatus used to clean the rail ends.

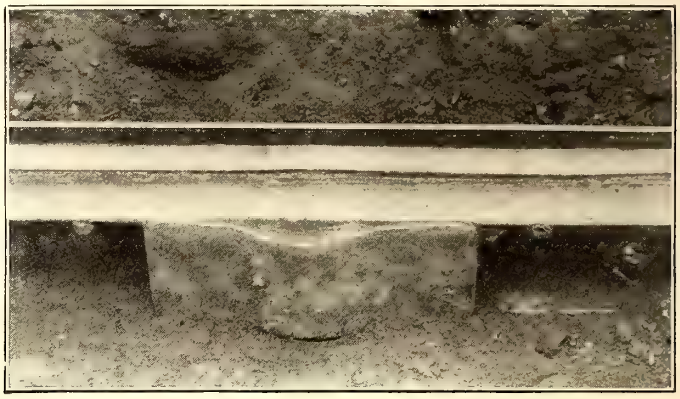


FIG. 11.—FINISHED JOINT

Fig. 4 shows a joint after it has been cleaned by this process, the steel having assumed an almost silver whiteness.

Fig. 5 shows the moulds, car and clamps used in preparing the joint for the pouring of the metal. Attention is called to the strength of this apparatus and especially to the bar. The purpose of this bar is to prevent "cocking" or "kinking' of the joint while cooling, and it has been found entirely efficient.

Fig. 6 shows two joints prepared for the pouring operation, the gate on one side and the vent on the other being very clearly discernible. Fig. 7 clearly shows the actual pouring of the joint. (These last four engravings are on page 581.)

Figs. 8 and 9 are of a completed joint, showing particularly the ease with which paving of any kind may be abutted thereto.

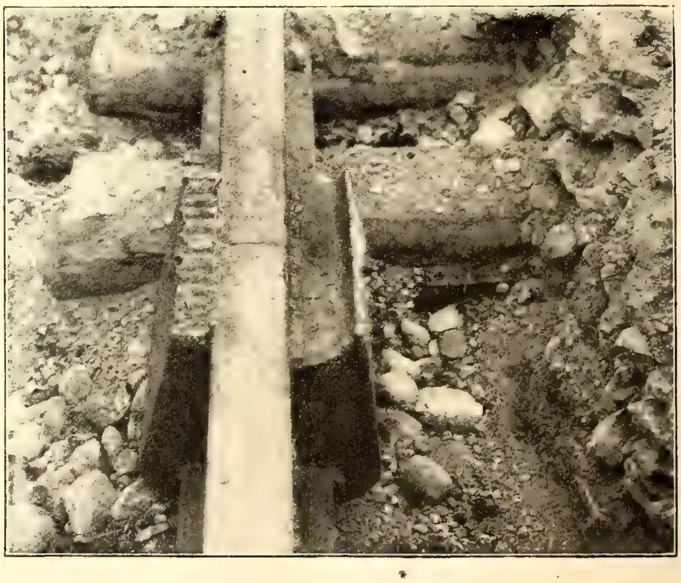


FIG. 9.—COMPLETE JOINT

Fig. 10 is of a section of a joint showing clearly the perfect bond of the metals.

The process is so fully outlined in the above set of cuts that I will presume to make but few explanations. The heating of the iron in the cupola is in no sense different from the operations of any ordinary cupola, and the mixture used is the only point requiring special mention. This consists of 75 per cent good pig iron and 25 per cent soft scrap.

The sand blast is of a simple construction and requires no particular mention. The importance of thoroughly cleaning 6 ins. or

8 ins. of each rail end to be welded cannot, however, be overestimated, as it is necessary to remove all scale as well as dirt, and the sand blast process is, of course, the most economical as well as the most efficient.

The heavy clamp-bar already referred to is also a very essential feature, as this weight of metal not only prevents "cocking" and "kinking" of the joint, but helps prevent an overheating of the ball of the rail. This bar is kept in place until all semblance of red heat has left the joint.

An absolute fusion of a portion of the ball and stem of the rail is necessary in achieving a successful cast-welded joint (a sleeve-joint is of no value), and this is not a difficult result. During the last three years we have welded our own joints, having purchased the apparatus shown above from the contracting company which had previously done the work, and during that time, although we have welded 6000 to 8000 joints, we have not had one pull or break.

Our electrical tests show the conductivity through these joints to be from 100 per cent to 140 per cent of the conductivity of the abutting rail, and in no case of a proper weld does this conductivity fall below 90 per cent. This applies with equal force to track just welded, and track that was welded six to ten years ago, and is borne out by regular periodical tests.

The latest rail adopted as a standard by the Milwaukee Electric Railway & Light Company is a 7-in. "Shanghai" section of T-rail, weighing 95 lbs. to the yard. The work shown above and the joints illustrated in Figs. 8 and 9 are upon a section of track built of this rail. The weight of cast iron used in this joint is 200 lbs. The total cost of the joint approximates $3.50 for the joint proper and $1.00 for the opening and closing of the street; upon new track this last item is almost eliminated.

Our cast-welding work is treated as a business by itself, and the fairest method of showing the cost of these joints to us is to quote from our yearly report for the calendar year 1904:

CAST-WELDING--OUTPUT 2414 CAST-WELDED JOINTS

			Per Joint
Account No. 180	Operating wages	$1,590.78	$ .659
Account No. 181	Repairs	704.83	.292
Account No. 182	Power and lighting expenses	40.10	.016
Account No. 183	Supplies	3,041.30	1.260
Account No. 184	Injuries and damages, 5 per cent	362.10	.150
Account No. 185	Interest, taxes, insurance	288.00	.119
Account No. 186	Miscellaneous	653.35	.271
		$6,680.46	$2.767

The operating wages, repairs and supplies shown above contain a certain percentage of increase over actual amounts to cover general depreciation. The 2414 joints were applied to rail ranging from 5 ins. to 7 ins. in height. In addition to the above an average of $1.00 per joint must be added as expense in opening and closing the street. A large proportion of the above were scattered over a wide area and were really welded under adverse conditions.

The above is given as being an exact statement of fact, and is the reason for our belief that in the present development of any of the methods of welding rail-joints, the cast-welding process comes most nearly striking the true average between economy and efficiency.

SUMMARY

To provide a summary of the foregoing papers is necessarily an undertaking which can result in little definite.

A few correlated ideas assembled and arrayed for purposes of comparison is more exactly what we may hope to accomplish; and in so arraying this correlated data, the fact that the information upon which it is based may not in all cases be complete, or the deduction drawn may not be the true one, serves only to accomplish the end desired, namely, a discussion of the entire subject matter.

Of the four methods of forming permanent joints illustrated above: three are properly designated as "welded," while the other (the zinc joint) cannot be classed exactly in this category. The deduction which the writer draws from the four papers, however, is, primarily, that it is possible, with the best knowledge, and by the use of sufficient and correct apparatus, to produce an almost absolutely satisfactory joint (as to efficiency) by any one of the four methods. Thus narrowing down the field of speculation, the question of amount and availability of apparatus becomes a vital one, which seems clearly outlined as follows:

The electrical welding operation appears undoubtedly to require the most cumbersome and very much the most expensive equipment, to such an extent, indeed, that, except in case of the very largest systems, private ownership would be virtually impossible, and all work would necessarily have to be done through contractors.

The zinc joint appears to rank next in point of expensive apparatus, but is followed very closely in this respect by the cast-welded joint.

The thermit welding process certainly requires very much the least expensive apparatus, and from this viewpoint stands in a class by itself. The relation of the joint to the abutting pavement in city streets is a much agitated question, but it has been shown beyond dispute that this agitation is needless, as the shape of the joint can be regulated to meet the condition.

There are many minor points which might be taken up, and which can be brought out in discussion, but in the opinion of the writer the meat of the entire subject, as it affects the great majority of the electric railway interests, is in the relative cost of an efficient joint by any one of the methods. There are, of course, local conditions which may, in isolated cases, warrant a departure from the seemingly economical method, but our object is at all times to serve the majority, and, therefore, while a much more exact comparison of cost will be easily obtainable during the discussion of this subject, such data as we have been able to secure is here assembled.

ZINC JOINTS

No figures as to cost obtainable; these joints are controlled by the Lorain Steel Company.

ELECTRICALLY-WELDED JOINTS

Information received from the Lorain Steel Company as follows: "Our prices are from $6.00 to $5.50 per joint, depending on the number of joints contracted for. Ordinarily we do not care to accept contracts for less than 3000 joints, on which, of course, the price of $6.00 per joint applies; contracts for 10,000 or more joints are made at the lower figure."

THERMIT-WELDED JOINTS

Mr. Pellissier's figures show that a joint on a rail of average size will cost about $4.50, of which the major share is the price of the thermit welding portion. To this he adds $1.25 for opening and closing the street.

CAST-WELDED JOINTS

The figures in this case show that the entire expense of applying a weld on a rail of average size (under disadvantageous conditions) is but little in excess of $2.75, with $1.00 additional for opening and closing the street. This, including interest, taxes and depreciation charges on the capital valuation of the apparatus. Therefore, in conclusion, and in advance of future enlightenment on this subject, which it is our earnest wish the forthcoming discussion may evolve, the writer seems to see that under present general conditions the cast-welded joint is so much more economical, from both the viewpoint of mechanical efficiency and actual monetary expense, as to recommend itself for first consideration.

If, however, the first cost of the portion of thermit required to make a joint can be reduced to the extent of 50 per cent or more than quoted, the other inducements held out by this method are sufficient to give it first rank in point of desirability.

THE POWER STATION

BY FRED N. BUSHNELL,
Chief Engineer, The Rhode Island Company, Providence, R. I.

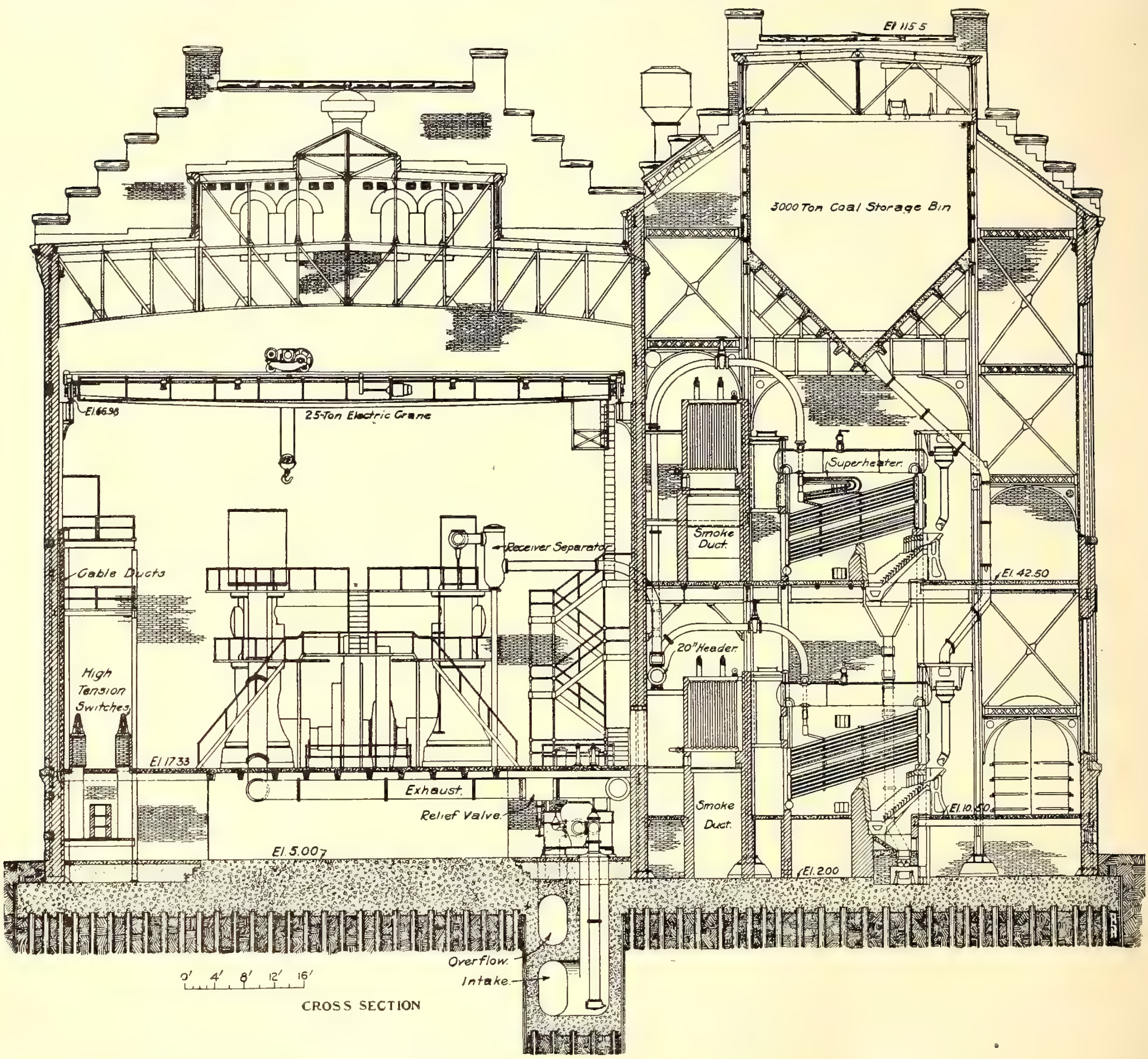
Since the advent of the direct-connected generator, the tendency in power-station design has been toward a more systematic and compact organization of the generating apparatus and the utmost simplicity of the entire plant consistent with the highest efficiency. The practice of different engineers has gradually worked toward a type of station which is now so generally adopted for street railway work where limitations are not placed upon the design by the size or shape of the available site, that it can fairly be said to represent standard practice in modern power station engineering. It embodies the following essential principles:

1. Simplicity of design.

2. Subdivision of the plant into separate sections, so as to localize the effect of trouble to any part of the generating apparatus.

3. Provision for the symmetrical extension of the plant to provide for future power requirements.

This station in its simplest form consists of a boiler room, engine and generator room, and switchboard gallery, arranged in parallel lines and separated from each other by substantial fireproof walls. In stations of very large size the boilers are frequently arranged in two tiers, or in groups, each group having its own chimney and flues and independent systems of feed and steam piping. This arrangement of the station is now generally referred to as the unit system, the distinguishing feature of which is that the boilers, engines and generating apparatus are arranged in separate units or groups, each one of which embodies all of the essential features of a complete generating plant, and the great advantage of which lies in the fact that trouble with any single piece of apparatus is local-



CROSS SECTION OF POWER HOUSE OF RHODE ISLAND SUBURBAN RAILWAY COMPANY

ized, so that its effect is felt only in that unit of which it forms a part. Provision for carrying the load in the event of a breakdown of any important part of the apparatus is made by installing an additional or spare unit.

While the unit system is now almost universally employed in the larger power stations, it is usually somewhat modified for smaller plants where the liability to interruption of the service is not so great or the results so disastrous, the chief difference being in the arrangement of the steam and feed piping. The steam piping from the boilers is run to a longitudinal header, from which the connections to the engines are taken off at convenient points. This steam header is divided into sections by means of gate valves, which permit of any section being cut out at the convenience of the operator for the purpose of making repairs. Usually two systems of feed piping are provided, one of which supplies hot water to the boilers through the heaters and economizers, while the second, or auxiliary system, supplies cold water, or water direct from the heaters, in case of trouble with the main system. This arrangement of piping provides sufficiently against interruption in small and medium-sized plants, and in a system carefully laid out with due consideration for the troubles which are likely to arise, it is hardly probable that the disarrangement of any one part will cause serious interruption of the service.

At the present time alternating-current generating stations and distributing systems are regarded as the most efficient to install in large cities where heavy traffic is distributed over a very large area, requiring current to be delivered to the line at a number of points, and where the interest upon the investment in direct-current feeders and cost of their maintenance would amount to more than the same charges plus the conversion losses in an alternating-current system; and for long suburban or interurban railways where the power required at any one point is small as compared with the total power generated. The use of alternating-current apparatus has steadily increased since its introduction, until at the present time approximately 60 per cent of the total power used by electric railways in the United States is generated by this type of apparatus.

In cities where the bulk of the business is within the economical radius of distribution for direct-current lines, and where direct-current generators form the larger part of the present equipment, the common solution of the problem is to use this type of apparatus for city work, adding alternating-current apparatus to supply the more distant portions of the system, or roads operating through outlying districts.

There is undoubtedly a great advantage in having all the apparatus of a uniform type. This simplifies the wiring and switching part of the electrical equipment, and permits of a more efficient distribution of the load in the station. But there can be no conversion of energy without loss, and in cases where a considerable part of the system can be supplied with direct current without the use of rotary converters, the composite type of station will frequently be found to offer advantages in lower first cost and higher efficiency.

The location of the power station, its general character, and the type of apparatus to be installed, depend to such an extent upon local conditions, that it is difficult to offer suggestions covering these points except in a general way.

If possible, the station should be located near an ample supply of water for condensing purposes, in order to secure the advantages from the use of the most efficient types of steam apparatus, and if possible, convenient also to a steam railroad or tide water, where the coal can be received and handled for the least expenditure of

labor. Its location in reference to the distributing system will depend upon the extent and type of the system employed. If the direct-current system is used, it will be desirable to select a location as near as possible to its center of gravity, in order to reduce the investment in copper, but in the case of an alternating-current distributing system, this is of less importance, and greater consideration will be given to the cost of the available site, the nature of the soil, cost of foundations, etc.

The building should in all cases be of fireproof construction and of neat and attractive design, appropriate to and suggestive of the purpose for which it is used. In determining upon the dimensions of the building, it is important that ample room be provided for all of the apparatus to be installed, so as to avoid unnecessary crowding. Passageways should be provided between each battery of boilers, and at the rear for the convenience of attendants in cleaning the tubes and connections and for making necessary repairs. Sufficient room should also be provided around each piece of apparatus in the engine room, so as to enable the attendants to inspect it regularly and keep it thoroughly clean, and to provide for the removal of any part in case of repairs.

In large cities, where land is extremely valuable, or the available area limited, the amount of power which can be generated per unit of ground area occupied is frequently the controlling factor in deciding upon the power station plans, and in such cases it is not always practicable to provide all of the space usually regarded as desirable for the convenience of attendants. This condition rarely exists, however, except in the larger cities, and in a great majority of cases no excuse can be offered for crowding the machinery to such an extent that it cannot be kept in proper condition and conveniently repaired by those responsible for the management of the plant.

Cleanliness is absolutely essential to the successful operation of an electric railway power station. It is necessary that the building itself be kept free from oil and dirt, and each piece of apparatus thoroughly clean at all times, in order to maintain it in its highest state of efficiency. The designing engineer should contribute his share towards this result by providing ample light throughout the building—boiler room as well as engine or generator room. All the walls of the building should be painted in some light shade, preferably with some kind of enamel paint which can easily be washed down and kept clean. This will be found to reflect the light into dark corners of the building or spaces around the machinery, which might otherwise form receptacles for dirt and rubbish. It will add very much to the cleanliness and general appearance of the plant, and will contribute toward its successful running.

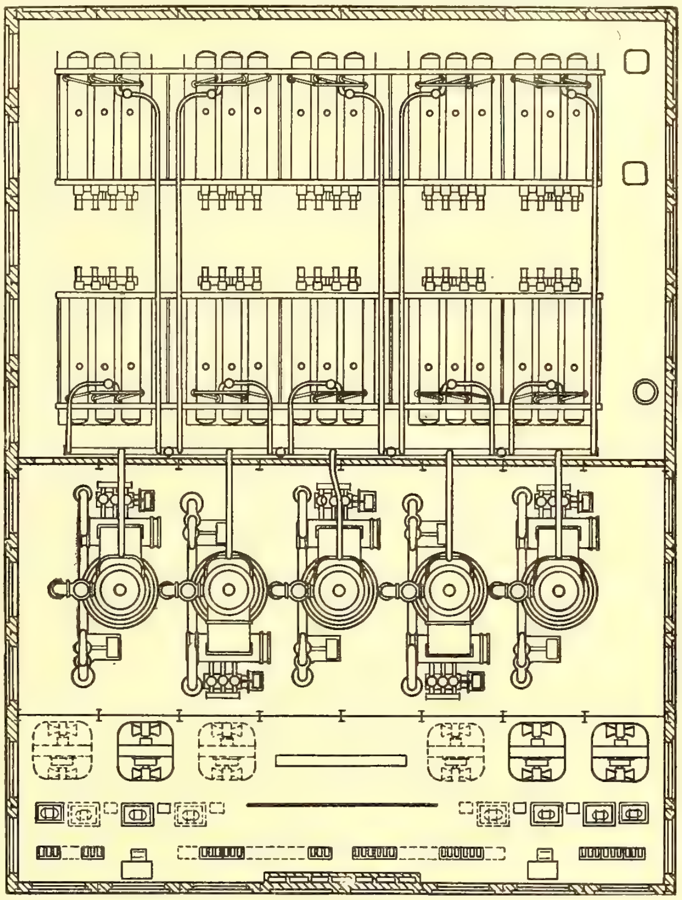
In designing a power station, the primary object in view is to deliver power at the bus-bars for the least expenditure of money, due importance, of course, being given to reliability of operation, which is the controlling principle in power station work. The fixed charges—interest, depreciation, insurance and taxes, should be as carefully considered as the cost of fuel, labor, supplies, repairs and other items which make up the operating expenses. Consideration should be given to each of these elements in proportion to its importance as a factor in the cost of power. In the great majority of cases fuel is the most important item of expense, frequently amounting to more than all other operating costs combined, and the perfection of these details of design and management which will effect the greatest economy in its use will usually make the best return for the time and labor expended.

Electrical apparatus has now been developed to such a state of perfection that in a well-designed and carefully managed power station over 90 per cent of the power of the engines is converted into electrical energy and delivered to the transmission system for the operation of cars. It appears, therefore, that no very great gain in coal economy is to be expected from the further improvement of electric generators or switching apparatus, and engineers are directing their efforts more than ever before to the steam portion of the power station, which offers a more promising field for a reduction in the cost of power.

The number and size of units to be installed is one of the most important problems bearing upon fuel economy which the engineer is called upon to solve. In order to obtain the maximum efficiency from the prime movers and their auxiliaries, it is necessary that they should be proportioned to the load they are intended to drive, so that if possible they may be operated at all times at or near their rated capacity.

In electric railway power stations it is not regarded as practicable to change the speed of the air or circulating pumps, or to alter the quantity of cooling water, to suit the varying loads upon the station, and these auxiliaries are usually operated at a point sufficient to take care of the maximum load. The power required to drive them is therefore practically constant, and their steam consumption per unit of output will vary indirectly as the load on the main engines. Under ordinary operating conditions, where the exhaust steam is used for heating the feed water, only about 12 per cent of the heat in the total steam generated can be used for this purpose, and all steam used by the auxiliaries in excess of this must go to waste; and it follows that in addition to the losses due to the reduced efficiency of the prime movers at light loads, the percentage of loss in the auxiliaries will increase very rapidly as the load upon the main engine decreases, and the best economy of the entire plant will be obtained only when the engines are operated at or slightly above their rated capacity.

The writer has before him the operating statistics of two railway power stations, a comparison of which illustrates the importance of proper attention to this subject. For convenience they will be referred to as Station A and Station B. Both stations furnish power for suburban railways upon which sufficient cars are run to provide a fairly uniform load during the greater part of the day, although subject to more or less violent temporary fluctuations. The general designs of these stations and their equipments are such that the fuel used per kilowatt-hour should be practically the same, provided the engines could be kept well loaded in both cases. In Station A there are three units, and the load conditions are such that one unit is operated during the night and early morning, when the travel is light; two are operated during the greater part of the day, and three at the peak of the load, which occurs shortly after 6 o'clock in the evening. By careful attention to the changes in the load, it is always possible to keep the running engines fairly well loaded.

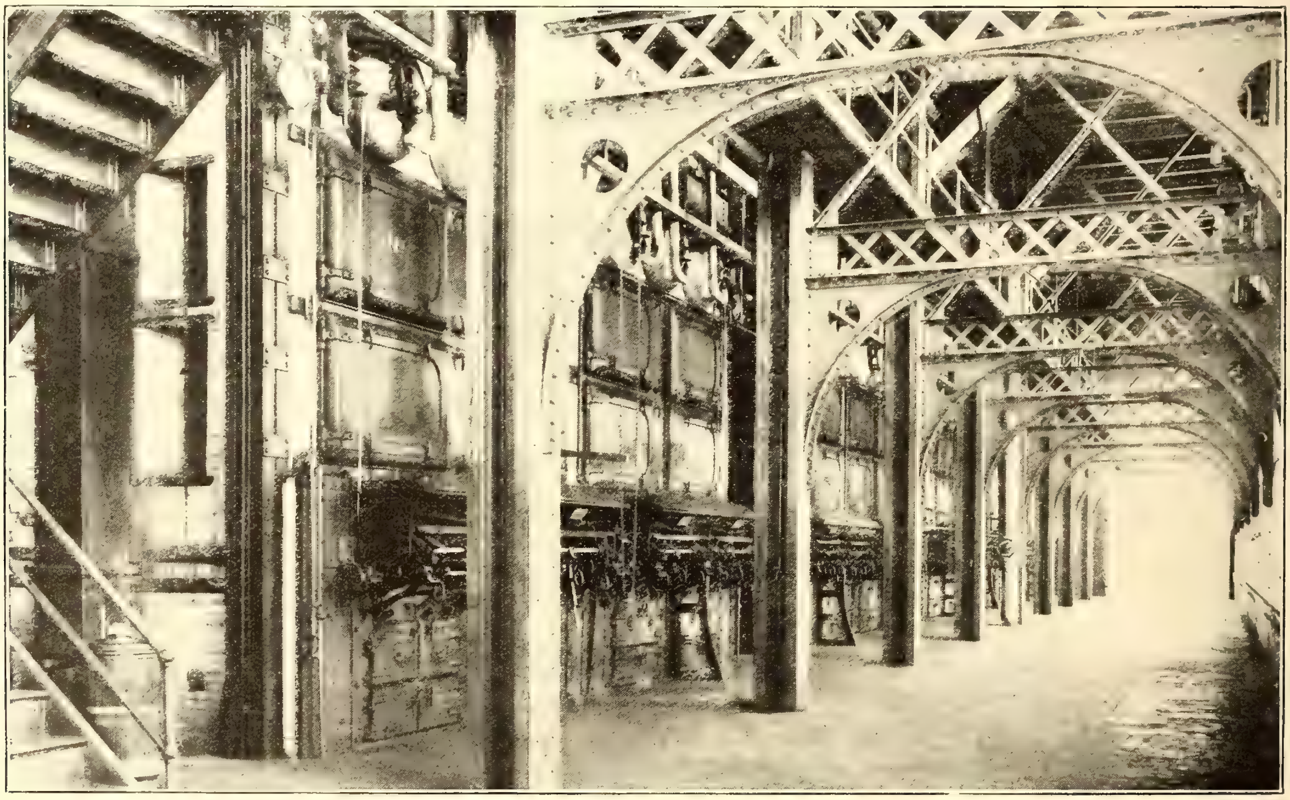


PLAN OF QUINCY STATION, OLD COLONY STREET RAILWAY COMPANY

In the case of Station B there are two units. The load at night and early morning is very light, so that the engine used is only about half loaded for this period, whereas for the greater part of the day the load is a little more than one engine should be required to carry, and it is therefore necessary to run both engines. The result, of course, is that the average load on the station is only a little more than 50 per cent of the rated capacity of the running engines, and they are, consequently, extremely wasteful of steam; and, too, the exhaust from the auxiliaries is probably quite a little in excess of that required to heat the feed water, which will also account, in a measure, for the low efficiency of the plant. Five pounds of coal per kilowatt-hour is the record of this plant, as compared with 3.8 lbs. for Station A. The greater part of this discrepancy is undoubtedly due to the more efficient load conditions in the latter station. It is probable that had a storage battery been

added to the equipment of Station B, the load on the engines could have been regulated so as to have made a much better showing in coal consumption, but it is still problematical if there is any net gain from the use of storage batteries in railway work, and the writer is disposed to think that the use of three smaller engines in place of two large ones would have been the proper solution of the question. Undoubtedly a saving in coal of from 15 per cent to 20 per cent would have resulted from the use of engines better proportioned to the load.

In deciding upon the number and size of units, therefore, it is necessary that a careful study should be made of the load conditions throughout the entire day. In providing an increase of power for existing roads, data will be available from which station load curves under varying conditions of traffic can be constructed, and a fair average decided upon as the basis for determining the size of the units. In the case of a new railroad proposition, this information will be more difficult to obtain, and an approximate load curve will have to be constructed from a study of all of the conditions bearing upon the subject. This involves decisions upon such matters as the location of track, with special reference to grades and curves, the distribution of copper in the feeder system, the weight and equipment of cars and train schedules, all of which are important factors in determining upon the power required.



BOILER ROOM IN STATION OF THE RHODE ISLAND SUBURBAN RAILWAY COMPANY

It is often necessary to estimate the size of a new power station before the final survey of the road is completed, or the details of the feeder system or train schedules definitely decided upon. In such cases the engineer will have to apply such data as he is able to obtain from other roads in which the conditions of track and the operating conditions are similar. But such data should always be used with the utmost caution, as vital differences in grades, in the feeder system, or in train schedules, must necessarily exist, which will render it extremely difficult to make comparisons sufficiently accurate for a final decision upon the size of the station.

Having ascertained the power required during the different hours of the day, the plant should be divided into as few units as will enable the engines and generators to be operated at or near their rated capacity, while at the same time a sufficient number should be installed so that in the event of trouble one can be shut down without causing interruption of service. A 3-unit station will permit of a fairly uniform distribution of the load in small plants, and in case of accident to one unit, the other two should be able by overloading, to supply sufficient power until repairs are completed. This number of units is therefore regarded as the minimum which should be installed in any power station.

The type of apparatus to be used, whether alternating or direct current, will not materially affect the design of the station except in so far as the question of the use of reciprocating engines or steam turbines is involved. Up to this time the steam turbine, which is rapidly growing in favor for electric railway work, has been designed almost exclusively for use in connection with alternating-current generators, and the manufacturers of electrical apparatus have held out scant encouragement that its speed could ever be so modified as to make its use with direct-current generators, particularly the larger sizes, practicable. Reciprocating engines have, therefore, been regarded as the only type of steam motor available for this class of work. It is probable that this will be the case for some time to come, but it is interesting to note that considerable progress is being made in the development of direct-current turbo-generators. A number of machines of this type as large as 500-kw capacity are in operation, and work is well advanced upon units as large as 2000 kw. There seems to be good ground for the belief that this problem will be successfully solved, and that in the near future this type of apparatus will be available in sizes as large as are generally required for direct-current work.

Engineers and steam users generally have been prepared for some time to welcome any form of prime mover which could be shown to possess any considerable advantage over the reciprocating engine, as the latter had come to be regarded as having largely fulfilled its possibilities, and no very great improvement in economy was to be looked for. The steam turbine seemed to offer the solution of the question, and while, at the time of its introduction into this country, its superior economy had not been demonstrated, its great simplicity as compared with reciprocating engines, lower first cost, and less floor space occupied, insured its prompt adoption by a large number of power users, and from the first its progress has been rapid. In a report of the committee for the investigation of the steam turbine made to the National Electric Light Association last June, it was stated that there were in operation at that time 224 turbines of an aggregate capacity of over 350,000 hp, the greater number of which had been installed in the last two years. The writer is informed that the orders for turbines taken by the largest two manufacturers in this country aggregate (July 1, 1905,) over 800,000 hp.

The remarkable progress made in the manufacture of these machines, and their general adoption by many of the most progressive railways in the country, proves them to be a most formidable competitor of the reciprocating engine, if, indeed, it does not indicate that they have already established their commercial superiority.

It is to be regretted that most of the data upon the efficiency of steam turbines has been derived from tests covering very short periods of time, usually only a few hours, and that so little data is available of their performance under actual service conditions. To the street railway manager or engineer, power station records for long periods, showing the coal consumed per kilowatt-hour, or,

better still, the efficiency of the plant expressed in percentage of heat energy in the coal converted into electrical energy at the switchboard, are of much greater interest and value than the record of any number of short-time tests for steam consumption only, as it provides him with a much more practical means of making comparisons with the performance of other stations with which he is familiar. The data which has been published illustrating the relative economy in steam consumption of turbines and reciprocating engines rarely ever shows comparisons between units operating under identical conditions as to steam pressure, superheat, or vacuum and therefore does not fairly represent the relative performance of the two types, and, too, the steam consumption of the auxiliaries is also invariably omitted, so that it is impossible to form an intelligent opinion as to the additional cost of the higher vacuum required for the turbine.

Up to this time most of the turbines installed in electric railway power stations are operated in connection with reciprocating engines, and owing to the difficulty of separating the operating charges, it has been practically impossible to obtain reliable information as to their performance under commercial conditions.

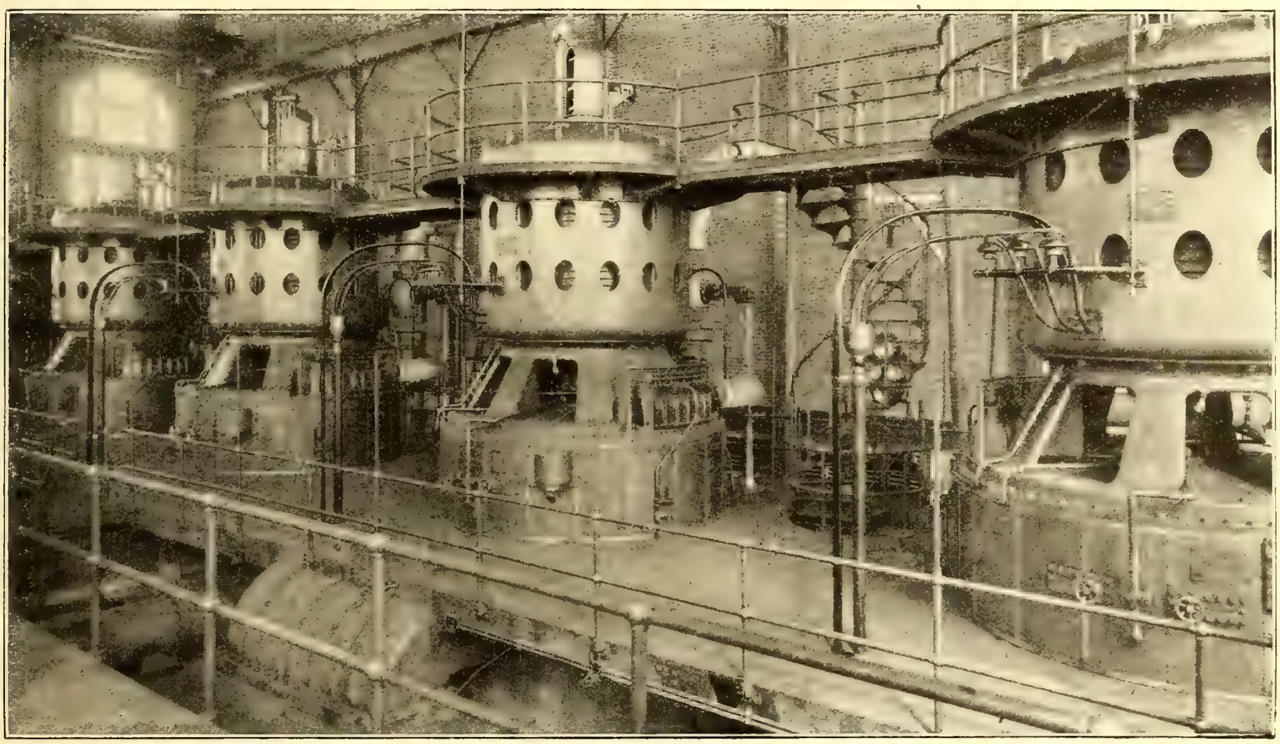
One of the plants where turbines are exclusively used is the Quincy power station of the Old Colony Street Railway Company, and through the courtesy of P. F. Sullivan, president of this company, the writer is permitted to publish some information regarding the performance of this station. This information was kindly furnished by C. F. Bancroft, superintendent of motive power and machinery.

It should be stated at the outset that this station, which will eventually furnish power for that portion of the Old Colony Street Railway Company's system, extending from Quincy on the north to the city of Fall River on the south, is not yet in full operation. Its connection with the latter city, where a large part of the current is to be used, has not yet been made, so that at present it furnishes power for only about one-third of the number of cars which it will eventually drive. Only two of the five turbines in the station are required for this work. One of these machines is run for 17 hours per day, and two for 24 hours per day. When the station is in full operation there should be a more uniform load, and it is expected that the station efficiency will be considerably increased.

The station contains five 2000-kw, 4-stage vertical turbines, running at 750 r. p. m., and connected to 13,200-volt, 25-cycle alternating-current generators. The steam pressure is 200 lbs. There are ten horizontal water-tube boilers of 750 hp each, equipped with internal superheaters, giving to the steam an average of 65 degs. superheat. Under-feed stokers are used. There are no economizers. One turbine is supplied with steam-driven auxiliaries; the other four have motor driven auxiliaries. At present, while only two units are in operation, the feed water is heated to 200 degs. F. by the exhaust from the steam auxiliaries. The average daily output is 52,500 kw-hours, giving a load factor of 54.7 per cent for the two machines. Georges Creek Cumberland coal is used, having an average calorific value of 14,000 B. T. U. per pound. The average coal consumption for this station, operating under the conditions outlined above, is 2.94 lbs. per kilowatt-hour, showing an efficiency of 8.36 per cent. This record covers a period of six months, ending June 30, 1905.

While this performance does not furnish conclusive evidence of the superiority of the turbine over reciprocating engines in electric railway work, it compares favorably with the results obtained in a large number of the better class of stations using the latter type of prime movers, and gives some force to the opinion that in actual practice there will be found to be very little difference in the coal consumption of steam turbine and reciprocating engine plants operating under similar conditions.

In order to develop the highest efficiency of the steam turbine, it is necessary to operate with a very high vacuum. It is claimed that each inch of vacuum above 26 ins. will increase the economy from 3 per cent to 4 per cent, and condensing apparatus is usually recommended which will produce a vacuum of about 28 ins. of mercury, or 2 ins. to 2½ ins. higher than that regarded as the most efficient for reciprocating engines. The type of apparatus generally installed consists of a surface condenser with a centrifugal circulating pump, dry vacuum pump and hot-well pump. In practice no trouble has been experienced in obtaining the high vacuum desired with this type of apparatus, but whether the gain of 3 per cent or 4 per cent in coal is sufficient to warrant the additional first cost and cost of operating this rather complicated system, is a question which would seem to be open to discussion. In cases where the cost of feed water is a material factor in the cost of power, or where it contains a large percentage of calcium or magnesium carbonate, or other scale-forming materials, there will be great advantage in using a surface condenser on account of the pure distilled water returned to the boilers, but where these conditions do not exist, it will frequently be found to be practicable to use some simpler form of condensing apparatus, such for example as the injector or barometric type of jet condensers. These types of condensers offer very great advantages over the surface condenser in the matter of lower first cost, space occupied, greater simplicity and less cost of maintenance. Up to this time they have not been very generally used, but there seems to be no good reason why they should not work as satisfactorily in connection with steam turbines as with reciprocating engines, and when properly proportioned to the work and installed with tight piping throughout, it is believed that in many cases they will prove to be as satisfactory as the more complicated types.



TURBINE ROOM, QUINCY STATION, OLD COLONY STREET RAILWAY COMPANY

A considerable economy in the steam consumption of both reciprocating engines and steam turbines has been shown to result from the use of superheated steam. In plants equipped with either of these types of prime movers using dry saturated steam, the introduction of superheated steam can generally be depended upon

to effect a saving in steam of about 1 per cent for every 8 degs. or 10 degs. of superheat. Where the quality of the steam is not so good, and the conditions are such that the condensation in the pipes or cylinders of the engines is excessive, the saving may be much greater than this, sometimes amounting to 1 per cent for every 4 degs. or 5 degs. of superheat.

With reciprocating engines, condensation in the cylinder resulting from the great difference in temperature between the incoming steam and the surfaces of the cylinder which have just been exposed to the temperature of the exhaust steam, has been recognized as one of the greatest sources of loss. Various means have been employed to reduce this loss, such, for example, as the use of steam jackets and reheaters, but these devices add materially to the complication of the engine, and under the most favorable conditions only affect a partial saving. For these reasons they have not been generally adopted in power station work. Superheated steam has been found to be a much simpler and more effective method of accomplishing this result.

Our knowledge of the subject of steam turbines is still so limited that it is impossible to state with any degree of positiveness just where the various losses occur, or to what causes we must attribute the gain in efficiency from the use of superheated steam. Undoubtedly a portion is due to thermodynamic reasons, and it has been suggested that a large portion is also due to the diminution of fluid friction within the turbine. Owing to the very high steam velocities in this type of apparatus, the friction of the steam passing over the surfaces of the buckets must cause a considerable loss, and this probably very much greater where the steam carries a large percentage of moisture than when it is dry or superheated. It is probable, therefore, that the larger part of the gain due to superheating can be attributed to this cause.

The prevention of the deposit of water on the inside of the turbine casing, also, must effect some saving, although this gain is probably small as compared with that resulting from the diminution in the friction of the steam as it passes over the surfaces of the buckets.

Whatever the causes may be, there can be no doubt that there is a very marked gain in efficiency in steam turbines from using superheated steam, amounting to about as much per degree of superheat as in the better class of reciprocating engines.

The following table, compiled by R. M. Neilson, shows the reduction in steam consumption in steam turbines and reciprocating engines due to superheating. These statistics were obtained from a number of tests made in this country and in Europe. The apparent discrepancy in these tests is explained by the statement that there was considerable difference in the quality of the steam in the different cases, and the engines were of different types and of different sizes:

Steam Turbines			Reciprocating Engines		
Degrees Fahr. of Superheat	Percentage Reduction of Steam Consumption	Percentage Reduction per Degree Fahr.	Degrees Fahr. of Superheat	Percentage Reduction of Steam Consumption	Percentage Reduction per Degree Fahr.
13	6.1	0.47	31	7.86	0.25
50	8.0	0.16	40	8.65	0.22
60	5.4	0.09	50	12.00	0.24
66	12.1	0.18	100	20.55	0.20
70	7.5	0.11	100	13.00	0.09
84	7.7	0.09	216	36.4	0.17
100	14.0	0.14	225	33.7	0.15
140	12.6	0.09	225	33.1	0.15
150	19.0	0.13	440	30.9	0.07
200	23.0	0.115			
260	24.5	0.09			

Unfortunately, superheated steam is now known to be rather expensive to produce, particularly at the higher temperatures, and consequently economy in steam consumption does not necessarily mean economy in the consumption of coal. The chief advantage in its use is obviously in the saving which can be made at the coal pile, and unless this saving can be shown to be sufficient to pay for installing and operating the necessary superheating devices, it will be extremely difficult to convince a careful street railway manager that it will be profitable to use it.

This is a subject upon which there is a vast amount of conflicting information. In a number of instances the use of superheaters has been discontinued either on account of mechanical difficulties or because there was not a sufficient saving in coal to pay for keeping them in service. In other cases no mechanical difficulties have been experienced, and the saving in coal has been all that could be reasonably expected.

It is noteworthy that manufacturers of reciprocating engines and steam turbines, as well as engineers, while still recognizing the value of superheated steam, are disposed to be much more conservative than formerly in recommending its use. At this time, the weight of opinion seems to be in favor of a moderate amount of superheat, say not exceeding 125 degs. Within this limit there should be a sufficient saving at the coal pile to justify its use, while the temperature is not sufficiently high to cause serious mechanical difficulties with any of the various types of steam apparatus generally used.

For many years after the inauguration of the electric railway industry, power station engineers seemed disposed to devote the greater part of their energies to perfecting the arrangement of engines, generators and switching apparatus, frequently neglecting the more important, though less showy, boilers and their accessories. In recent years they have come to realize that a larger percentage of saving can be made by a proper attention to the design and management of the boiler room than in any other department, as it is here that the greater number of preventable losses in a power station occur.

The designs of the standard types of steam boilers which are now generally used have been perfected to such a degree that efficiencies as high as 70 to 75, and even 80, per cent have been attained under favorable conditions, and there are very few improvements which the power station engineer can suggest which will produce any considerable saving in fuel.

The design of the furnace, as distinguished from the boiler, on the contrary, is one requiring careful thought and study, to make it conform to the conditions required for the perfect combustion of the specific kind of fuel which is to be used. Anthracite coal, owing to its small percentage of volatile matter, can be satisfactorily burned in almost any kind of a furnace, provided the grate area and the draft are sufficient to burn the quantity required to develop the desired capacity, but in the case of semi-bituminous and bituminous coals and lignites, containing a much larger percentage of volatile matter, the furnace should be so designed that this volatile matter, as well as the fixed carbon, will be completely burned in order to develop the full heating value of the fuel.

The following conditions are necessary to insure the complete combustion of the fuel:

1. A sufficient supply of air.
2. Thorough mixture of air and fuel.
3. A sufficiently high temperature of the air and the combustible gases to insure their ignition and perfect combustion before they come in contact with the cooling surfaces of the boiler.

The principal source of loss is due to imperfect combustion of the volatile gases, which are distilled very rapidly after fresh coal is placed upon the fire, and not being mixed with air at a temperature sufficient to cause ignition, pass off unconsumed; or the air supply and the temperature being sufficient, they are allowed to come in contact with the comparatively cool surfaces of the boiler, and their temperature reduced below the ignition point before combustion is completed, so that they escape when only partially burned. The mixture, temperature and time are therefore important factors in the combustion of the volatile gases, and it follows that the combustion chamber should be of sufficient size to allow the gases to become thoroughly mixed, and that they should be raised to a sufficiently high temperature and be protected by fire-brick walls and arches from the cooler surfaces of the boiler shell or tubes until the combustible portion has been entirely consumed.

As to the proper place to admit the air for the combustion of the volatile gases, D. K. Clarke says:

"It is a matter of perfect indifference as to effect in what part of the furnace or flue it is introduced, provided this all-important condition be attended to, namely, that the mechanical mixture of the air and gas be continuously perfected before the temperature of the carbon of the gas, then in a state of flame, be reduced below that of ignition."

A number of furnaces have been devised in which the air has been admitted at the bridge wall or at the sides or front of the furnace above the grate, and there have been many ingenious plans for heating this air to the proper temperature before its admission to the combustion chamber. Some of these furnaces have been fairly successful as a means of reducing the smoke, but it is doubtful if the admission of air above the grate has ever materially increased the efficiency of the furnace. By far the most common practice is to admit all the air through the grate, that required for the combustion of the volatile gases being heated to the proper temperature by passing it through the bed of incandescent fuel.

In many of the larger railway power stations the flue gases are regularly analyzed to ascertain the amount and distribution of the losses due to incomplete combustion and the amount of excess air admitted to the furnace, which information is necessary to enable those in charge to operate the boilers in the most efficient manner. The only way in which the waste which takes place in the furnace can be detected is by such an analysis, and its importance as a means of reducing boiler room losses is so great that it merits a much more general use.

In the combustion of coal the object in view is to produce the highest possible percentage of carbon dioxide per unit of fuel burned. The higher the percentage of carbon dioxide, the more perfect will be the combustion of the fuel and the higher the

furnace temperature, as is shown from the fact that a pound of carbon burned to carbon dioxide will produce 14,600 B. T. U., while only 4450 B. T. U. will be produced when, on account of an insufficient supply of air, carbon monoxide is formed. The gas analysis will show the percentage of carbon dioxide, carbon monoxide and oxygen. This information will enable the chemist to determine the total heat in the escaping gases, the amount of unconsumed gas, and the losses due to an excess air supply, and will also indicate the cause of these losses and suggest the proper remedy.

A low temperature of escaping gases is frequently regarded as an indication of efficient furnace conditions, but it is quite as likely to be caused by an excess of cold air, due to too strong a draft, uneven fires, or leakages through the boiler settings. The true condition of affairs can only be revealed by means of an analysis of the flue gases. Anything which will increase our knowledge of the conditions which take place within the boiler setting, and will permit a more intelligent use of fuel, should be encouraged, and for that reason the practice of analyzing the flue gases is recommended in all railway power stations where the cost of fuel is an important factor in the cost of power. It is always preferable to have this analysis made by an experienced chemist, but in small stations where the saving to be made is not sufficient to warrant the employment of such a man, it is said to be possible to obtain fairly satisfactory results from the use of one of a number of automatic or semi-automatic devices which are now manufactured for the purpose.

Mechanical stokers are now almost universally employed in electric railway power stations, on account of the increased efficiency over hand-fired furnaces and the reduced cost of operation. In a properly constructed furnace of moderate size, equipped with flat grates, an intelligent and careful fireman will produce results equally as satisfactory as any which have been obtained with any of the various types of mechanical stokers; but the trouble is that such firemen are not plentiful, and it is extremely difficult to secure men who will produce uniformly good results for long periods of time. For this reason the average fuel economy in a railway power station will generally be found to be somewhat better where the firemen are assisted by some form of mechanical stoking device.

It should be borne in mind, also, that in order to economize in space and the initial cost of the plant, the size of the boilers and the rate of combustion has steadily increased in the last few years until they have now reached a point where it is doubtful if the larger sizes can be properly stoked by hand, even by the most competent firemen.

The use of mechanical stokers is necessary in connection with these large sizes of boilers, in order to drive them up to the capacity required in electric railway plants.

There can be no doubt that mechanical stokers accomplish a considerable saving in boiler house labor. A reasonable day's work for a fireman is the shoveling of sufficient coal for about 500-hp of boilers, which in a railway power station will amount to from six to eight tons every twelve hours. Where automatic stokers are used, and coal is delivered to the hoppers by gravity, one man should be able to take care of about 2000-hp of boilers, which is equivalent to a reduction in labor of 75 per cent. The cost of maintenance of automatic stokers is somewhat greater than that of flat grates, and additional labor is required for repairs as well as for tending the coal handling machinery usually installed in connection with them, so that the net saving in labor will be somewhat less than that indicated above. There is a point, of course, at which this saving is not sufficient to pay for the additional fixed charges and repairs upon the mechanical stoking devices. This point is reached in a boiler plant of about 2000-hp capacity. In a plant of greater capacity than this, automatic stokers can generally be shown to return a sufficient net saving to warrant their use, while in smaller plants it will frequently be found to be profitable to use them on account of the cheaper grades of fuel which can be burned and the greater capacity which can be gotten out of the boilers.

Perhaps the most difficult problem to be solved in connection with the power station is to secure proper attention to details of operation by the subordinate employees. In the most carefully designed plant, equipped with the most efficient types of machinery, the results which the railway manager and designing engineer may reasonably expect in the way of economy will not be achieved unless the utmost care and vigilance are exercised by the operating forces. The successful operation of the station will depend largely upon the way in which the forces are organized, and discipline maintained. Just how the station organization should be made up is a question which can only be decided for each plant after a careful study of all the conditions; but it is safe to say that however the various departments may be organized, there should be one man in supreme authority, possessing considerable executive ability as well as a thorough practical knowledge of steam and electricity, whose decision should prevail in the event of disagreement among the heads of departments or at times of emergency. As he is the one who will be held responsible for the successful performance of the station, it is essential that whatever regulations there may be regarding the employment of his subordinates, he should have full authority to dismiss any who prove to be incapable or are not disposed to be attentive to their duties. It will be practically impossible to maintain proper discipline if among the employees there are those who feel a certain sense of security in their position through the influence of someone higher in authority than the man in charge of the station.

The work of the greater number of station employees is necessarily of a routine character. It is nevertheless important that they should be thoroughly instructed in their duties and required to perform them with the utmost regularity. For example, an oiler employed upon an engine should receive instructions as to the minutest detail of the work that he is required to do. He should not only be required to see that his lubricators are full and working properly, and that every part is receiving a sufficient quantity of oil or grease, but he should feel of every bearing and should observe every part of the engine as he passes around it to assure himself that it is in proper operative condition. He should be required to perform these duties at regular intervals of every 20 or 30 minutes, and his attention should be called to the time for him to commence his rounds by a bell or whistle, or some other form of signal. If there is any part requiring attention, it should be immediately reported to the engineer in charge, who will thus be given an opportunity to apply the proper remedy before the trouble has developed to such an extent as to cause damage or interruption to the service. If the oiler attends to his duties properly, there will be no trouble from hot bearings, from keys, pins or bolts working loose, or from any change in the adjustment of any part which it is possible to discover when the engine is running.

The work of all other station employees should be systematized along the same lines. The watch engineers should report in writing to the engineer in charge details of the apparatus which in their judgment require attention, and as soon as the machinery can be shut down, these parts should be carefully inspected, and if they show signs of weakness or excessive wear, immediately renewed or repaired. An examination of the enclosed parts of the engines and other working machinery should also be made at frequent intervals and before there are any outside evidences of trouble.

It is necessary that all subordinate employees should be under constant supervision to insure a proper attention to their duties, but this is especially true of the fireroom forces. Firemen are not generally disposed to take as much interest in their work as employees in other departments. They seem to be content to remain as firemen, and rarely endeavor, by excelling in their work, to advance their positions. It is in this department that the greatest losses will occur through indifference on the part of the attendants, and it is therefore of the utmost importance that their work should be carefully done. The only way to accomplish this known to the writer is to place this department in the immediate charge of an intelligent and capable man, whose salary and the knowledge that the permanency of his position will depend upon the results produced, will be sufficient for him to keep constantly in touch with those immediately under him and insist upon their performing their duties properly.

In most power stations records are kept of the coal and water consumption, the temperatures of the feed-water and flue gases, and the station output, by which the performances of the station from month to month can be compared. These records furnish a check upon the condition of the station, the manner in which it is operated, and assure its being maintained in a high state of efficiency. The writer has found that in addition to these records, an occasional test of the entire plant under actual operating conditions for periods of say, 24 to 48 hours, are also of great value as a means of furnishing definite knowledge as to just what the station is capable of doing. Such tests also have a certain educational influence upon the employees, particularly the firemen, as they illustrate to them what can be done when all engaged on the work are exerting their best efforts to secure the most efficient results possible.

At the Rhode Island Suburban Railway Company's Manchester Street station all of the usual records are kept, and the quantities and costs carefully determined for each month, and tests of the entire plant are also made as suggested above. The writer believes that these tests have a sufficient influence upon the regular performance of the station to justify a brief description of it, and the publication of the results in the matter of coal consumption from the time it was placed in commission, showing the gradual improvement in efficiency.

This station was originally designed for the Rhode Island Suburban Railway Company to furnish power for its lines operating in the vicinity of Providence. It was intended to use horizontal

units, and two 1500-kw alternating-current units and one 1600-kw direct-current unit were purchased. Before work on the building had progressed beyond the foundations, however, it was decided to increase the capacity of the station by installing two additional direct-current units of 2500-kws each. This required a number of changes in the structure, and necessitated double-decking the boiler room in order to provide the necessary additional boiler capacity. The present equipment of the station consists of fourteen horizontal water-tube boilers of 520 hp each, eight on the lower floor and six on the upper floor. The boilers on the lower floor have no superheaters, but those on the upper floor are equipped with internal superheaters, each made up of eighty-four 2-in. tubes, suspended below the boiler drums. The superheaters on two of the boilers were designed for only 125 degs. of superheat, and contain 615.3 sq. ft. of effective heating surface each. Those on the other four boilers were designed for 150 degs. of superheat, and contain 855.5 sq. ft. of heating surface. Each boiler has 5159 sq. ft. of heating surface.

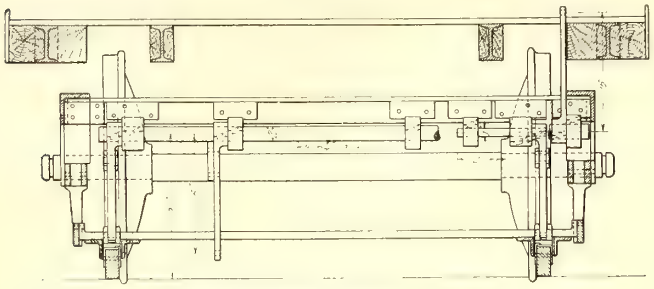


FIG. 2.—CROSS SECTION OF TRACK BRAKE APPLIED TO PECKHAM TRUCK

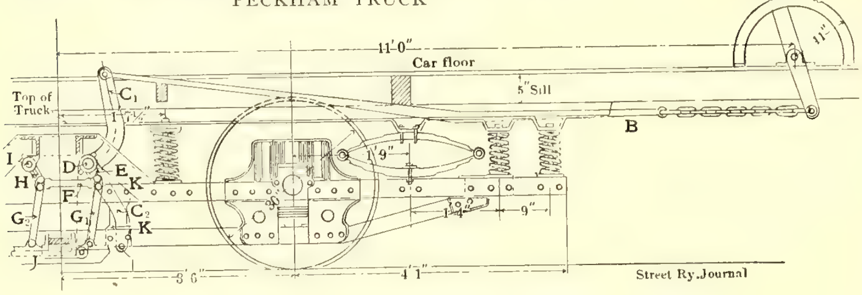


FIG. 1.—TRACK BRAKE APPLIED TO PECKHAM TRUCK

Roney mechanical stokers are used, each containing 112 sq. ft. of effective grate surface. A 280-tube Green fuel economizer is installed directly back of each battery of boilers, the flue being so arranged that the hot gases may be passed through the economizers or directly to the main flue as desired. The heating surface per square foot of grate is for boilers 46 sq. ft., for economizers 15 sq. ft., or a total of 61 sq. ft. Natural draft is used. The boiler pressure is 145 lbs. There are three horizontal compound engines with cylinders 32 ins. and 64 ins. x 54 ins., operating at 94 r. p. m., and two vertical compound engines with cylinders 42 ins. and 86 ins. x 60 ins., operating at 75 r. p. m. All of the engine auxiliaries are steam driven. Jet condensers are used, the air pumps being of the twin vertical type. The average vacuum in the engine cylinders is 25½ ins. of mercury. There are two alternating-current generators each of 1500-kw capacity, delivering current to the line at 11,000 volts, and one 1600 kw and two 2500-kw direct-current generators delivering current at 600 volts. The normal capacity of the station, therefore, is 96,000 kws. Direct current is furnished for 24 hours per day, and alternating current from 5 a. m. to 1 a. m. There are no feed-water heaters between the engine cylinders and the condensers, but the exhaust steam from the auxiliaries is carried to two heaters located in the basement on the suction side of the feed-pumps. These heaters are made up of horizontal U-tubes arranged in series, the steam entering at the top and discharging at the bottom, while the water enters at the bottom and discharges at the top. Each heater contains 750 sq. ft. of heating surface, and in practice all of the steam from the auxiliaries is condensed and is discharged at a temperature only about 35 degs. higher than the incoming cold water. The average daily output of the station is 102,500-kw hours.

The following is the performance of the station under actual service conditions from the time it was started in regular service, February, 1904. It should be borne in mind that the first battery of boilers with superheaters was installed eleven months after the station was started, and four months thereafter two additional batteries of boilers with superheaters were commissioned, and the performance of the station is therefore given for the period covered by these different conditions.

Eleven months, saturated steam, 2.87 lbs. of coal per kw-hour.

Four months, slightly superheated steam (no record of temperature kept), 2.73 lbs. per kw-hour.

Three months, superheated steam, average temperature at engine throttle 465 degs. (102 degs. superheat), 2.46 lbs. of coal per kw-hour.

The apparent reduction in coal consumption per kw-hour with steam superheated about 100 degs. is 14.3 per cent, but all of this saving cannot be attributed to this cause. A large part of it is undoubtedly due to the increased efficiency of the fireroom attendants. Probably not over 8 to 10 per cent should be credited to the use of superheated steam.

AN EMERGENCY TRACK BRAKE

BY F. F. BODLER,
Master Mechanic, United Railroads of San Francisco

The emergency track brake hereafter to be described is used on practically all of the cars in San Francisco. While San Francisco is an ideal city for operating street railways in many respects, especially as regards the absence of snow, ice and sleet, yet it has its drawbacks, namely, an enormous number of steep grades. In order to operate safely over these in wet weather and on slippery rails it was necessary to provide another means of braking a car than the wheel brakes.

In 1895, G. W. Douglas, then master mechanic of the Market Street Railway Company, started to experiment with a track brake on electric cars. Twelve single-truck cars were equipped with track brakes, and operated successfully until 1899. In that year Mr. Douglas reconstructed his brake, and made it successfully applicable to double as well as to single trucks.

Primarily, the brake (see Fig. 1) consists of a hand lever A connected by a brake rod B to an arm C-1, keyed on a rocker shaft D extending clear across the truck. This shaft is connected on each end by means of a short lever E keyed to the shaft, to a connecting link F and to a toggle lever G-1. The connecting lever F is connected to a lever H keyed to a short shaft I, and to a toggle lever G-2. The shell J for holding the shoe is connected to the toggles G-1 and G-2 by means of two heels.

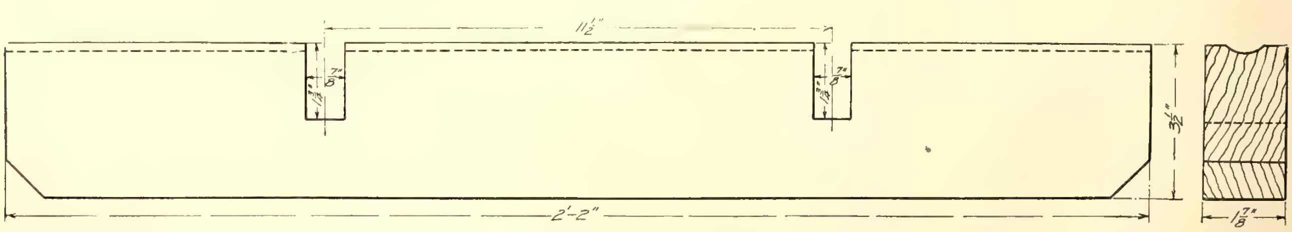


FIG. 6.—STANDARD TRACK BRAKE-SHOE

By pulling back on lever A the shaft D turns from left over to right, tending to make the short lever E assume a vertical position. This motion is transmitted to lever H by means of connecting lever F. The simultaneous parallel movement of levers E and H causes the toggle levers G-1 and G-2 to assume a vertical position and to force the shoe to the rail. The heels on the shoe, one on each side of a channel-iron across the truck, act as a guide and allow the shoe to travel only in a vertical direction. A lever with a counterweight attached to it, keyed to shaft D at any convenient position or bolted to arm C-1, acts as a release.

In order to adapt this brake to a Peckham or Brill single truck it is necessary to fasten a flat iron K, bent as shown, to the side frames, using the holes on each side of one of the spiral body

springs. Two angle-irons are placed transversely across the truck, and fastened to the bent flat iron K. To these angle-irons the brass boxes for holding shafts D and I are bolted. The large shaft D is held in position by three boxes, one on each end and one near the arm C-1. The short shaft I is held by two boxes, one on each side of lever H.

To operate the track brake from the opposite end of the car an arm C-2 is keyed to the shaft D, the brake and rod being placed under and on one side of the motor, as shown in Fig. 2.

Fig. 3 shows the brake applied to a Brill single truck. This brake is placed on double trucks practically as on a single truck, except that each truck has an independent brake, operated from the end nearest the truck. On double trucks the rocker shaft boxes are fastened directly to the transom angle-irons. The arm C-1 has to be placed in middle of shaft D, on account of the swing of the truck.

Fig. 4 shows a Brill 27-G truck, and Fig. 5 a Peckham 14-B-3-S truck with this brake.

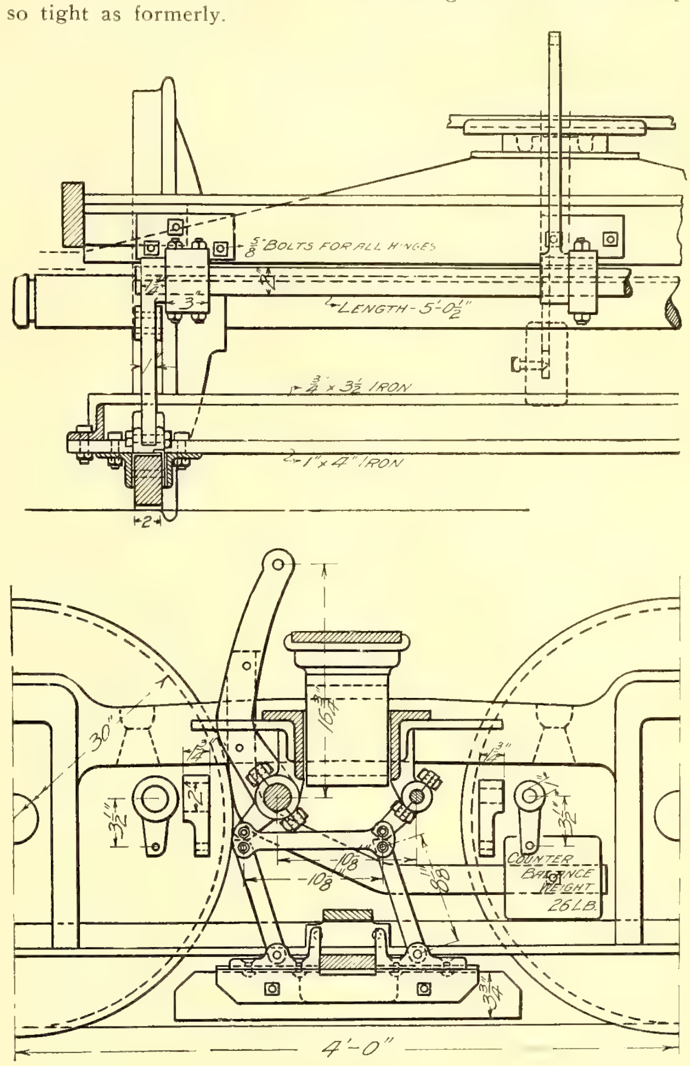
Fig. 6 shows a standard track brake-shoe. This shoe is made of Oregon pine, costs about $.0275 and lasts about one week. All kinds of wood, all kinds of metal, combinations of wood and metal, and metal with all kinds of inserts were experimented with, but for cheapness, general utility, and highest braking efficiency the Oregon pine shoe was found to be the best. The shell for holding through the holes shown in the shell and through the recesses shown in the shoe, not only clamping the shoe by means of the shell, but also preventing the shoe from slipping backward or forward. In order to facilitate the removal of wornout shoes, sections of rail slightly longer than the shoe are sawed off and hinged on the car house tracks. The cars are placed with the shoes over these hinged rail sections, the hinged rail is swung out, and by loosening the two bolts the shoes drop out. The time required for replacing four shoes on a double-truck car is about 2 minutes. The shoes can be adjusted when partly worn, by inserting wooden shims between the top of the shoe and shell.

As seen by various sketches this brake can only be applied on trucks having outside-hung wheel brakes. On double trucks it can only be used when the bolster spring is half elliptic and hung under the side frames. It can not be used on M. C. B. bolsters, on account of lack of room. In fact it requires close figuring to adapt it to the above mentioned trucks, in order to prevent the bolster from coming down on the connecting lever, F.

It has been proved that the brake is most effective when brake levers as shown in sketches are used. The efficiency of the brake is proportionate to the rapidity and force with which the shoe is brought down on the rail. An ordinary ratchet handle with the ordinary spindle is of little use. With a cam on the spindle it is decidedly more efficient.

The strong points of this brake are: Extreme simplicity; high efficiency; low cost of maintenance; independence of all other brakes, and its being purely a mechanical contrivance. It can readily be operated by compressed air, by adding a brake cylinder.

Whether it would be as successful in cities where there is much snow, ice and sleet as it is in San Francisco, the writer would not care to say, yet there seems to be no reason why it should not. It may appear to some that on account of taking considerable weight off the wheels, there would be danger of skidding the wheels, yet the number of flat wheels has steadily decreased since these brakes were put on. The reason for this is probably that there is no need of "cinching" the wheel brakes up so tight as formerly.



FIGS. 4 AND 5.—SECTION AND ELEVATION OF TRACK BRAKE APPLIED TO BRILL 27-G DOUBLE TRUCK

Cars are operated over one 17.5 per cent grade, four 14.5 per cent grades, and any number of 10 to 12 per cent grades.

A single-truck car, weighing 10 tons, can be stopped on the steepest grade over which electric cars are operated in the city, in a reasonable distance, by first applying the wheel brakes, and then the track brake. This brake originally was intended only for emergencies; it has been found so serviceable, however, that it is used almost as much as the wheel brake is. It ought not to be used on curves, switches, or crossings, but should it be used, about the only damage resulting would be a split shoe.

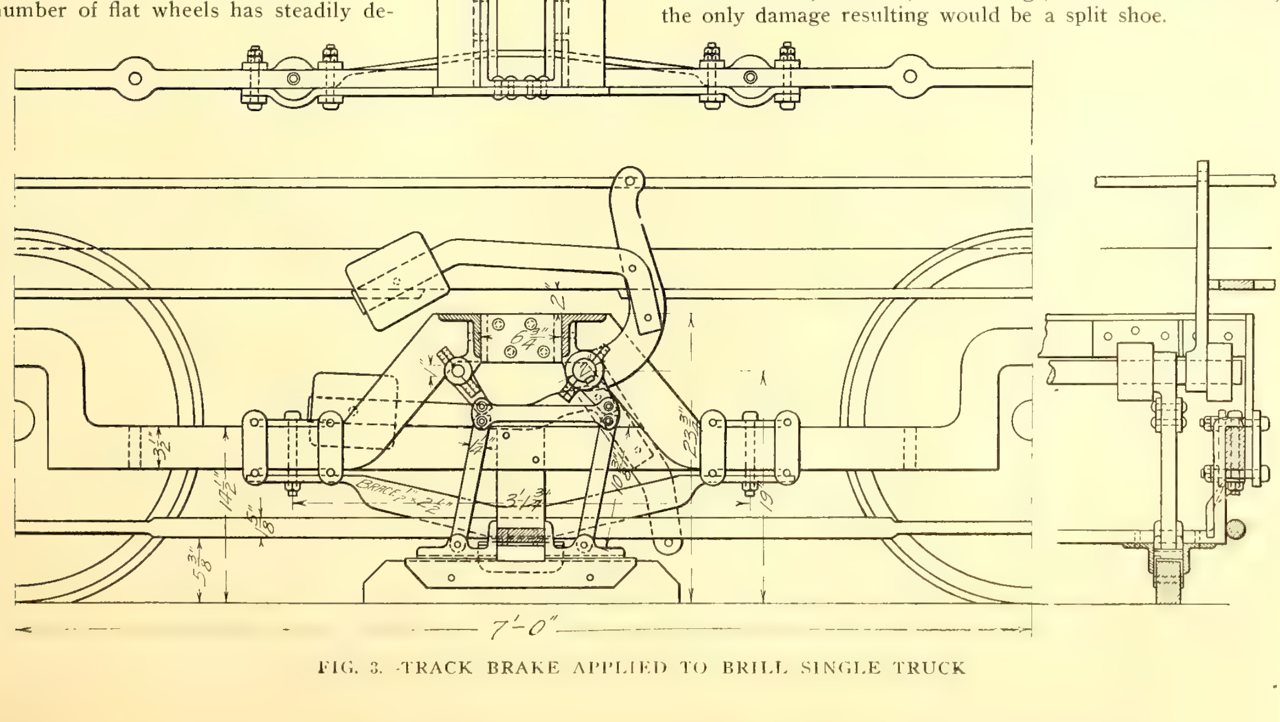


FIG. 3.—TRACK BRAKE APPLIED TO BRILL SINGLE TRUCK

PAPERS READ AT THE PHILADELPHIA CONVENTION OF THE AMERICAN STREET RAILWAY ASSOCIATION

NOTES ON THE DESIGN OF LARGE GAS ENGINES WITH SPECIAL REFERENCE TO RAILWAY WORK

BY ARTHUR WEST

The following remarks, as the title indicates, are applicable to large size gas engines only. The smaller sizes are unsuited to important electric railway installations on account of first cost, multiplicity of parts and greater expense for attendance, etc. The tendency of the modern plant is constantly in the direction of large size units. This is indicated by the rapid increase in the size of steam turbines installed in modern stations. Similar reasons will, it is believed, cause a demand for large size gas engines for electric railway work in conjunction with producers to operate them.

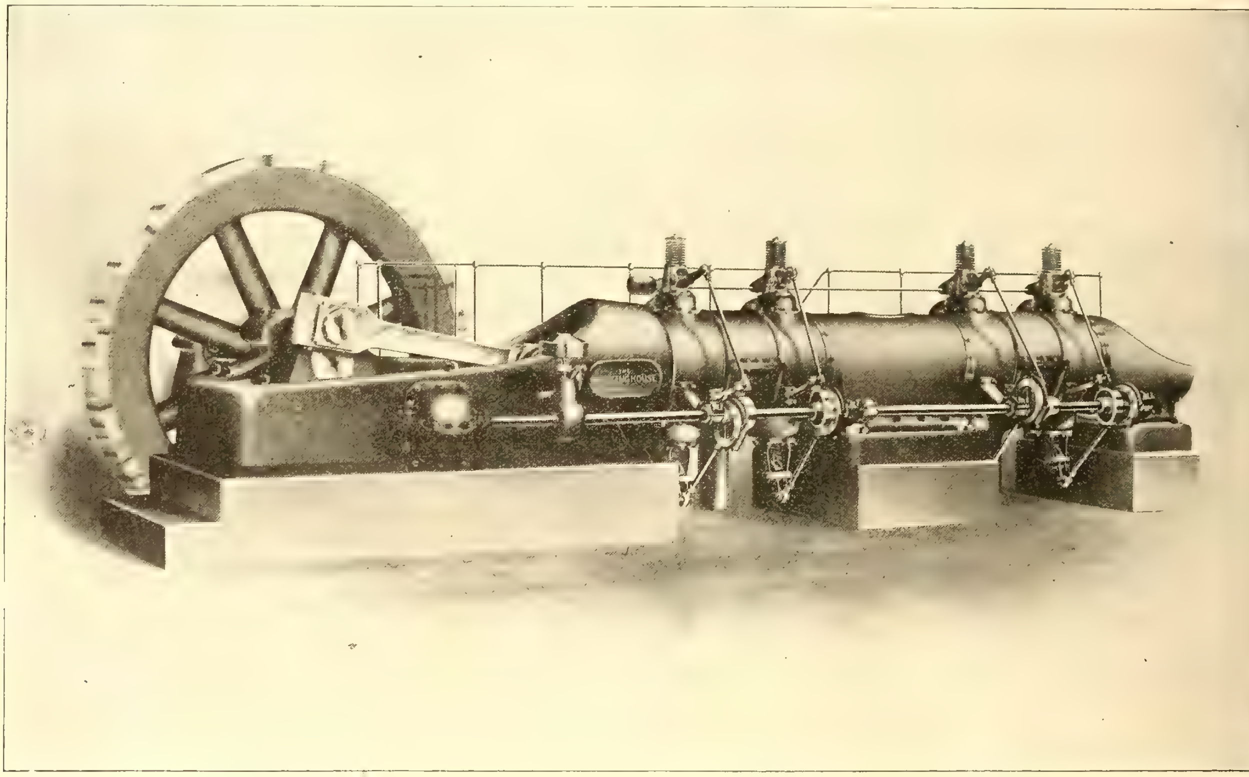
One of the most important considerations in the design of large gas engines is the arrangement of the cylinders. In a single-cylinder, single-acting, 4-cycle engine an explosion takes place once in every two revolutions. In order, therefore, to get the same rotative effect as with a double-acting steam cylinder, it is necessary to work four single-acting cylinders on the shaft or two double-acting gas cylinders tandem on one crank pin. With this arrangement four explosions are obtained in two revolutions, or an explosion every 180 degs. of crank angle. In case of a misfire or premature ignition due to bad gas, the crank can only move one-half a turn before another explosion takes place. In a single-cylinder, single-acting engine the crank must move two whole turns before the next explosion, while with two single-acting cylinders opposed to each other or one double-acting cylinder, the crank may be required to move one and one-half turns before the next explosion. The relative evil effects of a premature or misfire are, therefore, in the following ratios:

Two double-acting cylinders	1
Two single-acting cylinders, opposed type	3
One double-acting cylinder	3
One single-acting cylinder	4

Gas engines and producers to be commercially successful must be designed to be run with the same class of help as is employed on Corliss engines and boilers. This being the case, misfires and prematures are liable to occur occasionally, and the designer must minimize their possibilities for evil. These considerations, as well as the capacity for caring for heavily swinging railway loads, have caused our adoption of tandem double-acting cylinders for railway work.

It is sometimes argued that cylinders so arranged are inaccessible. If, as is the practice of the Westinghouse Company, ample space is arranged between the cylinders, and if the inlet and exhaust valves are not located in the heads, but in the cylinder body and entirely above the floor level, such a gas engine is as accessible as a tandem-compound Corliss engine or as a Corliss engine driving an air compressor.

The speed of a gas engine must be adapted to the kind of generator to which it is to be directly connected. In a general way, its speed will usually somewhat exceed that of a Corliss engine of the same cylinder dimensions. In my experience, the speed of large steam engines is limited by the inertia and consequent wear and tear of the valve gear rather than by the inertia of the reciprocating parts themselves, which is absorbed by the compression. Inasmuch as in a 4-cycle gas engine the valve gear only moves at half the speed of the engine, somewhat higher speeds are permissible than would be the case with a steam engine having the same dimensions of cylinders.



GAS ENGINE FOR UNION TRACTION COMPANY, INDEPENDENCE, KAN.

The speed regulation adopted for large Westinghouse gas engines is especially suitable for generator driving, in that no conditions of changeable load or variable friction of valve gear affect the regulator. Our gas engine regulator governs the speed by means of a relay cylinder, and therefore produces results similar in type to those obtained with the relay governor used by the Westinghouse Machine Company on steam turbines. The advantage of such a relay governor with the gas engine is that the varying friction of valves with different qualities of gas does not affect the sensitiveness of the governor. Without a relay cylinder, the only way in which this result can be accomplished on large gas engines is by some form of a drop cut-off controlling the gas. This is objectionable on a gas engine, as any slight change in the speed of the dash pot very seriously affects the mixture of gas and air, with corresponding bad effect upon the regulation. Such small changes in speed of dash pots are frequent in a Corliss engine, where they cause no bad results. The Westinghouse arrangement employs no releasing gear of any kind, but secures all the advantages of regulation without its use.

The question is frequently asked as to whether large gas engines will drive a. c. generators successfully in electrical synchro-

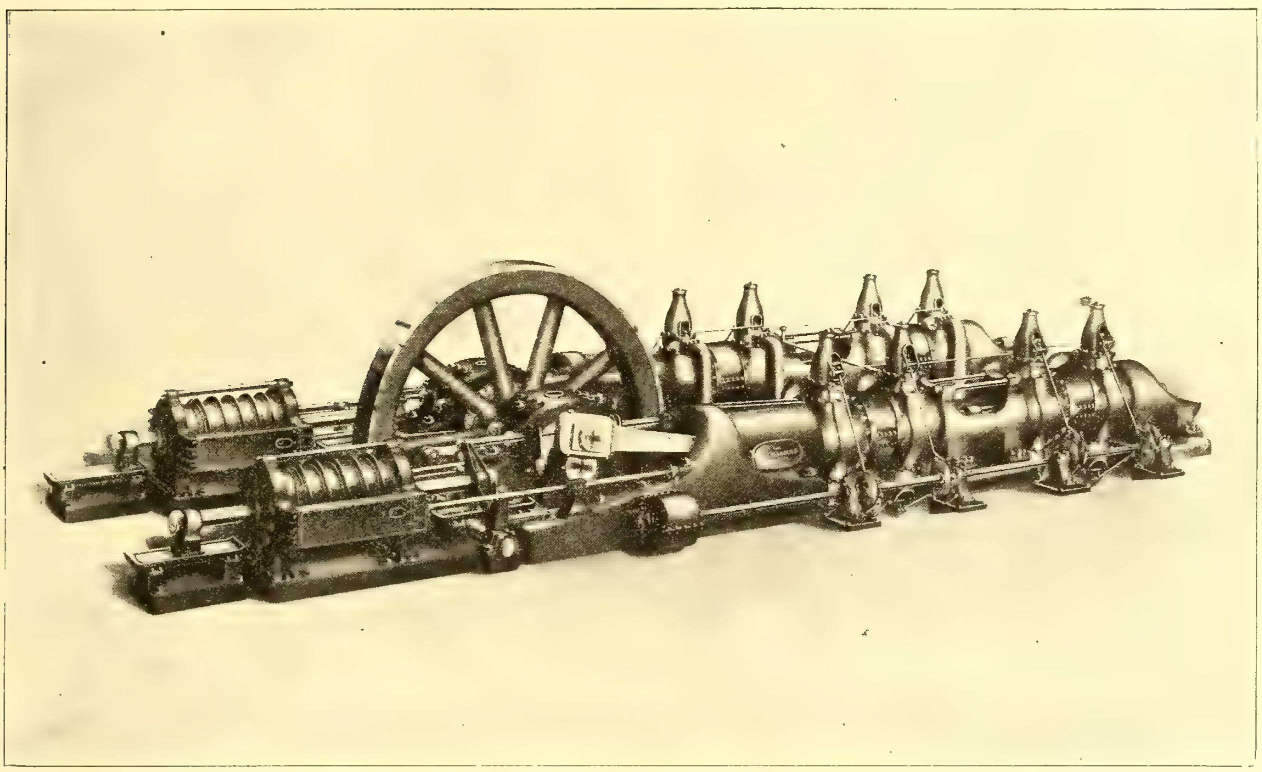
nism or "parallel." This has been done for several years past in Germany with entire success, and it has also been done in a number of instances very successfully by our company. We have at the present time orders for several such plants on our books, one of which is to drive an electric railway from Warren, Pa., to Jamestown, N. Y., which we expect will be in operation some time during the autumn.

It is sufficient for our purpose to observe here that the cyclic variation—i. e., the degree of departure from absolutely uniform rotation—is sufficiently small to conform with the design of generators now built for steam driving.

The European designer of gas engines has allowed himself an amount of complication in valve gear which would not be permissible under American operating conditions. The successful American machine must be as nearly "foolproof" as is the large Corliss engine. If it is not, it will fail to be a success from the purchaser's point of view—no matter what thermal efficiency may be claimed by the builders—as a consequence of such complication as the European engineers have been prone to adopt. In the designing of valve gear for large gas engines, wide range of quality of gases must be considered. In this respect the design of the gas engine is very different from that of a steam engine, inasmuch as the steam used has practically constant characteristics, differing only in such minor points as pressure and superheat. With the different kinds of gas to be met with, however, the proportions of air and gas, and sometimes of compression, are radically different, and no gear can hope to be a universal success which does not provide for meeting the widely varying conditions to be encountered in the market.

We are frequently asked, "What is the overload capacity of your gas engine?" A clear understanding on the part of the purchaser of the limitations in this direction is very desirable, from the point of view both of the buyer and the seller. A gas engine and producer is thermally very much more efficient than a steam engine and boiler. It is, perhaps, not amiss to say that, with a well-designed producer and gas-engine plant, a horse-power can be delivered with one-half the cost of fuel that is possible with a well-designed steam-engine plant. The power of the gas engine, however, is limited by the total volume of explosive mixture which can be drawn into the cylinders during the suction stroke, compressed and finally ignited. This condition sets a limit which does not allow of a large temporary increase of the power, such as obtained with the Westinghouse steam turbine by the automatic operation of the secondary admission valve. Such overload capacity is, of course, convenient for the purchaser, but it is unobtainable on a gas engine, unless the engine is largely underrated, and the purchaser should consider that this is one of the prices that he pays for the enormously increased output obtained with the gas engine per pound of coal. The overload capacity is, therefore, simply the amount which the builder rates his machine below its ultimate capacity. It has been our practice to rate our gas engines in such a way that they would have a safe overload capacity of 10 per cent. Our machines are ordinarily good for somewhat more than this, but conservative engineering requires that there be a margin of power in order that overloads may not materially reduce the speed. The above remarks on overload furnish a general guide which may be of service in selecting suitable generator capacity for a gas engine. For ordinary cases the overload capacity of the generator and that of the gas engine should be about equal, although the gas engine will indefinitely carry its overload, while the generator will not, in all cases, unless it is bought with that understanding.

The mechanical efficiency of a large gas engine is very much greater with a 4-stroke cycle than with a 2-stroke cycle, this being one of the arguments against the 2-cycle engine. It is no uncommon thing to see 2-cycle engines which do not realize as brake horse-power more than 60 per cent of the work actually done by the combustion in the cylinders. The efficiency of a 4-cycle engine varies considerably, but it may be said in a general way that a well-designed engine will deliver about 85 per cent of the gas indicated horse-power in the form of brake horse-power. This 15 per cent of power lost is not exclusively composed of frictional resistance of journals, cross-head slides, etc., as is the case in a steam engine. The 4-cycle engine has, of course, to draw in its own mixture of air and gas and compress the same, and its functions, therefore, combine those of a pump, a compressor and a motor. It is the pumping and compressing work which causes the mechanical efficiency of the gas engine to be somewhat lower than that of a steam engine. The actual friction of the working parts need be no greater than with a well-constructed Corliss engine, viz., 90-95 per cent. In order to keep down the friction and increase the reliability of the machines, it is the practice of the Westinghouse Company to design large gas engines with provisions for attaching a continuous return oiling system. The large amount of oil put through the journals increases the safety, requires less attendance and keying up, and washes out dust if the engine is required to operate in an atmosphere which is not clean.



TWIN TANDEM FURNACE GAS-BLOWING ENGINE FOR CARNEGIE STEEL COMPANY

(Foot Note) (Efficiency $= \dfrac{\text{Heat equivalent to work done.}}{\text{Heat input.}}$

The thermodynamic efficiency of the gas engine varies so much with different kinds of gas that it is hard to say just what the average value would be. It is probably not far from the truth, however, that its thermal efficiency is about 25 per cent, though in favorable cases gas engines have obtained efficiencies well over 30 per cent.

There is an impression rather prevalent that a gas engine is uncertain and hard to start. A properly designed engine, supplied with fairly decent gas, can be started as easily as a steam engine. Large Westinghouse horizontal gas engines are started by means of compressed air, the only operations required being: (1) open the main gas valve; (2) close the igniter circuit; (3) open one compressed air valve, similar in construction to an engine throttle. The compressed air puts the engine in motion, which draws the charge into the cylinder and compresses the same, after which the first explosion takes place. Air is shut off and the engine is in full operation. We find no more difficulty in starting our gas engines than a steam engine of comparative size. I desire to lay stress on this point, as one of the stock arguments against the gas engine is that it is difficult to get into operation.

With certain kinds of gas, inspection of the interior parts of the cylinders is often desirable at regular intervals of, say, a couple of months. This is especially the case with blast furnace gas, and also with producer gas made from certain kinds of fuel. We have taken particular pains to arrange our cylinders so that no parts of the valve gear or valves are below the floor. The inlet valves being located directly on the top of the cylinder, easy access can be had to either end of either cylinder by removing the inlet bonnets. The exhaust valves are also a part of the engine which need occasional attention for regrinding. Especial care has been taken to render these quite easily removable. The cylinders are, therefore, directly accessible from the top through the inlet openings and from the bottom through the exhaust openings. The fact that all the valve parts are entirely above the floor line renders these operations much easier than if a large part of the valve gear extended downward into foundation parts. It is not necessary to remove the cylinder heads, except to examine the piston rings themselves, which is not often required. Inasmuch as clean gas cannot always be secured, the importance of such easy entrance to the gas cylinders cannot be overestimated.

The general type of engine commented on above is shown in the two accompanying illustrations. The first shows the type of two engines being built by the Westinghouse Machine Company for the Union Traction Company of Kansas, Independence, Kan., one being of 500-brake hp and one of 1000-brake hp. The second photograph shows one of two twin-tandem furnace gas-blowing engines now under construction for the Edgar Thomson plant of the Carnegie Steel Company. For electric railway work, no change would be made except to omit the blowing tubs. As electric units, these engines would have a capacity of about 3500-brake horsepower each.

The large size gas engine has come to fill such an important place in Europe, and has there proven itself to be so reliable and serviceable, that there is no question about its being adopted in this country in the near future, in a form suited to American operating conditions.

It is hoped that these general observations will be found of interest to intending users of gas power in large quantities.

THE APPLICATION OF GAS POWER TO ELECTRIC RAILWAY SERVICE

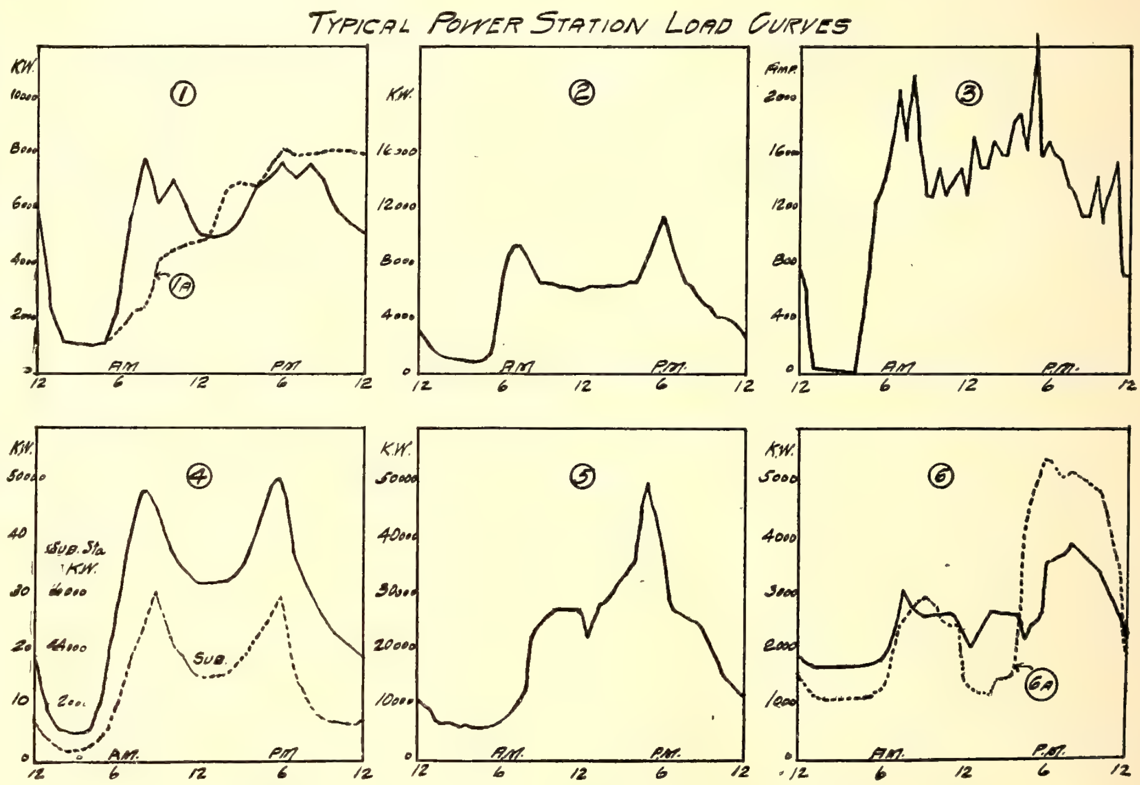
BY J. R. BIBBINS

In bringing this subject before you, we do so with the conviction that the problem of ultimate adoption of gas power is a present and serious one. You may not be in entire accord with our present optimism. In fact, on few subjects does engineering and commercial opinion exhibit greater conservatism (possibly due to lack of direct experience with gas power or to the influence of adverse reports from small and inadequately equipped plants). Yet, we feel that the practical difficulties incident to the development of such an important power system have not been so far overcome as to warrant the fullest optimism. We have but to look abroad for complete vindication.

Primarily, our objective is to place before you, as fully as possible, results that have already been attained, leaving to your own judgment the soundness of our opinions upon the topics discussed in this paper.

CHARACTERISTICS OF STREET RAILWAY SERVICE

In a paper read last year before your association we considered steam turbines, in their special application to railway work. Three important characteristics for a prime mover were mentioned, viz., close speed regulation, considerable overload capacity and high economy over normal ranges of load. Although these qualifications are, indeed, most desirable, entire success may only be attained through the harmonious working of the entire plant, whether steam or gas; in fact, in the case of the latter successful operation may be attributed in almost equal proportions to the gas and power generating sections of the plant. Unfortunately, it is true that the faults of the one may all too readily be charged to the other; yet a careful study of practical operation shows the futility of such distribution of responsibility.



FIGS. 1 TO 6.—TYPICAL POWER-STATION LOAD CURVES

A perspective view of railway service, as distinguished from electric lighting service, may be had by examining the daily load curves from typical power stations. See Figs. 1 to 7 and Table No. 1.

From the data presented it is obvious that, as a whole, a generating plant for railway service, especially for suburban and heavy duty work, must be unusually responsive to sudden power demands; to accomplish this the two sections of the plant must be peculiarly well fitted to operate together under normal load conditions. The plant should also be quick in starting, capable of standby for long periods without excessive loss of heat, and, above all, should show high all-day fuel economy. This is admittedly a formidable list of requirements; yet we may

TABLE No. 1.—LOAD CHARACTERISTICS.

Fig. No.	Character.	City.	Load Factor %*.	Ratio Loads. Max / Min.	Ratio Loads. Max. / Avg.	Approx. Fluctuation%.	Remarks.
1	Metropolitan.	Pittsburg..	68.	7.7	1.48	10–15	300–400 cars at rush hours, single and double truck part trailers Storage battery at sub-stations.
1a	Metropolitan. (Holiday)	Pittsburg..	60.	8.5	1.66	.....	Fourth of July.
2	Metropolitan.	Detroit....	55.8	10.9	1.79	15–25	Cars max. Single truck and high speed interurban. Battery at main and sub-stations.
3	Interurban...	Cleveland.	56.	100.†	1.78	36–60	Double truck. High speed. Cars. No battery.
4	Rapid Transit (Elevated)	New York	60.	9.7	1.67	40% at sub-stas.	Multiple unit trains. Six cars. Battery at sub-stations. 1,337 cars maximum.
5	Lighting.....	New York	47.	....	....	Steady..	Central and down-town district. Battery at sub-stations.
6	Lighting.....	Pittsburg..	65 8	2.26	1.52	Steady..	Central and down-town district. Avg. day cloudy. No battery.
6a	Lighting Max	Pittsburg..	46.7	4.85	2.14	Steady..	Christmas, 1904.
	Railways.....	Pittsburg..	66	7.44	1.52	Fluct...	Week ending July 1st, 1905.
	Lighting.....	Pittsburg..	71.2	2.11	1.4	Steady..	Week ending January 7th. 1905.

$$* \text{ Load Factor} = \frac{\text{Average Load.}}{\text{Steady Max.}}$$

not dodge the issue with gas power any more than with steam.

ADAPTABILITY OF GAS ENGINE AND PRODUCER PLANT

Does gas power fulfil in every respect the conditions imposed? As the old and much-abused saying goes, "The proof of the pudding lies in the eating thereof." This phase of the subject may best be approached through comparison, step by step, with steam power with which every one is familiar. This is done not for the purpose of discrediting the latter, but merely to obtain a clearer conception of the points involved.

THE GAS ENGINE

Primarily, the fitness of the gas engine for driving electrical machinery must be demonstrated beyond question. This has repeatedly occurred in practice, examples of which will be later cited. The paper by Mr. West has already treated important points in detail. He has observed that with certain cylinder arrangements, rotative speeds, uniformity of turning moment and speed regulation are as well suited to both d. c. and a. c. generator driving as the standard cross-compound steam engine; that the gas engine is as simple a machine to operate; that its efficiency as a mechanism is as high, and as a heat motor far higher; and that its overload capacity is largely dependent upon the dimensions of the customer's purse. Assuming, then, that the gas engine is already established in its position, we come to the gas generating plant, which, in many respects, is the crucial point of the system, except in special localities where natural gas is available at reasonable prices.

THE PRODUCER

We believe ourselves conservative in the statement that the future of the gas engine in its general application depends largely upon the development of a producer gas system especially suited to the use of low-grade bituminous coal. Anthracite producers have already reached a high state of perfection, are reasonable in price, simple to operate and are usually unencumbered with much auxiliary apparatus. They do not deteriorate rapidly, and generally show an efficiency considerably higher than the best steam boiler and furnace, viz., 75-80 per cent.

The ideal bituminous producer is yet to come, viz., one in which the volatiles are completely converted into fixed gases without serious loss and without complication of the operating system. There are a number of makes now on the market intended to be used with bituminous coal, but when the gas is to be used in engines they are attended with special, and often complex, cleaning apparatus for the removal of suspended impurities. The efficiency of bituminous systems is also generally lower than anthracite, not only owing to the fact that some of the valuable distillates are lost, but on account of the distillation of volatile matter requiring heat for its accomplishment. Present types, however, sometimes exceed 70 per cent efficiency, which rivals that of the best boiler plant.

FUEL ECONOMY

In actual running, fuel consumption, gas power presents its most striking advantage over steam. It is difficult to obtain

TABLE No. II.
SUMMARY OF RESULTS—PRODUCER GAS TESTS.
U. S. Government, St. Louis, 1904-1905.

175 kw.—235 H. P. Producer Gas Plant—Belted—Full Load.

Approximate Calorific Value Dry Fuel..................	14,000	13,000	12,000	11,000	10,000	Sum'ary
No. of Tests.	4	5	3	3	2	17
Average Length in Hours	17 1/2	32 3/4	22 1/3	23 3/4	23 3/4	25
FUEL						
Name	W. Va.	Ind., Ill., Ala., Ky., Ind. Ter.	Ind., Ill., Col.	Mont., N.D. Texas.	Wyo. and Texas.	U. S.
Character....................	Bit.R.M.	Bit.R.M.	Bit. & Black Lg.	Lignite.	Bit. and Lig.	Bit and Lig.
B. T. U. per lb. Dry...........	14,501	13,225	12,667	11,425	10,792	12,854
B. T. U. per lb. Actual.........	14,223	12,303	10,942	8,242	8,458	11,346
GAS						
Yield cu. ft. per lb. dry.........	66.4	51.06	50.5	31.9	32.7	49.0
B. T. U. per cu. ft.............	145.3	154.6	153.3	168.5	160.4	155.3
Prod. Effcy.—%.............	65.4	64.9	70.8	65.9	62.1	65 9
PLANT DUTY						
Lbs. per BHP Hour, Actual....	1.16	1.51	1.44	2.28	2.12	1.62
Lbs. per KWH, Actual.........	1.82	2.38	2.27	3.59	2.83	2.50
Lbs. per KWH, Dry...........	1 79	2.21	1.95	2.52	2.55	2.16
B. T. U. per BHP Hr., Actual .	16,498	18,580	15,755	18,780	17,920	18,375
B. T. U. per KWH, Actual.....	28,890	29,295	24,838	29,600	23,915	28,350
B. T. U. pei KWH, Dry.......	29,975	29,225	24,725	28,800	27,505	27,790

statistics truly comparative in every respect. Some data, trustworthy in the aggregate, are available from the tests conducted during the past year at St. Louis by the United States Govern-

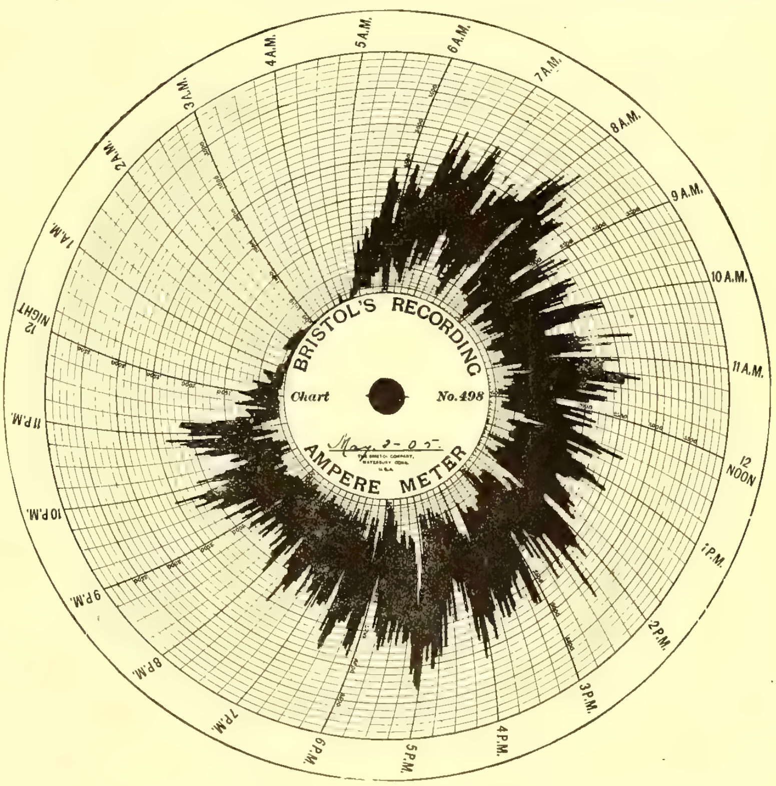


FIG. 7.—RECORDING METER CHART, SHOWING FLUCTUATIONS OF INTERURBAN LOAD

ment. Table 2 gives a resume of these tests, covering seventeen different grades of coal, all of bituminous character. The most remarkable result is that the poorest grade coals and even lignites are entirely suitable for producer work. Thus, Montana, North Dakota and Texas lignites, averaging only 8242 B. T. U. per pound (11,400 dry), yielded a gas of 169 B. T. U. per cubic foot, a gross producer efficiency of 66 per cent, and a duty of 2.5 lbs. per kw-hour dry, or 3.6 lbs. per kw-hour as fired. The best coals

(West Virginia) gave an actual duty of 1.57 lbs. per kw-hour, and the poorest 3¼ lbs. to 4½ lbs. as fired. The average of the seventeen tests showed a plant duty of 2.2 lbs. per kw-hour dry, or 2.5 lbs. as fired. Fig. 9 shows, in a general way, the rapid decrease in coal consumption with higher grade coals.

It is fortunate that the government extended these tests to embrace steam* as well as gas power. Fig. 10 shows the results of comparative economy tests with practically the same size plant under identical conditions and with identical coal. Taking a common heat value for average bituminous coal, 13,000 B. T. U. per pound, we observe that the plant duty is less than 2 lbs. per kw-hour with gas and 5½ lbs. with steam. Furthermore, the fuel consumption of the steam plant increases much more rapidly in the comparison with the poorer grades of coal. This is reasonable, owing to the greater difficulty in securing proper combustion. In this particular the producer has a decided and important advantage over the steam boiler.

Many more results might be cited which would strongly emphasize the high gross economy of the producer gas power plant; yet it is not the formal efficiency test at full load, but the long period test, which reveals to the operating man the fullest economy of gas working.

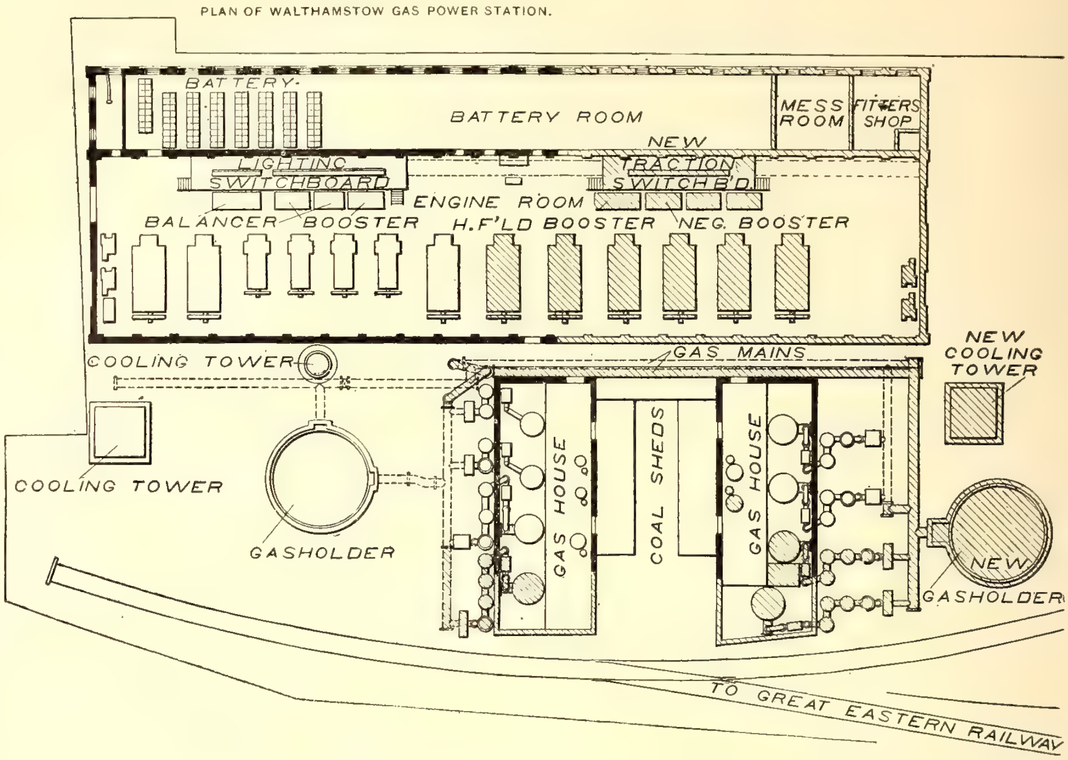


FIG. 8.—PLAN OF WALTHAMSTOW GAS POWER STATION

The following results may be of interest, as obtained from a large gas power railway and lighting plant at Walthamstow,† England, which will later be mentioned in further detail:

TABLE NO. 3.—RESULT OF TWELVE DAYS' OPERATION, WALTHAMSTOW, LONDON, JANUARY, 1902

Average output per day in kw-hours	1,525
Average load in kilowatts	64
Average load factor, per cent	35
Coal (anthracite) per kw-hour, in pounds, including fuel for boiler and banking	1.78

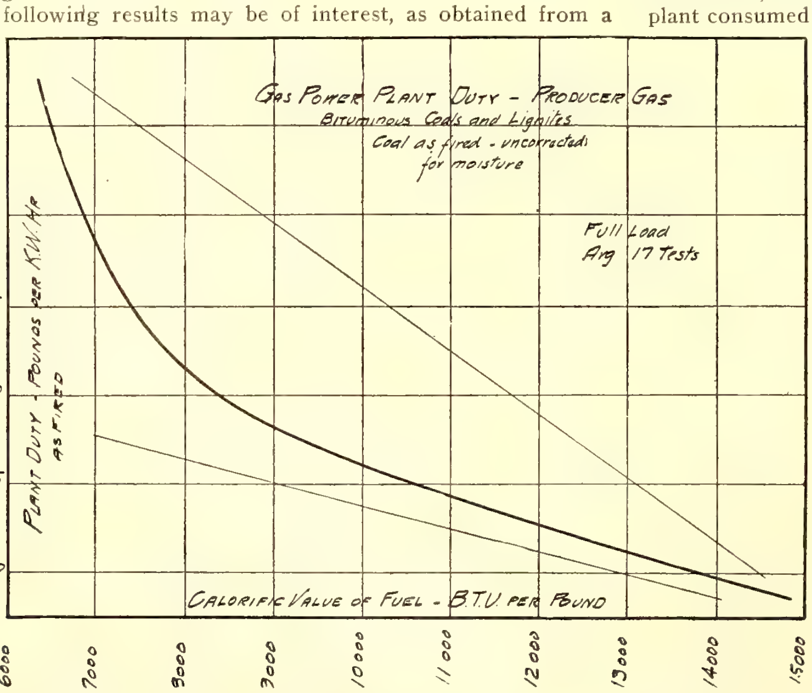


FIG. 9.—SHOWING THE RAPID DECREASE IN COAL CONSUMPTION WITH HIGHER-GRADE COALS

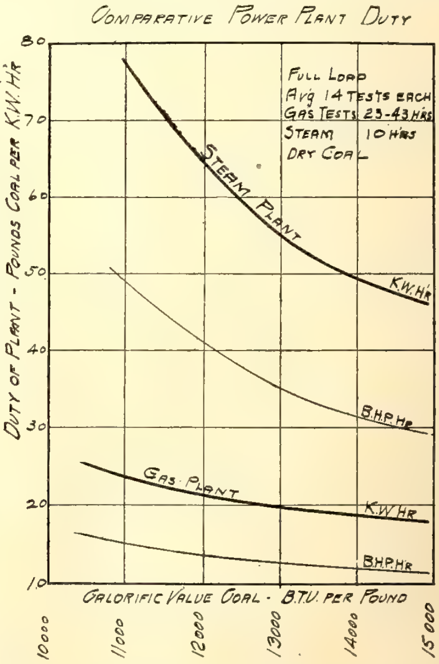


FIG. 10.—COMPARATIVE ECONOMY TESTS OF STEAM AND GAS PLANTS UNDER SIMILAR CONDITIONS WITH LIKE FUEL

A striking series of comparative observations‡ between a steam and gas station operated by the same company at Guernsey, England, is summarized in Fig. 11. With approximately the same load factor, which is high, owing to power supply, the gas power plant consumed about 2.25 lbs. per kw-hour, and the steam station 5.5 lbs., although a much larger station and equipped with triple-expansion high-speed engines.

RESPONSIVENESS

Passing to some of the practical points, a producer, if provided with an automatic blast control, may be made almost instantly responsive to variations in demand for gas. This is shown by the success which the suction producer has attained in small sizes; and in this respect the steam boiler is quite outclassed, owing to the

* Non-condensing.

† Walthamstow is one of the largest suburban districts of London, having a population of 116,000, and served by a gas-driven central station.

‡ Campbell, Mechanical Engineer, Dec. 3, 1904.

more direct effect of the blast in transferring the heat content of the coal to the working medium—gas. In one type of producer familiar to us as possessed of this automatic feature the steam blast, and consequently the gas generated, is controlled entirely by the pressure in the delivery gas main and in inverse proportion. It combines this feature with the conservation of the sensible heat of gases leaving the producer. By this means steam is generated at a rate proportional to the demand for gas without requiring extra boiler equipment or fuel. This largely increases the producer efficiency. In some types of producer we recall that the fuel for steam amounts to as much as 15 per cent to 20 per cent of the total coal gasified.

This producer is designed for use without a gas holder and has been successful in this particular. The especially severe conditions of heavy railway work, however, prescribes storage capacity at some part of the system. Owing to the limitations of gas-engine capacity, dealt with in the preceding paper, electric storage is evidently the most desirable, as it relieves the machinery of the wear and tear of fluctuating loads. There is ample precedent the world over for the use of a storage battery auxiliary in railway plants, and it should prove even more desirable in a gas power than in a steam power plant. In fact, gas storage is often to be desired in many plants where the gas demand varies greatly, simply as an insurance against poor gas, due to careless operation. This, however, simply relieves the gas generating equipment, while electric storage relieves the entire station.

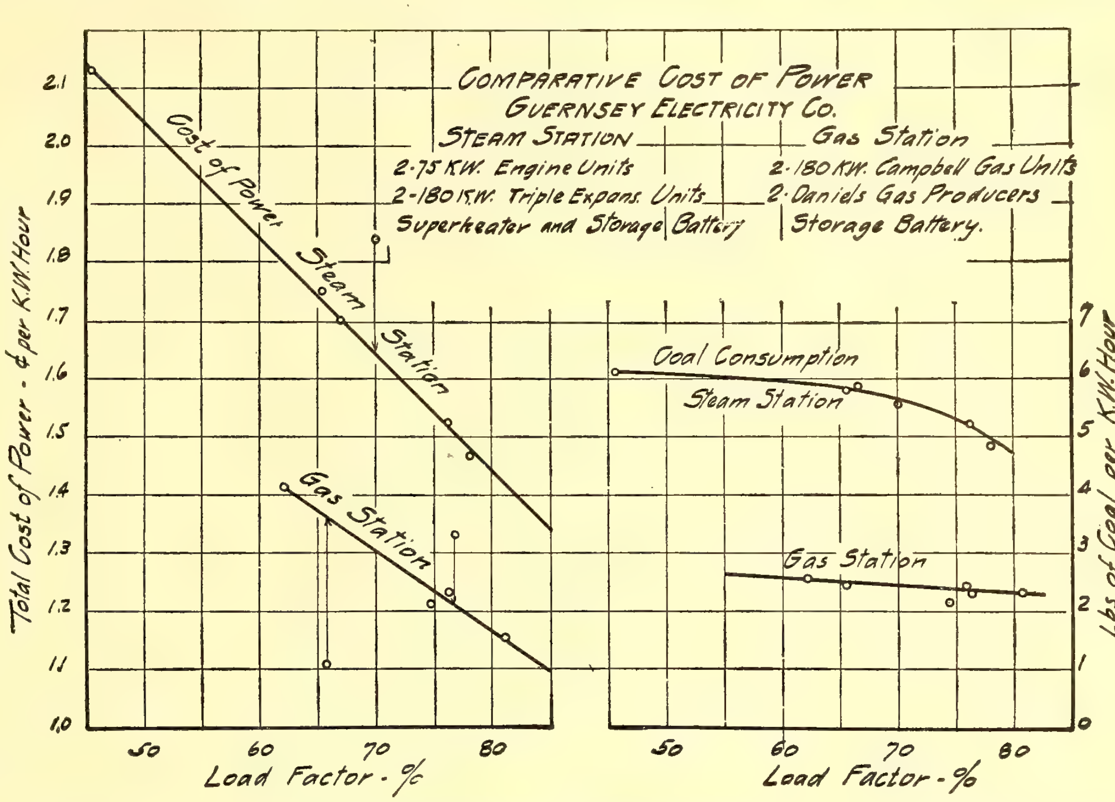


FIG. 11.—RECORD OF COMPARATIVE OBSERVATIONS BETWEEN STEAM AND GAS AT GUERNSEY, ENG.

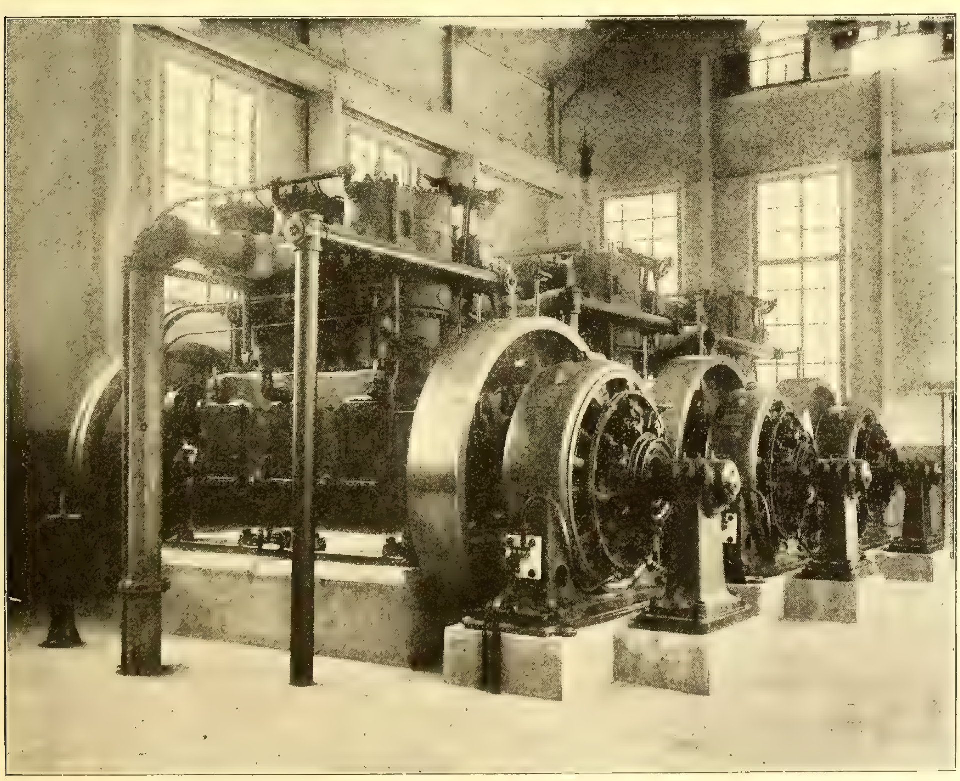


FIG. 12.—SECTION OF 1900-HP INDUSTRIAL GAS PLANT OF THE WINCHESTER REPEATING ARMS COMPANY, SHOWING SOLE-PLATE PIER CONSTRUCTION

LOSSES

Standby losses in a steam power plant are an important source of inefficiency and difficult to determine accurately. Mr. Dowson has made some comparative observations* with eight steam plants and several producer plants, averaging about 250-hp capacity. The actual standby fuel consumption of the boilers was 35-180 lbs. per hour, and of the producers 2-4 lbs. per hour. Whether the exact ratio holds for larger plants is immaterial. We do know that the producer losses are almost inconsiderable, which is reasonable, owing to the great heat content of the fuel bed and small opportunity for loss of heat by radiation when the producer is shut off from the atmosphere. Running losses are evidently also much less. We may pipe gas for great distances with small loss. Not so with highly superheated steam under high pressure. When a gas engine plant is shut down the losses practically cease; with steam, condensation is uninterrupted.

LABOR

The comparative cost of labor and supplies for gas and steam plants is difficult to state in definite terms. With the same character of labor there should be no appreciable difference between the two. We have compiled Table 4 (page 598) to show the operating costs of eleven London district stations, as compared with the gas plant at Walthamstow. These plants have been chosen, as they are located similarly in respect to accessibility of fuel. The table shows labor cost slightly in favor of steam, but it must be remembered that this is a comparison of one gas plant, having small units, against a number of larger steam plants, which might readily be more favorable in larger gas installations. With an up-to-date steam plant, using high-pressure steam, superheaters, economizers, high-grade condensing apparatus and the like, the labor item should, if anything, exceed that of a gas plant equipment of the same grade. At the two Guernsey

* Journal of Institution of Electrical Engineers, April, 1904.

stations referred to above the labor cost averaged very nearly the same for steam or gas.

It is true that a gas plant cannot be successfully operated by an ignoramus, any more than can a high-grade steam plant, which, however, if allowed, results sooner or later in a swelling of the repair account. A fair comparison will not admit of any but intelligent labor in either steam or gas plants, so there is no reason why steam engineers, after proper instruction, cannot take charge of a gas plant, as has been proven in practice.

A very important point, however, is the personal attitude which engineers take toward gas machinery. The best plant will quickly depreciate in the hands of operators who have taken a personal dislike to the innovation. The inevitable result of such attitude cannot be truthfully laid to the door of gas power. But it is almost always the case that personal prejudice may be overcome by systematic educational methods. In many of our plants the old steam engineers and oilers have been retained and placed in charge of gas equipment, after a thorough coaching by competent erecting engineers. After this is done properly the invariable result is highly successful operation.*

OIL

In well regulated plants, equipped with a continuous return system, the oil consumption should not much exceed, if any, that of a steam plant. Two 500-kw gas plants at Franklin and Bradford, Pa. (each consisting of five Westinghouse vertical enclosed type engine units), average through the year less than ½ gal. per unit day, at a total cost of under 7 cents (.0032 gal. per hp-day). At another station, near Warren, Pa., using three ver-

* As the chief engineer operating a plant in Northern Pennsylvania stated to the author recently, "I would rather throw up my job than go back to steam." He freely acknowledged his initial prejudice, which disappeared as he became acquainted with the gas engines.

TABLE IV.—OPERATING COSTS*

London Metropolitan Boroughs.—Year Ending March 31, 1904.

	Plant Capacity, kw.	Output Sold.	Ratio Sold Generated %	Load Factor %	Operating Cost—d per K. W. H. sold. Fuel.	Supplies**	Labor.	***Repairs	Works.	Total.
Average of 11 Steam Plants †.	2,799	2,997,500	83.9	17.25	597	.059	.214	.218	1 09	1.41
Walthamstow....	810	1,019,326	80.0	15.45	.368	.152	.288	.048	0.856	1.05
Savings % (favor gas)........					+38.4	††	-13.5	+78	+21.5	+25.4
Operating Expense Items—% Works Cost (Steam)..					55	5.4	19.6	20	100	129
Operating Expense Items—% Works Cost (Gas)....					43	17.8	33.6	5.6	100	123

*Data from "Electrical Times." Financial Reports.
**Oil, waste, water and miscellaneous supplies.
***Includes repairs to buildings, electrical equipment and distribution system.
†Steam Plants—Hackney, Stepney, Poplar, Battersea, Hammersmith, St. Pancras, Fulham, Shoreditch, Southwark, Hampstead Islington.
††Artesian well not in service. Water paid for

TABLE No. V.—OPERATING COSTS—800 HP. GAS POWER STATION. BRADFORD, PA.

	1904.	1903.
Annual output, K. W. H..........	804,032	780,300*
Station load factor, per cent..........	19.54	.....
Gas consumption, cubic feet..........	20,056,000	18,162,000
Plant duty (including heating), cubic feet per K. W. H.....	24.9	22.4
Average price of gas, cents per M cubic feet	12.32	16.5
OPERATING COSTS—CENTS PER K. W. H. GENERATED.		
Fuel (including heating)..........	0.307	0.384
Labor, power station only..........	0.380	0.392
Supplies..........	0.059	0.072
Repairs, engine and electrical equipment..........	0.079	0.050
Repairs, gas engines only..........	0.010	0.013
Total works..........	0.825	0.898

* Estimated from nine months metered output.

TABLE No. VI.—WORKING COSTS—GAS POWER STATION, WALTHAMSTOW DISTRICT COUNCIL, "GARCKE'S MANUAL."

Population—110,000. Supply commenced September 20th, 1901.
System—Three wire, D.C., 230–460 volts.
Capacity Station—2,890 B. H. P.—2,000 kw.
Equipment:—
Gas Generators—8-Dowson-Anthracite.
Engines—4-115 B. H. P. Westinghouse 3 cylinder vertical engine type.
3-250 B. H. P. Westinghouse 3 cylinder vertical engine type.
6-280 B. H. P. Westinghouse 3 cylinder vertical engine type.
Generators—Helios-Engine type.
Batteries—Tudor-2x254 cells 1,000 amp. hr. capacity.

SUPPLY RECORD (Year ending March 31........	1904.	1903.
Number of lamps connected (16 c.p. equivalent)........	21,000	16,070
K. W. Hrs. generated..........	1,019,326	659,796
K. W. Hrs. sold..........	814,187	542,423
Gross efficiency system—per cent..........	80.	82.25
Maximum load on feeders—kw..........	600	406
Average load on plant—kw..........	116.4	75.5
Load factor..........	15.45	15.25
Prices charged, lighting—cts. per K. W. H..........	8	8
Discount, power—cts. per K. W. H..........	5–3	5–3
FINANCIAL RESULT.		
Capital expenditure to date:		
Land and buildings..........	81,050	75,650
Plant, engines, machinery..........	198,000	179,600
Total expenditure..........	546,100	367,000
Revenue, total..........	63,000	48,380
Costs, total..........	21,640	16,910
Profit, total..........	41,360	31,470
Profit—per cent to average capital..........	9.05	10.87
Sinking Fund—per cent to average capital..........	2 66	3.20
Average price obtained—cts. per K. W. H..........	7.14	8.40
Per cent working costs to revenue from current..........	38.46	40.9

OPERATING COSTS..........	Cts. per Kw-h. Sold.	Gen.	Cts. per Kw-h. Sold.	Gen
Coal* and other fuel, delivered..........	0.932	0.745	0.84	0.69
Oil, waste, water** and general supplies..........	0.383	0.306	0.46	0.37
Wages of workmen..........	0.738	0.590	0.82	0.67
Repairs and maintenance†, total..........	0.081	0.065	0.24	0.19
Total works cost..........	2.134	1.706	2.36	1.925
Distribution, public lamps, rent, management, taxes, insurance, etc..........	0.649	0.519	1.11	0.929
Total general costs..........	0.649	0.519	1.11	0.929
Total costs..........	2.783	2.225	3.47	2.854

* Cost of coal averaged $6.50 per ton in 1902-3; $6.75 in 1903-4 ** Artesian well not yet in service; water purchased. † Including buildings, mechanical and electrical equipments, storage batteries and distribution system.

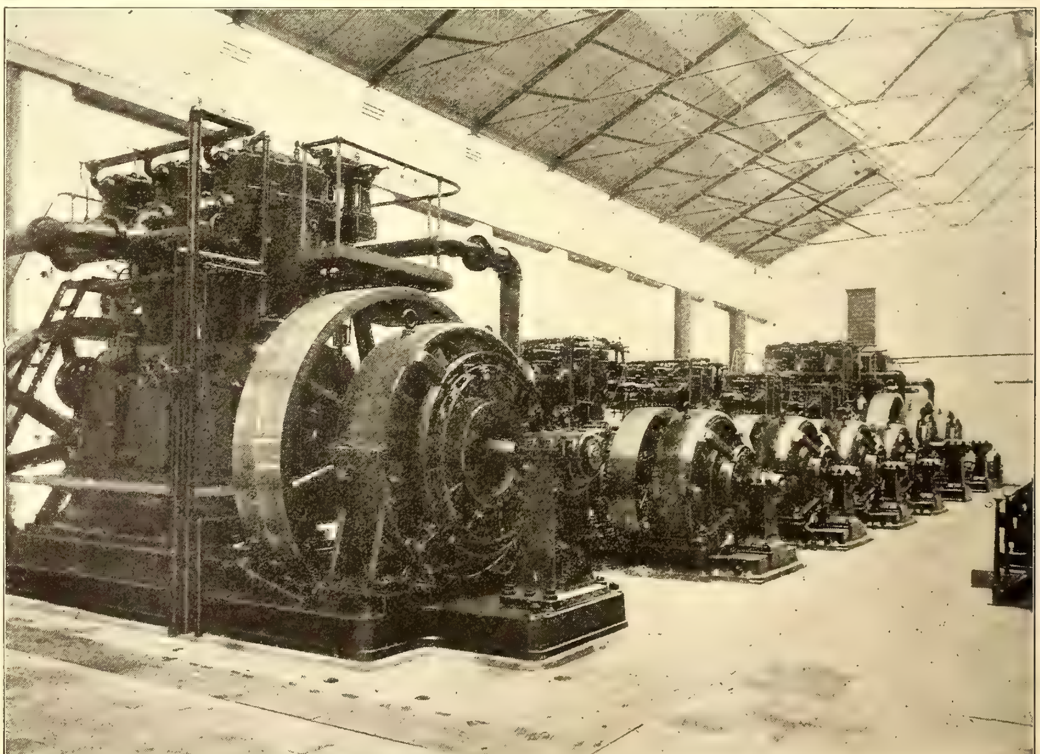


FIG. 13.—800-HP GAS POWER RAILWAY AND LIGHTING STATION, BOROUGH OF WALTHAMSTOW, LONDON

tical open type engines of 275-hp capacity each, the oil consumption averages under .9 gal. per unit day. This is certainly not excessive; in fact, we know of a large steam station in the Pittsburg district, equipped with several 1600-hp cross-compound engines, in which the oil consumption averages .0025 gal. per engine hp-day, and has reached double this amount for weeks at a time. This plant has a return oiling system; the others have not.

MAINTENANCE

Maintenance expense is frequently thought to be excessive in a gas station. When this is so we may look for faulty operation or design of the plant. Recent data from the station at Bradford, Pa., show what may be accomplished when the equipment is properly operated. The plant is in its seventh year of service; yet the average cost of repairs on the engines for the past two years was $92.70 per year, 11.6 cents per horsepower-year, or .0125 cents per kilowatt-hour generated. Returns for the past two years are shown in Table 5 (page 598). As an example of the results secured, we may mention the following: After six years' service, averaging 18 hours per day, it is found necessary to inspect the engines only once in twelve months. This was formerly done in three months and later in six months. At each inspection a set of piston rings is replaced by new ones, whether worn out or not. Up to the present time no extensive repairs have been made on any of the engines, except a voluntary change, on the builders' part, from dry to water cooled exhaust valves. The present exhaust valves average one year's working without regrinding, and even then are not in bad condition. Some valves have run fifteen months. Admission valves require no attention. Igniters average about nine months without repointing. By reversing the current each day electro deposition is entirely avoided, so that the points wear evenly.

In Table 4 the repair costs at Walthamstow are much lower than the steam plants cited. In a 300-kw manufacturing plant at Birmingham, using Westinghouse vertical engines and Mond gas, the typical year's expense for repairs and renewals was but 0.174 cent per kilowatt-hour generated, incurred in the proportion of 65 per cent to the gas and 35 per cent to the engine plant.

A notable run was recently reported by the superintendent of a gas compressing station in central Ohio, where a 650-hp Westinghouse vertical engine is at work.* This engine was under maximum gas load continuously night and day for forty days, without a misfire or mishap of any kind, and without incurring extra expense for repairs.

* After running practically day and night for nearly three and a half years, the total repairs on the plant have been:
One set of igniters.
Two sets of exhaust valves (one spare).
One admission valve (jammed accidentally).
One cylinder head (cracked from mud deposits).
One intermediate gear.

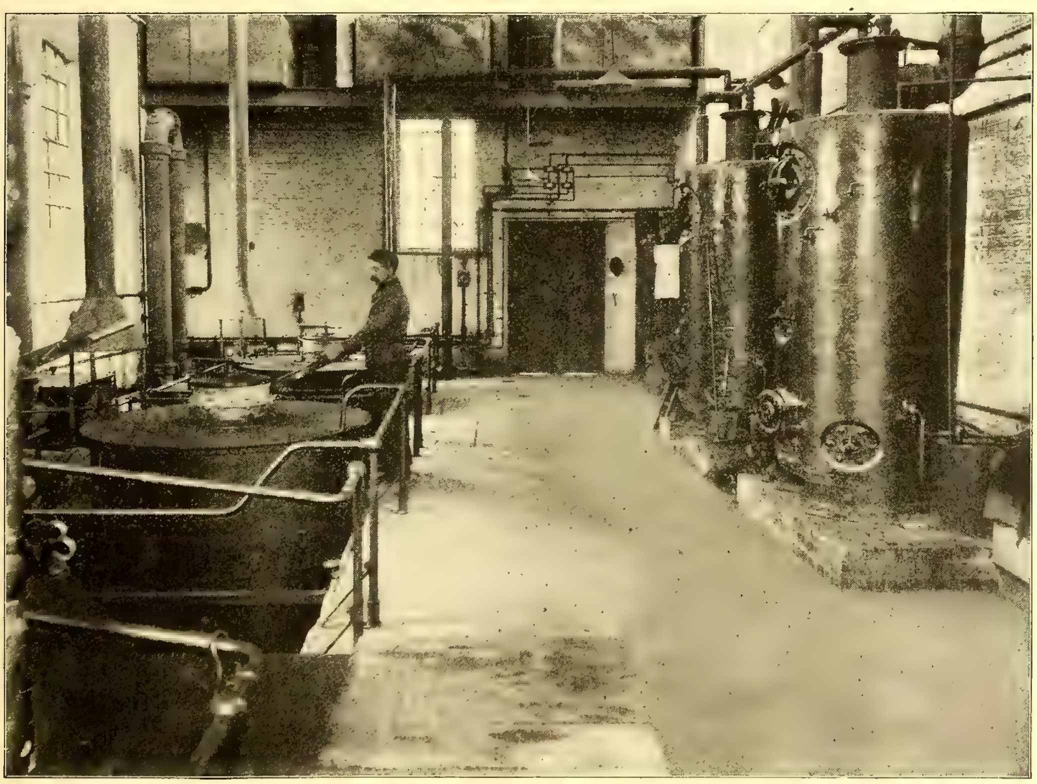


FIG. 14.—WALTHAMSTOW STATION PRODUCER HOUSE, CHARGING FLOOR

COST OF POWER

Comparative plant economy is best brought out in figures expressing the total operating cost of power. The complete returns from Walthamstow are shown in Table 6 (page 598). With a load factor of only 15½ per cent and coal at $6.75 per ton, delivered, the total cost of generating current was 1.7 cents per kw-hour; or, based upon current delivered to consumer, 2.13 cents per kw-hour, the average price obtained being 7.14 cents, and the net profit 9 per cent. Referring again to Table 4, the summary shows that in the average borough steam plant of over three times the capacity and of higher load factor, the generation cost is 2.2 cents. It is presumable that the steam plants used cheaper coal; yet with gas coal at $6.75 a ton, the saving of coal alone was over 38 per cent in favor of the gas station. At this price the Walthamstow plant required throughout the year's run but slightly over 2 lbs. of coal per kw-hour generated. Of the total operating cost, fuel represented 43 per cent; in the steam plant, 55 per cent; repairs, 5 per cent for gas, and 20 per cent for steam. At the Birmingham plant, mentioned above, the total operating cost was 1¼ cents per kw-hour, of which fuel represented 26½ per cent, and repairs 14 per cent; this on a load factor of 43 per cent average, and bituminous coal having 31 per cent volatile. The total coal consumption averaged 2.9 lbs. per kw-hour through the year.

TABLE No. VII.—CAPITAL COST GAS AND STEAM PLANT PER KW. CAPACITY.

	Gas Plant.		Generating Plant.		Total.
	$	%	$	%	$
Average tender	35 00	31.2	77.00	68.8	112.00
Accepted tenders	24.00	24.5	74.00	75.5	98 00
Steam Plant.					
Lowest tender					75.00
Highest tender					106.00
Mean tender					90.00
Recommended					92.00

TABLE No. VIII.—SUMMARY OF GUARANTEES.

GUARANTEE.	Producer Plant.		Generating Plant. ⅔ Rated Load.			Power Station.	
	B. T. U. in Gas Per Lb. Coal.	Efficiency with 12,000 B. T. U. Coal.	B. T. U. per Kw-hr.	B. T. U. per B. H. P. Hour.	Kinetic Efficiency, Per Cent.	Kinetic Efficiency 12,000 B. T. U. Coal.	*Duty Lb. Coal per Kw-hr.
Highest	9,500	79.2	12,300	10,440	27.7	21.9	1.29
Lowest	7,000	58.3	18,000	15,290	19.0	11.1	2.57
Average	8,729	72.7	13 876	11,775	24.6	17.85	1.59
Accepted	8,500	71.0	13,700	11,630	24.9	18.1	1.61

* Estimated.

At the Bradford, Pa., station (see Table 5, page 598), although handicapped with old type belted machinery, the average yearly gas consumption is less than 25 cu. ft. of gas per kw-hour on a 19½ per cent load factor, and a total operating cost of power of about 0.8 cent per kw-hour.

The station at Franklin, Pa., operating on natural gas of exceptionally high calorific value, gives experience of similar character. The engines regularly operate 30 hours to a run. With a

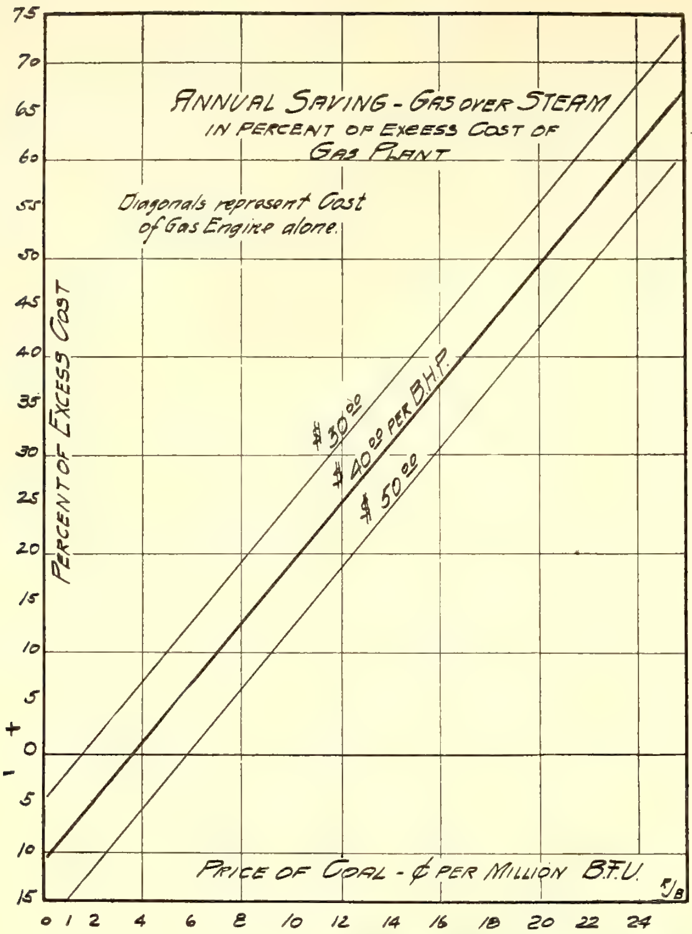


FIG. 18.—SHOWING ANNUAL SAVING OF GAS OVER STEAM

load factor of 15 per cent to 20 per cent, as low as 17 cu. ft. of gas per kw-hour was recorded for the year 1904, at a total operating cost of under 1 cent per kw-hour. In the cases of both the Bradford and Franklin plants building heating by natural gas is included in the gas charge for the engines.

CAPITAL COST

Much of the prejudice against gas power is due to exaggerated statements regarding the comparative capital cost of steam and gas equipments. In some instances it has been stated that for the same character of equipment the gas plant costs double. This is not the case; in fact, in larger plants the two may be brought nearly to a parity, and the higher economy of the former will soon wipe out the difference in actual cost.

We cannot do better than cite the returns* of tenders for one of the largest gas power stations in Europe, over 8000-kw in capacity and designed for both railway and lighting service. Tenders were invited for both steam and gas equipment complete, in every respect the best obtainable and with considerable spare plant. An approximate summary of the tenders received from over thirty of the most prominent European manufacturers is as follows, including erection, but not including transportation charges. (See Table 7.)

The engineer's report on the accepted tenders shows a total excess cost of gas plant of 7.4 per cent actual, or 14 per cent with certain extras charged to the gas plant for additional ground and building requirements; yet the annual saving in operation is estimated sufficient to annul the excess cost of gas plant in less than two years. Capitalized at 5 per cent interest, this annual saving represents a capital of $1,485,000, or considerably more than the original cost of the entire gas power station. In other words, the gas plant might have cost twice the actual amount and still realize a definite annual saving over steam power. Incidentally, the efficiency guarantees are of interest. These are shown in Table 8. The heat conversion efficiency of the generating equipment at two-thirds load is as high as 25 per cent, giving an over-all plant efficiency of

COMPARATIVE ESTIMATES—GAS vs. STEAM PLANT.

Assumption for Diagrams, Figs. 15 and 18.

GENERAL.	GAS PLANT.	STEAM PLANT
Rated capacity	5,000 kw.	
Character of load	Street Railway	
Load curve	Figure 1-B.	
Load factor, average	66%.	
Maximum mean load	3,750 kw.	
Load fluctuation	10%—normal, 15%—light loads.	
Number of units (one spare)	Five 1,000 kw.	
Type	Horiz. tandem double acting, heavy duty.	Horiz. compound, Corliss, condensing.
Overload capacity	10%	
Average load	2,611 kw.	
Daily output	62,688 K.W.H.	
Daily engine hours	75¼.	
Average load on units	83% rating.	
HEAT CONSUMPTION.	10,000 B. T. U. per B. H. P. Hr.	14 lbs. steam per I. H. P. Hr.
Overall efficiency unit	80.9%.	83.7%
Auxiliaries	5%.	10%.
Producer—efficiency	75%.	
Boiler—efficiency (13,000 B. T. U. coal)		60%.
Plant duty, B. T. U	23,275 per K. W. H.	42,900 per K. W. H.
Coal consumption	1.8 lbs. per K. W. H.	3.3 lbs. per K. W. H.
CAPITAL COST		
Generating plant	$77.20 per kw.	$43.60 per kw.
Boiler—producer plant	25.06	27.50
Buildings, coal storage and switchboards	16.50	18.00
Total	$118.76	$89.10
Excess cost of gas plant	$29.66—30%.	

WORKS OR OPERATING COST OF POWER.	CHARGED.
Fuel for all purposes	Pro rata
Labor	Equal for gas or steam.
Supplies, including oil, waste, water, etc.	Equal for gas or steam.
Repairs (working repairs only, not betterments)	0.5 cts. per K. W. H.

FIXED OR CAPITAL COSTS
Interest (6%).
Insurance and taxes (2%).
Depreciation (physical depreciation only).
Engine plant 6⅔%, boiler plant 7½%, producer plant 5%, buildings and switchboard 3%
Average for complete plants—gas 5.8%—steam 6.2%.
Total cost of power comprises works and fixed costs.

*Steam pressure 125 pounds, feed temperature 180° F., evaporation 8.1 pounds from and at 212°—7.5 pounds actual.

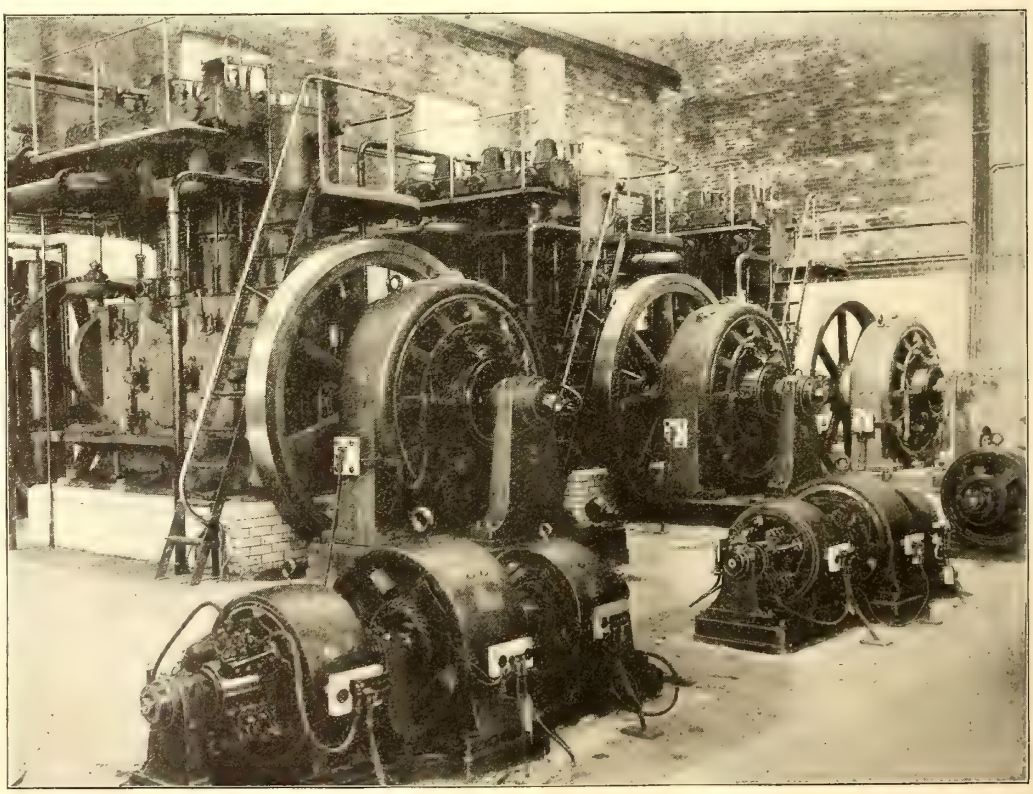


FIG. 16.—GENERAL VIEW OF ENGINE ROOM, MIDLAND RAILWAYS, DOCK TERMINAL POWER PLANT, HEYSHAM HARBOR, ENGLAND

* For obvious reasons, the names of the customer and manufacturers are withheld.

about 18 per cent. The average well-equipped steam plant rarely exceeds 10 per cent.

The problem of gas vs. steam power thus partakes of the nature of economies, rather than mechanics. In order to demonstrate more clearly, the diagram, Fig. 15, was prepared, which shows the relative cost of steam and gas power for different grades of coal. By expressing the cost* of the latter in terms of million thermal units, the differentials in transportation are avoided. This diagram is based upon an actual load curve, Fig. 17, and the present approximate cost of power plant equipment, f. o. b. factory, but including erection. From the assumptions (page 600), you will observe that if we have erred it is upon the conservative side, favoring, if anything, the steam plant, especially in the matter of cost.

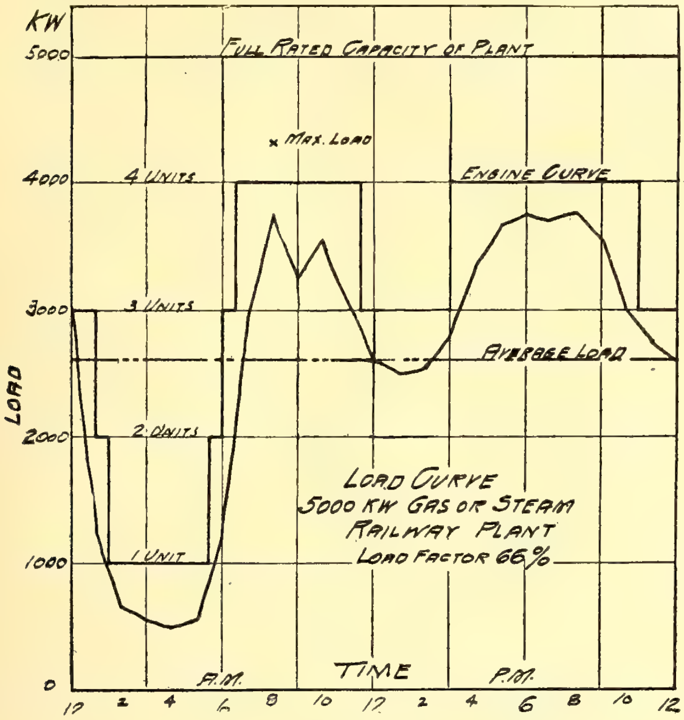


FIG. 17.—LOAD CURVE OF 5000-KW GAS OR STEAM RAILWAY PLANT

In Fig. 15 the shaded area represents reasonable range for capital cost of gas engine. You will observe that the diagonals for steam and gas intersect at the left of the diagram. The interpretation of this is that at this point, with coal costing 3.5 cents per million B. T. U., or about 90 cents per ton, both plants can deliver power at the same cost, or, in other words, we cannot afford to use gas plant with cheaper coal. Fig. 18 expresses this saving in per cent of excess capital cost of gas over steam plant. Thus, with coal at $3.50, the annual saving is 30 per cent of the original excess.

Upon the assumption of equal labor, supplies and repair costs, it is quite evident that any excess fixed charges on the gas plant will fix a definite economic limit of saving over steam, and it thus occurs that gas will be more effective where fuel is not dirt cheap. If, however, a gas plant can effect a saving in the cost of labor, supplies and repairs, as is the case at Walthamstow, then it may be operated to advantage on still lower grades of coal.

FIELD PRACTICE

This subject may be well concluded by a brief perspective, as it were, of the work that has already been accomplished in the American gas power field. To be sure, the application to railway service has in this country been limited; yet we find abroad many evidences of successful working. A prominent European engineer reported in 1903: "Nineteen stations on tramway work, totaling 6000-hp capacity. These include Barcelona, Tunis, Lausanne, St. Gallen, Poictiers, Orleans and Zurich, from 400 to 600 hp, each working on either producer or town gas." As a result of the excellent experience with Walthamstow electricity station, 650 hp has been added to the plant for operating the new tramway system* recently constructed. At Buenos-Aires, South America, two plants, aggregating 2240 hp, are at work for the Buenos-Aires Great Western and Great Southern Railways. Both used Mond gas.

But eclipsing in interest probably all former gas power railway undertakings is that of the Warren & Jamestown Railway system† now under construction. As the details may not be entirely familiar to you, a brief review is given on page 604. This plant will practically inaugurate the use of the heavy-duty type engine, in connection with single phase railway systems in America.

The new engine equipment, now nearing completion, consists of two 500-hp Westinghouse double-acting engines of the horizontal tandem type,§ each direct connected to a 260-kw a. c. engine type generator. These engines are both of the single crank type, but

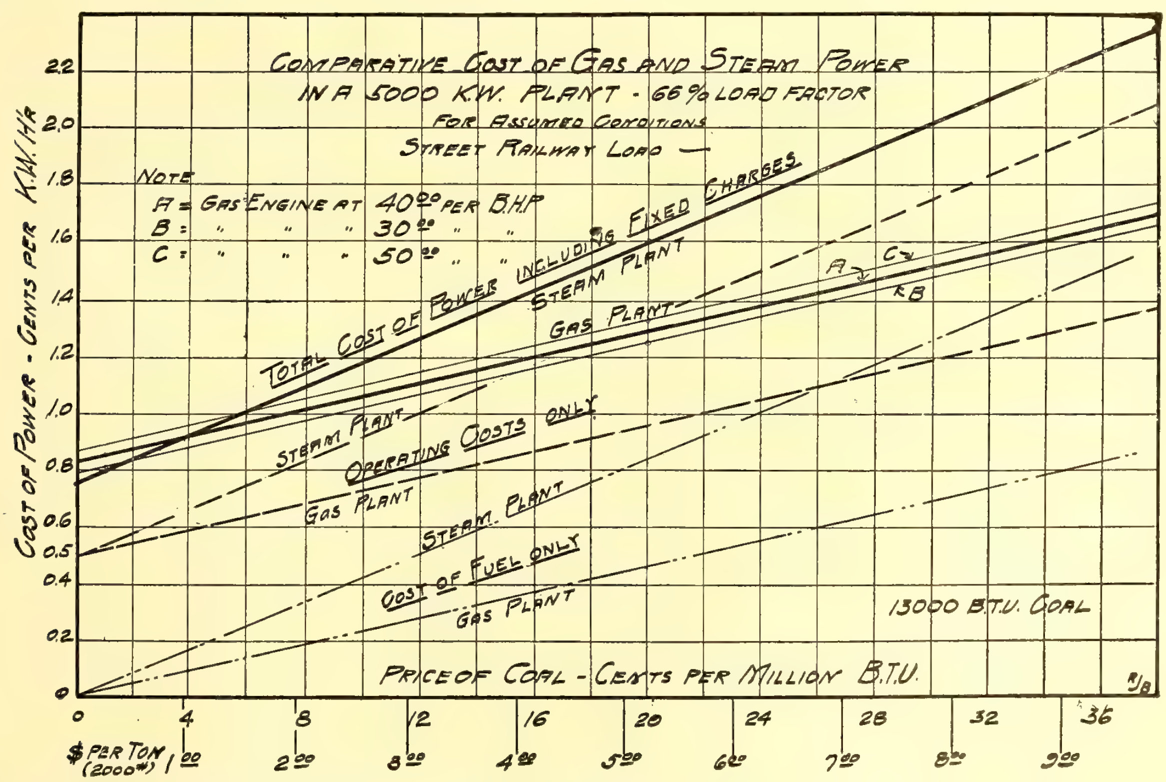


FIG. 15.—SHOWING RELATIVE COST OF STEAM AND GAS POWER FOR DIFFERENT GRADES OF COAL

* In estimating the cost of labor, supplies and repairs, these three items are assumed to be the same for either steam or gas plants, as it is reasonable assumption that any possible excess cost of upkeep on the gas engine equipment would be balanced by the smaller expense of maintaining the producer equipment.

* Length of line 9½ miles, 100-lb. girder rails, thirty-two double-deck single-truck cars, double trolley.

† Following the precedent established by the Warren plant, the Union Traction Company, of Independence, Kan., has adopted double-acting engines of the same size, type and design for railway service, using Kansas natural gas as fuel. The initial equipment will comprise single-crank and double-crank units of 500 hp and 1000 hp each (sea level rating).

§ Dimensions of engines: Cylinder diameter, 21 ins.; stroke, 30 ins.; speed, 150 r. p. m.

with the tandem arrangement, a power stroke is developed at each half revolution, as in the double-acting steam engine. The gas units will operate in parallel on the electrical end, without the necessity of synchronizing the cranks.† Owing to the absence of a battery and the small number of cars, the plant will be subjected to the most severe test possible. It is estimated that one generating unit will take care of the present maximum demand with two cars starting and two running.

FIG. 20.—PRODUCER PLANT AT HEYSHAM HARBOR, SHOWING COAL-HANDLING APPARATUS

Natural gas fuel is entirely used in this territory, and at the present price and heat value will correspond with producer gas delivered at a cost of about 2 cents per thousand cubic feet. The economy in operating with natural gas is striking. In the old gas plant it is estimated that the cost of power averages 75 cents per kw-hour, including all items chargeable to operation, except repairs on buildings and battery; the corresponding gas consumption being 20 cu. ft. per kw-hour.

Among gas power stations in American and British territory we find a large number up to 2600-hp capacity operating on producer, natural and oil gas, and many with the a. c. system with generators running in electrical parallel. In fact, parallel operation by gas engines on a large scale was first accomplished in this country at East Pittsburg, with three cylinder engines of the vertical single-acting type. In view of the success with this type of engine, it is evident that the tandem and twin-tandem double-acting type should be even more suitable. In Great Britain twenty central stations, from 40 kw to 2000 kw in capacity, are in operation, mostly with producer gas.

In the field of electric lighting much has been accomplished. Outside of the Walthamstow station, already mentioned, an interesting plant is the 1150-hp station of the Rockland Electric Company, at Hillburn, N. Y., equipped with Westinghouse horizontal double-acting engines, operating on Loomis-Pettibone producer gas. As in several other industrial plants using this type of producer, most of the water gas generated is used for furnace heating, while the "air" or "blow" gas, too lean for other purposes, is used entirely in the engine plant. In many respects this system is unique, in that it makes possible the commercial use of otherwise expensive water gas, while the cheap "air" gas is rendered useful for generating power.

The utilization of waste products of manufacture has within recent years made great progress. Gaseous by-products have already been put to use on a large scale, but the near future may readily witness the use of the producer in its present or in modified form for utilizing all combustible wastes recoverable in manufacturing processes. Blast furnace gas applications are now more or less familiar; coke oven gas from by-product coke ovens has many notable applications in Europe (a small plant is in use at Camden, N. J.); and oil gas (obtained by fractional distillation of petroleum—a by-product in the refining process) has lately been successfully applied in America.

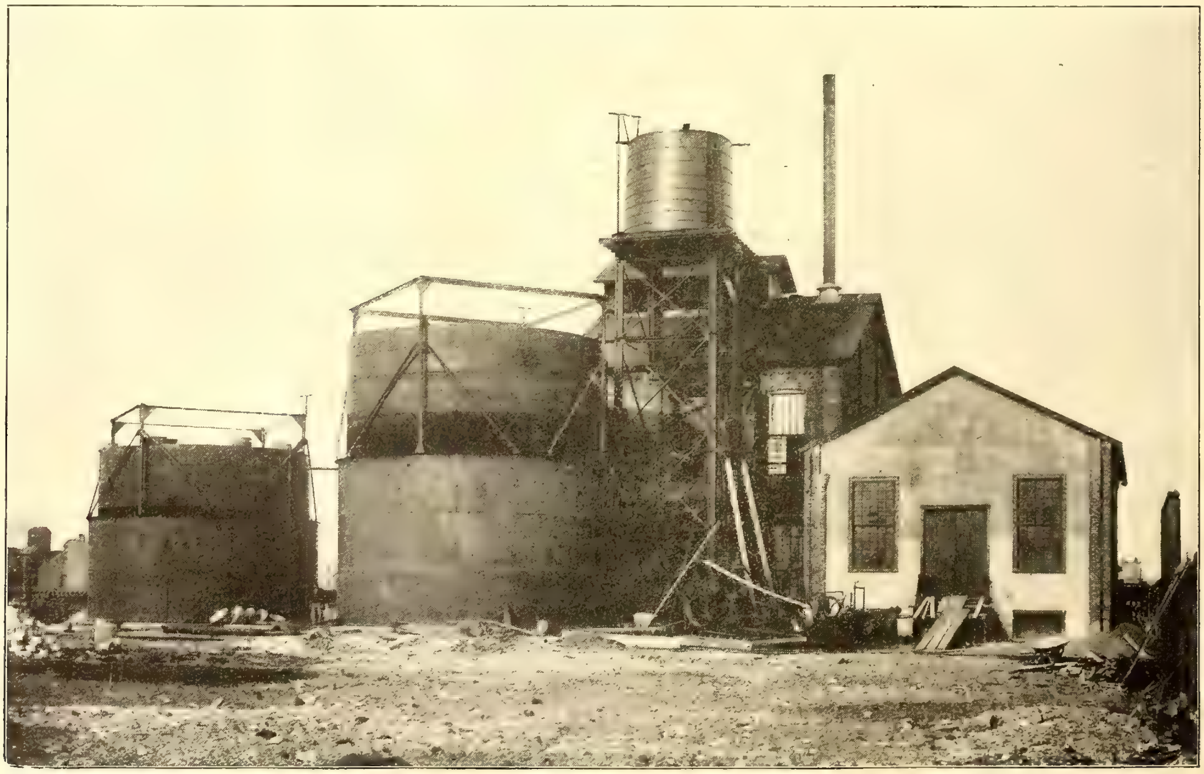


FIG. 19.—TYPICAL GAS POWER PLANT FOR COMBINED POWER AND METALLURGICAL SERVICE, ATLAS TOOL COMPANY, NEWARK, N. J.

SUMMARY

The large number of small plants that has come within our range of experience has not prevented us from obtaining similar ex-

† The cylindrical speed variation and the governor regulation is sufficient to meet present a. c. generator specifications.

perience from larger ones. The operation of close to 100 plants, from 200 to 2600-hp capacity, would seem to indicate that some measure of success has been attained. That one-half of the aggregate capacity operates on natural gas and but one-third on producer gas, simply emphasizes the value of this country's natural resources, rather than reflects upon the producer gas system, especially when one considers the comparatively short time that producer gas has been seriously taken up. About 10 per cent of the larger plants (above 200 hp) operate city and suburban railway systems. The remainder are devoted to many classes of service, such as light and power for city and suburban territory, power for the electrical driving of industrial works; power for operating railroad terminals, gas compressing stations, water pumping plants and high-service fire systems. A notable example of the latter is the 2200-hp station in Race Street, Philadelphia. Most of the prominent types of producers are represented, including the Mond, Loomis - Pettibone, Dowson, Taylor and the more recent Westinghouse system. A few small plants are working on suction gas. This indicates that successful operation is not confined to any particular type of producer.

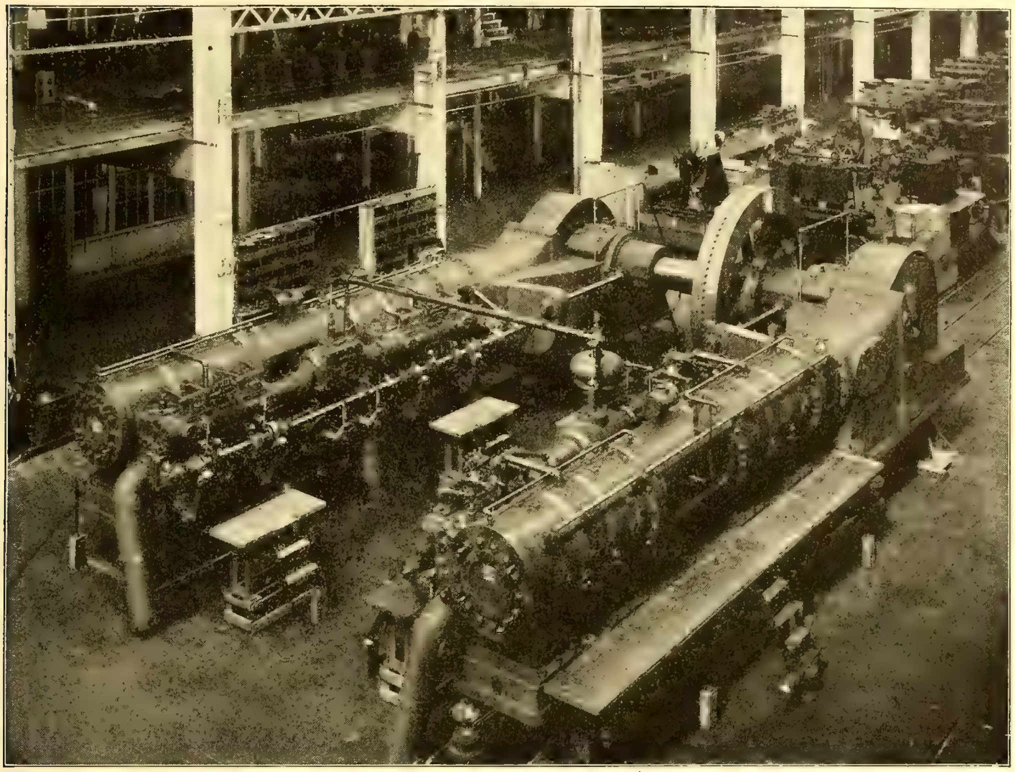


FIG. 21.—1000-HP WESTINGHOUSE DOUBLE-ACTING GAS ENGINE FOR INDUSTRIAL WORKS SERVICE AT WINCHESTER REPEATING ARMS COMPANY, NEW HAVEN, CONN.

In conclusion we can but reiterate our premises:

1. That the gas engine has been brought to a state of development where it is capable of doing the same work as the steam engine, with far greater efficiency, and usually at reduced cost.

2. That the producer has been so far perfected as to be a reliable and more efficient generator than the steam boiler.

3. That the gas power plant "in toto" is entirely suitable for even the severe service incident to electric railway operation.

4. That its component parts, engine and producer, are possessed of characteristics leading to harmonious co-operation.

5. That practical difficulties incident to gas power working have been so far overcome as to warrant commercial confidence.

6. That experience with gas power in almost every known line of modern industry has proven its general sufficiency for any power service.

Such data as has been obtainable is presented in the light of a record of past performance rather than in the nature of prophecies regarding the future. The future is believed to be already assured.

CHARACTERISTICS OF RAILWAY LOADS

The various systems may be classified as follows:

Metropolitan.—Light cars, many in number, small headway (1 to 5 minutes), small load fluctuation—yielding a station load that may be readily predicted and closely followed up by the requisite engine capacity.

Urban.—Light cars, few in number, medium headway (10 to 15 minutes), station load fluctuating considerably.

Interurban.—Heavy cars, few in number, large headway (30 to 60 minutes), high speed, moderate acceleration, heavy grades, load violently fluctuating, cannot be closely predicted.

Rapid Transit.—Heavy cars, multiple-unit trains, small headway at rush hours, rapid acceleration, load fluctuating at sub-stations.

Specific examples may be found in the curves, Figs. 1 to 6, which are explained in Table No. 1. In all the city systems the morning and evening peaks are strongly accentuated and the daily average is high. Owing to the superposition of loads from various distribution centers or sub-stations, the fluctuations at power stations are not necessarily severe. With heavy service, however, sub-stations are subjected to severe fluctuations; *e. g.,* Manhattan

FIG. 22.—2200-HP HIGH-PRESSURE FIRE PUMPING STATION, CITY OF PHILADELPHIA

sub-station No. 2, shown in Fig. 4, where the fluctuation is 40 per cent above and below the average load.

The interurban load presents less distinct peaks, but, although the average is high, the station is subjected to violent fluctuations. This may be appreciated from the recording meter chart, Fig. 7, corresponding to the load curve shown. Although the inertia of the instrument pointer has probably exaggerated the indications, it is safe to say that fluctuations of 30 per cent from the mean load are ordinarily encountered, and with a reduced number of cars as high as 60 per cent.

The characteristics of electric lighting service, on the other hand, are quite different. Except in the case of occasional storms, the load may be closely predicted and followed up with necessary generating capacity, and rapid fluctuations are practically absent.

WARREN & JAMESTOWN RAILWAY SYSTEM

The Warren & Jamestown Railway is a high-speed interurban road, approximately 21 miles in length, operating over a comparatively level and straight right of way between Warren, Pa., and Jamestown, N. Y., at the southern end of Lake Chautauqua. The population of the territory traversed is estimated at 50,000, with 11,000 tributary, not including a large summer population at the various lake resorts. Heavy high-speed cars will be used, approximately 52 ft. over all, and with a normal seating capacity of fifty-four persons, each car being equipped with four alternating-current, 50-hp motors on 33-in. wheels. Four cars will be operated at present, with two additional cars later on.

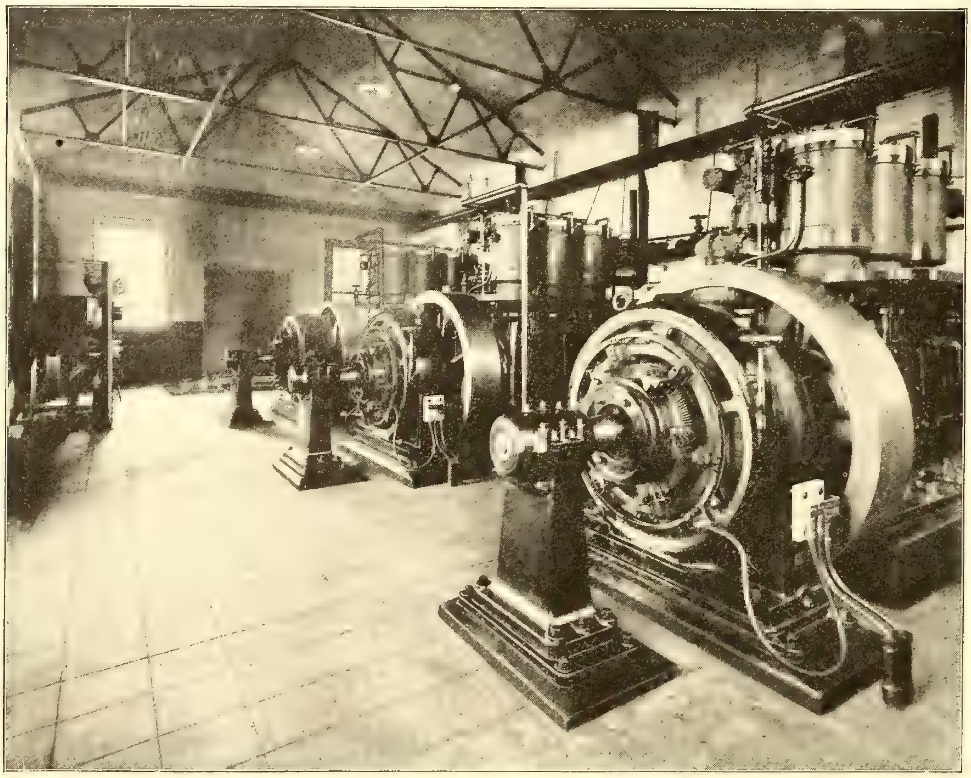


FIG. 23.—ENGINE ROOM OF ATLAS TOOL COMPANY, SHOWING GENERATOR SOLE-PLATE CONSTRUCTION

Power will be generated at the power house now operated by the Warren Street Railway, at Stoneham, 4 miles south of the city. For some time gas engines of the vertical single-acting type have been used for operating the present city railway system, and it is due to the general successful experience from gas power that gas engines will be used for operating the interurban road.

A noteworthy feature of the new interurban system is that Westinghouse single-phase apparatus is used throughout, with 22,000 volts transmission and 3300 volts on the trolley, which is of the Westinghouse catenary construction. A step-up transformer station is located at the power house, and two step-down sub-stations about 1 mile distant from both Warren and Jamestown. These equipments contain transforming, switching and protective apparatus alone. As no direct-current is used upon the system it is impracticable to employ storage batteries, so that the generating equipment will thus be required to sustain at all times the entire demand. In the present city system a 150-amp.-hour (1 hour rating) storage battery is in use, which is kept floating on the line throughout the load fluctuations, to the relief of the gas engine equipment. In the new plant the gas engines must sustain both load and fluctuations without assistance. Each unit complete of the new equipment occupies a floor space of 20 ft. x 47½ ft., allowing 4-ft. to 5-ft. passageways, which is equivalent to 3.65 sq. ft. per kilowatt, or 1.9 sq. ft. per horse-power capacity.

THE SINGLE-PHASE RAILWAY SYSTEM

BY CHARLES F. SCOTT,
Consulting Engineer, Westinghouse Electric & Manufacturing Company

It is the purpose of this paper to present some of the salient features of the single-phase railway system, and the results of the work which has been accomplished in the development of apparatus to meet the increasing demands in electric traction.

The questions which a railway manager is apt to raise with regard to the single-phase railway concern is its suitability for his particular conditions, its present practical status and its cost. The answers which apply in one case may be misleading in others, so that the discussion of the subject must be general rather than particular.

There are two other questions which have been asked so often that they deserve a passing comment: Will the motor start with good torque and accelerate rapidly? Will it commutate? Suffice it to say that the single-phase motor of the variety which I am considering does start and accelerate and commutate.

It is not the motor itself, but the single-phase system which the motor makes possible that is of prime importance. And the system is of commercial value only as it is able to operate electric railway service more effectively and economically than is practicable by other means.

SINGLE-PHASE AND DIRECT-CURRENT SYSTEMS COMPARED

The single-phase system accomplishes the same results in car movement that may be obtained by direct-current equipments, but in many cases with less first cost, less operating expense, increased flexibility and greater simplicity.

The radical difference between railway systems using direct-current motors and those using single-phase motors is not so much in the car or the power house as it is in the circuits connecting them. In the first place, the high voltage used on the trolley wire does away with expensive feeders, and it also enables the current to be carried to a greater distance from the power house or from the sub-station. Second, the sub-station employed in the single-phase system requires simply a lowering transformer. The sub-station for supplying a direct-current railway requires the rotary converter and a set of lowering transformers. Third, the number of sub-stations for a single-phase road is less than is required for direct current, and these do not require the attendance which is necessary for the operation of rotary converters. It is these characteristics that peculiarly adapt the single-phase system to interurban and long-distance railways.

CONSTITUENT PARTS OF SINGLE-PHASE SYSTEM

The motor is the feature which has received particular interest and comment, for it has been conceded that if a single-phase motor be available the other elements would follow as a matter of course. No one has questioned the adaptability of control apparatus, transformers and high-tension line construction to the requirements of the single-phase railway system. This simply involves the application of well-known apparatus and methods to the particular requirements of railway operation. But a perfected motor does not mark the completion of development work. Control apparatus for handling alternating current must be devised and constructed. It must be suitable for hand control for small cars and it must be adapted for the multiple-unit operation of heavier equipments. Still other forms must be suitable for operation interchangeably on either direct or alternating current. Transformers, line switches and other auxiliaries must all be combined into a workable equip-

ment. Forms of trolley and overhead construction must be developed suitable for the new conditions of current and voltage. The announcement of a commercial single-phase motor, made in the paper of Mr. Lamme before the American Institute of Electrical Engineers three years ago this month, was necessarily the beginning rather than the end of the development of the system as a whole in all its details.

ADVANTAGES PROVED BY SERVICE

In how far have the advantages claimed for the single-phase system been realized? Among the important features are the following:

A high-voltage trolley construction has been developed and has proved to be simple, strong and thoroughly practicable. Thirty-three hundred volts has been used and has proved to be safe and reliable.

A sliding contact device which does not require reversing when the direction of the car is changed is found more satisfactory, especially for high-speed operation, than the trolley wheel. Its wearing surface lasts longer than trolley wheels operating lighter cars on direct current.

Transformer sub-stations supply current satisfactorily without feeders and without station attendants.

The car equipments show simplicity and effectiveness in the control apparatus. Less than half the controller notches required for direct current give equally smooth and as rapid acceleration with alternating current. Platform controllers are simpler, as no magnetic blow-out is required. The multiple-unit control system is readily adapted for the operation of single-phase motors, and is in some points simpler than the control of direct-current motors.

The operation interchangeably by alternating current and by direct current is a feature of an important road which operates large equipments on direct current in the city and on alternating current across country.

Motors of four or five sizes have been built and show excellent commutating features. The commutators take a good polish. The motor windings are such that there is a practically balanced magnetic pull, even if the armature be slightly out of center. Although the armature speed is higher than in corresponding direct-current motors, the advance criticism has proved ill founded, as there have been no bearing troubles. The oil lubrication has proved highly satisfactory.

The foregoing features, which are the important elements upon which the claims of the single-phase system are based, have been shown by actual operation to be entirely feasible and practicable and such as to inspire confidence.

Difficulties have been met which have been annoying and vexatious. The difficulties, however, have usually been due to some error in the general engineering features or to some specific point of weakness in the insulation or construction of some part of the apparatus. In other words, the troubles have not been fundamental and inherent in the single-phase system, but have been incidental and capable of ready remedy. Some particular difficulties will be taken up further on in this paper.

LEADING FEATURES OF SINGLE-PHASE SYSTEM

As a guide to determine the conditions under which the adoption of the single-phase system is advantageous it will be useful to review briefly some of its features which are particularly concerned in its installation and operation.

The Motor.—A motor which is protected from the trolley voltage and lightning disturbances by an intervening transformer winding, which has only 200 to 250 volts across its terminals, which may have its brushes grounded or short circuited without "flashing" or "bucking," and which may have full voltage thrown on its terminals without disaster to itself, is essentially a safe motor. The armature has a bar winding on sizes of 30 hp and upward. The increased current required at low voltage necessitates brush capacity equivalent to that on a direct-current motor of twice the output.

The Control.—One usually thinks of the direct-current street railway motor as a variable-speed motor. Yet it is, in a sense, fundamentally a one-speed motor, for with definite trolley voltage, weight of car and grade, the motor soon attains a definite speed, at which it continues to run until there is a change either in the voltage applied or in the load. If two motors be operated in series there is a second definite speed, which is about half of the speed when they are in parallel. Other speeds are obtained by lowering the voltage on the motor by means of resistance, but this is inefficient and is admissible only in starting.

Certain results follow. The speed of the car depends upon the trolley voltage. If the voltage be low, the speed is low. The efficient speeds are fixed by the trolley pressure and not by the motorman. The relation between speed on level and the speed on grade is fixed by the inherent characteristics of the motor. A given motor with definite gear ratio has its one definite speed depending upon train resistance and electromotive-force. There is no range of adjustment like the throttling of an engine without the introduction of the wasteful rheostat. In a series motor the current determines the torque, and the electromotive-force determines the speed. Hence, for speed control there must be voltage control. In the direct-current system efficient voltage control is not attainable, but with alternating current it is easily secured. The simplest method of variable voltage is by means of taps from the transformer winding. The low voltage required for starting is obtained from a low tap, and the successively higher voltages for increasing speeds are secured from successively higher taps from the winding. As there is no rheostat, the motor may run efficiently from any tap, thereby giving the motorman a control over his car movement which is not possible with direct current. If there be a tap giving a voltage higher than that required for normal running, it is available for giving a higher speed for making up lost time, or for supplying normal voltage to the motor when the line pressure is low. The car can run at any time at the pressure needed.

The number of points required on the controller for smooth acceleration is much less with alternating than with direct current. The whole control system, in fact, is simply half a dozen taps from the transformer to the controller, by means of which any one of them may be connected to the motor. An intervening preventive coil enables the controller to pass from one point to the next without opening the circuit or short circuiting the two taps. The controller may consist of a drum of ordinary form on the car platform or of unit switches placed under the car and operated by a master controller. The latter type used in heavy equipments and also when several cars are to be operated in the multiple unit system. An effective form of switch with magnetic blow-out has been developed for heavy currents. The switches are assembled in a compact group, thoroughly protected and easily accessible.

Trolley Voltage.—Twenty years ago the electric railways of the United States, as measured either in miles, in cars or in kilowatts, comprised less than 1 per cent of what they do to-day. In this enormously rapid growth two features of the electric railway have remained unchanged, although other elements have been greatly modified. These two features are: First, the series motor; second, the use of direct current at approximately 500 volts. During this time the generating plant has changed from small belt-driven to large direct-connected units, and then from direct current to alternating current. High tension transmission circuits with rotary converter sub-stations have been common. Motors have increased in size and have been improved in design and in reliability and the multiple unit system of control has been introduced for larger equipments. The trolley voltage, however, has been limited to approximately 500 volts on account of the limitations of the direct-current motor and the inability to transform direct current on the car from a high voltage to a low voltage. The general trend of electrical engineering has been toward alternating current at high voltage. Many can remember the time when the use of 1000 or 2000 volts was decried as impracticable or unsafe, and when 5000 or 10,000 volts was the limit to laboratory experiments. Progress has been made in design, in construction and in materials until voltages, which not long since were impracticable, are now operated with greater reliability and safety than were the lower pressures a few years ago. Safety is very largely a question of mechanical excellence. In railway motors and control apparatus, in the mechanical equipment of heavy and high-speed cars, in overhead construction and in power house equipment, reliability is primarily dependent upon mechanical excellence.

While any considerable increase in voltage may not be safe on existing trolley lines, it is practicable by an increase in mechanical strength to offset the higher pressure and produce a high-voltage trolley system of greater reliability and safety than the present construction for low voltage affords. Such a construction has been developed into a commercial form in the catenary suspension of the trolley wire. An auxiliary steel cable with a moderate sag at the center of spans supports at frequent intervals the trolley wire which is thereby maintained at a uniform height. It is adapted for high-speed running and it possesses a greatly increased strength. The excess cost of the catenary construction over the cost of poles and overhead construction of the ordinary type is moderate, and, in a large measure, is justified by the gain in mechanical reliability quite aside from the question of voltage.

The Sub-Station.—To one familiar with an ordinary rotary converter sub-station interest will center chiefly in the negative characteristics of the single-phase sub-station. There is no rotary converter—a most essential link in the old system, one which behaves remarkably well when all is favorable, but is inclined to be

fussy and obstreperous when the conditions are not to its liking. There is no synchronizing, no sparking, no flashing, no dropping out of step. The transformers are not arranged in banks of two or three little ones, with polyphase switches and auxiliaries in primary and secondary, and the direct-current switchboard has disappeared entirely.

So much for what it is not. In its simplest form the substation is a single transformer with its primary and secondary connections. Additional transformers, switches, lightning protection and instruments are added as circumstances require.

Short circuits have lost much of their terror. The alternating current on short circuit is limited by the self-induction of the circuit, and a transformer is not disturbed by a "short" as is the commutator and the speed of a rotary converter.

The difference in the effect of a short circuit on direct current and on alternating current is well illustrated in the underground circuits in New York City. In an 11,000-volt cable system a fault in the cable causing a short circuit is usually confined within the cable and merely burns out a few inches of the conductor before the circuit-breaker opens. On a low-tension system, however, the currents are very large and considerable lengths of the conductor may be melted before the current is interrupted. In an alternating-current system the normal current in a circuit delivering a given amount of power is less in proportion as the voltage is increased, and, as the increase of current above normal is not as great on account of the self-induction of the circuits and apparatus, accidents are less liable to be destructive.

OPERATION ON DIRECT CURRENT

If the single-phase road is to be an extension of an existing road, it may be desirable to run the single-phase cars over the tracks which have a direct-current trolley wire. While single-phase cars can be arranged to operate from a direct-current trolley wire, it handicaps in some measure the single-phase equipment. The addition of resistance to the car equipment and the extra switches and the like for enabling the change to be made in the current supply are obviously objectionable. It is best, therefore, to keep single-phase equipments free from operation on direct current if it be practicable to do so. When it is found necessary for them to operate from an existing direct-current trolley wire, the motors are connected two in series for 500 volts, and if there be four motors the two pairs may be connected first in series and then in parallel as in ordinary series parallel control. The transformer is cut out, and the control apparatus and motors operate in substantially the same way as those on an ordinary car.

SOURCE OF POWER

The standard frequency for the single-phase motor is 25 cycles, (3000 alternations). Generators may be wound for single-phase, or current may be taken from one phase of a two-phase or a three-phase generator. Current from the several phases of a polyphase generator may be used for operating different divisions of the railway.

If power is to be taken from a power house which generates a higher frequency it cannot be applied directly, but must be changed to 25 cycles. This may be effected by a motor-generator set. A polyphase motor taking power equally from each phase of the high frequency circuit may drive an alternator, either single-phase or polyphase, for furnishing current to the single-phase railway. The converting outfit may be located in the main power house or in a sub-station as may be found most convenient.

THE FIELD FOR SINGLE-PHASE RAILWAYS

The development of a new and more efficient method for accomplishing a given result often leads on and opens new fields which had not been commercially practicable before. Such is the case with the single-phase railway. The direct current interurban railway has its limitations. If a region be sparsely settled the available traffic will not show a profit on the cost of circuits and rotary converter sub-stations. There is a material reduction in the investment and operating expense incident to the single-phase railway that will enable it to be built and operated with a profit in cases where the traffic would not support a rotary converter system.

On the other hand, in heavy service the direct current has not made much headway, being handicapped by the heavy cost of sub-stations and of conductors. Heavy and relatively infrequent trains are the hardest loads for sub-stations. For example, if sub-stations be 8 miles apart, each will supply 8 miles of track. A train running 40 miles per hour will receive current from a given sub-station for 12 minutes. In order that a sub-station may be continuously supplying current to trains in one direction they must have a headway of 12 minutes. If they be an hour apart the current from each sub-station is used but one-fifth of the time. Trains in two directions will double the sub-station output, but as the peak load is considerable when two trains pass near a sub-station the load factor is extremely low. Therefore as the aggregate capacity of the sub-stations must be large in proportion to the actual power taken by the cars, it follows that the sub-stations will involve a relatively large expense if they are equipped with expensive rotary converters and require constant attendance, whereas the cost will be relatively small if they require simply lowering transformers having an efficiency very much higher than the rotary converter sub-station and not requiring attendance. The reduction in the sub-station is therefore of especial value when the service is infrequent. Moreover, the single-phase equipment by reducing the size of conductors frequently enables the sub-stations to be more widely separated. This possibility in the reduction in the number of sub-stations and in the aggregate capacity of sub-station equipment, as well as the elimination of rotary converters with their energy losses and their attendants makes practicable the operation of long-distance roads which could be operated by direct current only at an excessive cost.

The single-phase system therefore decreases the cost of installation and operation for the kind of interurban service which has been successfully developed by the direct current, and it extends the field of commercial operation to include, on the one hand, rural roads with relatively light traffic, and on the other, a heavy, infrequent, multiple unit or locomotive service for passengers or for freight approximating steam railway conditions.

SINGLE-PHASE RAILWAYS IN OPERATION

The single-phase railway which shows the most extensive operation as measured in car-miles, is the Indianapolis & Cincinnati Traction Company. Operation was begun over a short length of track Jan. 1, and on April 1, 37 miles were covered. Since July 1 a regular schedule has been maintained over 41 miles, 37 miles of which is under alternating-current trolley and the remaining 4 miles is under direct-current trolley in the city of Indianapolis. The company has 10 cars, each equipped with four 75-hp motors. A maximum speed of 60 to 65 miles per hour is secured, and the cars are not only the heaviest, but they operate upon the fastest schedule of any of the numerous suburban roads radiating from Indianapolis. Some defects have developed in the equipment, which, however, have been incidental in character, and not in those new features where trouble might reasonably have been anticipated. It was found that the natural ventilation under the car was insufficient for the transformer and a ventilating motor was added. A weak point developed in the armature insulation when the cars, which had been running for some time by alternating current, were first run regularly over the direct-current lines into Indianapolis. One feature of the new condition was the opening of the circuit with four motors in series, the motors having laminated fields which give greater field discharge than solid poles. The remedy was obviously the strengthening of the insulation. This brings out the interesting fact that operation on alternating current at 3300 volts with an intervening transformer is less severe upon the motor than operation on direct current at 500 volts. Experience showed wherein the control apparatus, suitable for both alternating and direct current, could be simplified and the apparatus reduced in quantity. The result is a control system which is relatively simple and compact, although suitable for operation interchangeably between alternating current and direct current.

The best verdict upon the working of the single-phase system on this road at Indianapolis has been given by the operating company. It is found in the contracts which have been placed for extending the present line a distance of 16 miles; also in extending the single-phase operation to the Shelbyville line, both to the 29 miles which have been operated by direct current and for a 20-mile extension. The length of track is therefore to be increased from about 40 to 100 miles; the number of cars will be double the present number and all equipments will be similar. It is significant that a company which has been operating two substantially similar suburban lines, one by single-phase current and the other by direct current, should see fit to throw out the direct current and substitute single-phase alternating current. It may be noted that this course was taken, although the reverse was easily possible, as provision was made in the original contract for the single-phase apparatus by which it would be exchanged for direct-current equipments if its operation proved unsatisfactory.

Other single-phase roads which are operating Westinghouse equipments show a variety of conditions, some having exceptionally sharp curves and steep grades. On the road between Derry and Latrobe, in Pennsylvania, 30-ton cars are started on a 10 per cent grade. The cars have platform controllers and are equipped with four 50-hp motors. In some cases the initial operation has been handicapped on account of incompleteness, or through the use of temporary apparatus either in the power house or on the car. In its fundamental elements, however, the operation is proving perfectly satisfactory.

SOME NEW ROADS

The extension to long distances will soon be shown in the carrying out of the contract which has been closed by the Spokane & Inland Railway Company for 150 miles of railway running south from Spokane, Washington. The equipment will consist of fifteen motor passenger cars, each with four 100-hp motors, six motor freight cars, each with four 150-hp motors and six 40-ton freight locomotives which may be in pairs for heavy trains. The engineer of this road has been intimately connected with the installation and operation of the single-phase road at Indianapolis.

The most notable recent event in electric traction is the purchase of Westinghouse single-phase locomotives by the New York, New Haven & Hartford Railway Company. The passenger trains on this road which enter Grand Central Station in New York run over the tracks of the New York Central Railroad for about 12 miles. As steam locomotives cannot enter the new terminal station, and as the New York Central is equipping its track for direct current, it is imperative that the New Haven trains be handled over 12 miles by direct-current power. Instead of changing from electric to steam locomotives for all local and through trains at the end of 12 miles it was decided to extend the electrification and to do it, not by extending the direct current, but by changing to alternating current. The single-phase locomotives will be designed so that they may operate interchangeably from direct current or from single-phase alternating current.

The adoption of the single-phase system by one of the leading railroads of the country for its heavy and important passenger service is all the more noticeable; first, because its officials are already familiar with electric traction matters through the operation of many important city and interurban railways in New England, and second, because the obvious thing to have done would have been to follow the example of the New York Central by adopting direct current locomotives. Probably this is the turning point, and the coming electrification of heavy railways will follow the conspicuous example set by the New York, New Haven & Hartford Railroad Company in adopting the single-phase system.

ELECTRIC RAILWAY EQUIPMENT

BY W. B. POTTER

The annual meetings of the American Street Railway Association are not only occasions for the exchange of ideas between the operating companies, but they also afford an excellent opportunity for engineers concerned in the selection or development of the various appliances to study the present and future requirements in their broader aspect.

Recent years have witnessed such radical changes in many details of electric railway equipment, that it is advantageous to occasionally review the modifications made to meet the requirements of modern railway practice. Numerous changes are made each year, and while the general trend is toward improvement, the ultimate degree of perfection is only attained through the experience resulting from a thorough trial of the new ideas under operating conditions. In this respect the designing engineer and manufacturer owe much to the operating company, an obligation which should be, and I believe is, fully recognized.

The limits of this paper will permit only a reference to a few of the features relating to the development of the past few years.

STEAM TURBINES

No more prominent example can be found to demonstrate the rapid march of progress, than the introduction and successful operation of the steam turbine, of which there are several types now on the market. The extent to which the reciprocating engine is being superseded is indicated by the sales during the past three and one-half years of one type of turbine alone, which amount to over one-half million kilowatts, of which about one-third are for electric railway service. These figures are mentioned for the purpose of emphasizing the recognized importance of the steam turbine as a prime mover.

As compared to the reciprocating engine there are several important advantages generally known, but perhaps not appreciated at their true value. The steam economy of a turbine at full load is at least equal and frequently higher than that of an engineer of similar capacity, and at fractional loads the degree of economy is decidedly in favor of the turbine. This is owing to the relatively more efficient utilization of the steam at partial load and also the lower frictional losses. As the load factor of a prime mover is commonly less than full load, the resultant relative economy of the turbine is considerably higher than if it were judged only by a comparison of the steam consumption of both the turbine and engine at full load—a comparison at one-half load would more nearly represent the average operating performance of a railway power station. The turbine has also the advantage of a better maintained operating economy, as it is not dependent upon the setting and fit of admission and exhaust valves, the derangement and leakage of which may reduce the initial economy of the engine 15 per cent, or even more, depending upon the degree of attention which the engine receives. The attendance and maintenance, as would be expected from a comparison of the mechanism, of the turbine and engine is in favor of the former. The reliability has also been proven by extended runs and further by the accidental admission of water, which although harmless to the turbine, would have caused serious injury to an engine.

The curves shown in Fig. 1 illustrate the performance of a 2000-kw Curtis turbine at different loads and under various steam conditions, and show the characteristically high economy at the fractional loads. The higher economy secured by superheating does not altogether represent an equivalent reduction in fuel, as a certain additional amount of coal is required to produce the superheating. The net result, however, shows a saving in favor of superheating. While the larger sizes of turbines have been more generally applied to driving alternators, they are adapted for direct-current railway generators, and turbine sets of this character have been built up to 2000 kw. The turbine certainly gives great promise of being the only steam-driven prime mover of the future for producing electric power, and its usefulness is by no means limited to that particular field.

MOTORS

Each year bears evidence of the growing popularity of electric traction, and the increase in traffic has naturally affected both the size and weight of the cars and the schedule speeds. The more onerous conditions imposed on the electric apparatus to meet the ever increasing demand for larger and heavier equipments, and the demand for greater seating capacity on systems already operating at 500 to 550 volts, has led to an increase in the generated voltage. We have been accustomed to consider 500 to 550 as the standard direct-current voltage, but 600 volts is now being used to such an extent that it has really become the standard for the power station. The rôle of the manufacturer is to design and construct such apparatus as will best meet the conditions of the operating companies, and it is, therefore, the requirements of the operator that should be studied rather than the development of any particularly idea.

The direct-current railway motor has been greatly improved, and has undergone more changes in detail than is perhaps generally appreciated. The old troubles of sparking and flashing at the commutator have been practically eliminated. Previously it was con-

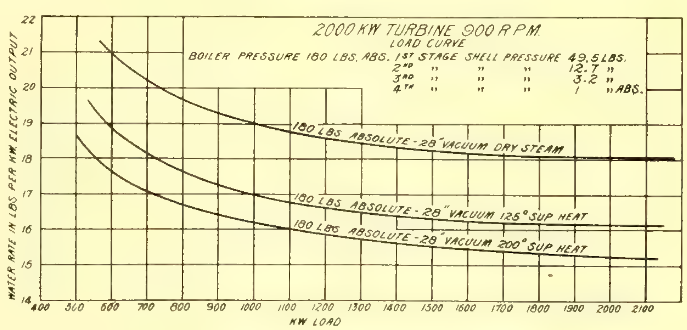


FIG. 1.—PERFORMANCES OF A 2000-KW CURTIS TURBINE AT DIFFERENT LOADS AND UNDER VARIOUS STEAM CONDITIONS

sidered advantageous to short circuit a turn on the field winding to reduce the sparking at the brushes and in the controller, the idea being to restrain the rapidity with which the magnetism of the motor changed, but several years ago it was found that while this provision decreased whatever troubles occurred, due to opening the circuit, it was a positive cause of flashing in case the current was interrupted and suddenly applied. For example this trouble would occur on passing a section insulator with the controller on, and more especially when operating with sleet on the trolley wire or running over a third rail with an uneven surface.

The field coils as now made not only have no short circuiting turns, but where metal spools are used, it is customary to split the spool and introduce an insulation into the shell to eliminate every feature of a short circuited turn.

The armature revolutions of a motor as affecting the peripheral speed of the commutator have also an effect on the sparking and wear of the commutator. The armature revolutions further affect the performance of the bearings, and while it would be possible to build a lighter and cheaper motor at higher armature speeds, a maximum of 1500 r. p. m. appears to be the highest desirable limit as indicated by experience.

To meet the requirements of the higher voltage now more commonly used, and to further insure the stability of the motor as regards flashing, it is now the practice to provide a greater number of commutator segments; that is, the voltage difference per commutator bar has been reduced to a lower figure.

The commutator being a revolving switch, it is important if sparking and flashing are to be avoided that the brushes should maintain good electrical contact with the copper segments. The commutator being built up of alternate sections of copper and mica, it sometimes happens that the mica does not wear evenly with the copper. In such cases the sparking becomes more pronounced, and there may even be serious trouble from flashing; the most effectual remedy in such a case is to groove out the mica between the commutator segments to a depth of about 1-32 of an inch below the surface of the commutator. Many cases of troublesome commutation may be wholly cured by this expedient.

The performance of a motor for any service may be limited by its commutation, or, as is more commonly the case, by its heating. The heating of a motor is affected by the losses in both the copper and iron, but the relative heating effect of these two elements is quite different. The copper losses predominate during acceleration and the iron losses when running at the higher speeds; the effect of the iron losses is, therefore, to limit the capacity of the motor for continuous running. Although the service in which motors are now commonly used does not call for a continuous run of many hours at full speed, without occasional acceleration, the iron losses are, nevertheless, of importance, and more care than formerly is now exercised in the selection of the iron for armature. The principal cause of these iron losses are the eddy currents in the iron, and to eliminate these a special study has been made of annealing and japanning the laminations.

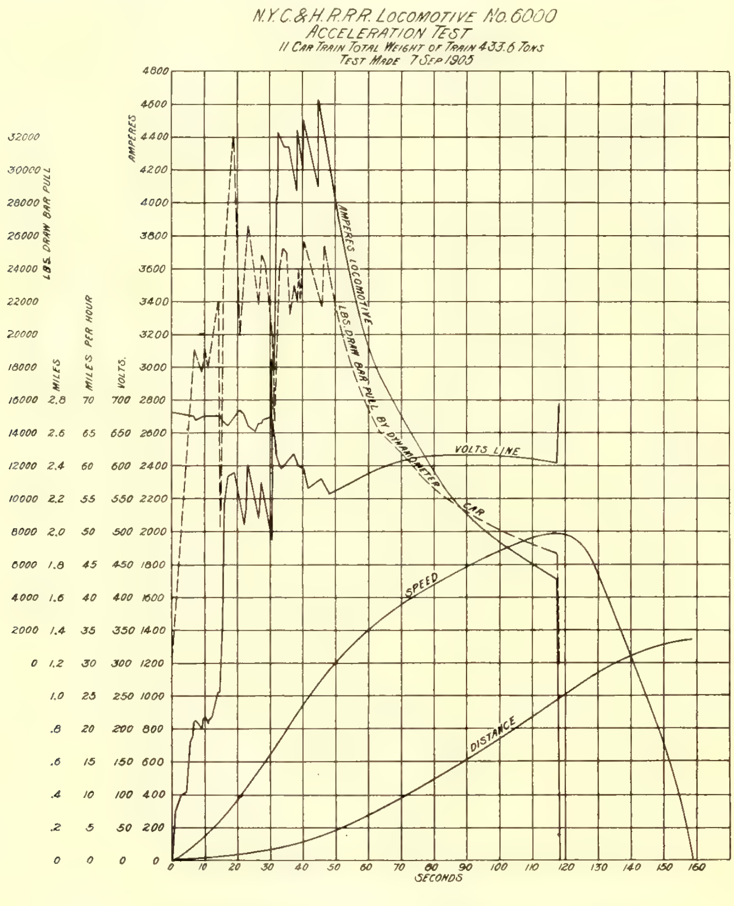


FIG. 2.—ACCELERATION TEST ON NEW YORK CENTRAL LOCOMOTIVE

While the temperature of a motor under given conditions is proportional to its internal losses the actual temperature rise may be greatly influenced by ventilation to assist in dissipating the accumulated heat. Forced ventilation by means of a blower, similar to those used with air-blast transformers, may be employed. By this means the temperature of the motors in any particular service may be very much reduced, but the complication is such that it does not seem well adapted to the ordinary electric car. Forced ventilation is, however, well suited to locomotive work where the blower may be carried in the cab. As the motor commonly used depends upon its own rotation for ventilation, the arrangement of the ventilating passages must be carefully studied, not only to secure the best cooling effect, but also to prevent depositing brake-shoe and carbon dust or other injurious material upon conducting surfaces of the motor which cannot be conveniently cleaned.

For this reason it is inadvisable to provide ventilating ducts just at the back of the commutator ears, for any accumulation of conducting dust at this point is sure to produce burn-outs. It has also been found advisable wherever ventilating ducts are provided through the core head to extend the slot insulation of the armature coils for some distance beyond the end of the core.

The use of oil in preference to grease for the lubrication of motor bearings seems now to be universally favored. Of the various methods which have been tried, a waste-packed journal with an oil well, similar to the journal box of a car truck, has given the most satisfactory results. Nearly all the larger motors at the present time are designed for this method of lubrication.

The mechanical injury to motor armatures usually results either from the armature striking the pole pieces or the mechanical weakness of the armature binding. The former, where resulting from the wear of the armature bearing linings or loose cap bolts, can be avoided by a proper system of inspection, but the latter is a question of motor design.

The strains to which the armature bindings are subjected, particularly if the car is speeded above the normal by driving it with power down grade, are not ordinarily appreciated. As an illustration, the weight of the armature coils in a 125-hp motor is less than 200 lbs., yet the radial centrifugal strain of all the coils at 1500 r. p. m. is about 48 tons, giving a resultant strain of over 15 tons on the binding wires. Even if these wires are strong enough to hold the coils without breaking, they may stretch enough to permit a considerable movement of the coils in the armature slot, resulting in an abrasion of the insulation. An armature should be so bound that there will be no evidences of weakness at 50 per cent above the maximum normal speed, and the ultimate strength of the binding or bursting speed of the armature should be at least double the maximum normal speed to insure the proper margin of safety.

The field coils of a motor, although subject to less potential than the armature, by reason of their location in the motor, are more subject to injury from occasional water. A distinct improvement has been made in the construction of the field coils by immersing them in a bath of hot compound under vacuum. The effect of this process is to thoroughly fill all air spaces with compound. This not only renders the coil more waterproof, but also makes it more solid and less liable to injury from mechanical vibration.

More attention is being paid to the fit of commutator and oil well covers, which, being frequently opened, are now provided with machined seats in order to insure a better fit for the exclusion of dirt and water.

With the increased capacity of the motors the strains on the gearing have very much increased, particularly on the pinion teeth, which are of weaker section than the gear teeth. To meet these more severe conditions a very high grade of steel is required, both with respect to ultimate strength and elastic limit. The grades of steel commonly used five or six years ago would by no means answer for the pinions of the larger motors built to-day. Not only are the strains severe, but owing to the overhang of the pinion, the face of both the gear and pinion teeth, when new and doing heavy work, are not in contact across their full width. The strain is borne principally by the end of the teeth nearest the motor, with the result that a shearing action takes place, which will sometimes break out a part if not the whole of a pinion tooth. As a pinion wears the teeth become thinner on the side toward the motor, so that a pinion which has been in service until its teeth match with the gear across the full face, may prove stronger under stress than a new pinion.

The solid axle gear is to be preferred to the split gear, and, were it not for the inconvenience of removing the car wheel, would doubtless be more generally used. The objection to removing the car wheel for the reason that its fit on the axle is impaired, may be overcome by the use of a wheel with an extended hub, on which the gear is shrunk, as proposed by Messrs. Doyle and Brinkerhoff, and in use on the Interborough Rapid Transit Railway in New York.

The more severe demands of present service have also necessitated changes in the older type of controllers, as well as the development of new types of control and control appliances. The cylinder controllers have been improved by making the arc deflectors of a more vitreous material, less affected by the arc and productive of a much smaller quantity of conducting gas when opening the circuit under abnormal conditions.

CONTROLLING SYSTEMS

For the control of equipments aggregating 200-hp and over, the type-M control, consisting of electrically-operated contactors or switches, is recommended and is being very generally used. It is not only possible to handle heavier currents and a higher voltage by contactor switches, but a further advantage lies in the fact that the master controller occupies considerably less space than a cylinder controller handling the full motor current.

Whether the cars are operated singly or in trains, as the Sprague-General Electric multiple-unit system, the control may be either hand-operated or automatic in its action. In the former case the handling of the master controller is similar to the ordinary cylinder control, and there are controller notches corresponding to each rheostatic step and the series and parallel running points. In the automatic control there are only three positions of the handle, the first one giving slow movements to the car for switching; the other two points are the series and parallel running positions. The intermediate rheostatic points are actuated automatically by a series relay on each car of the train. The automatic form of control is well adapted for services where the rate of acceleration may be predetermined, and need not be dependent upon the judgment of the motorman.

FUSES

For automatically protecting the equipments from the results of accidental short-circuits, it was the early practice to provide fuses consisting of a composition of lead and tin, and, although magnetic fuse boxes were used, their action with this type of fuse was not always satisfactory. It was partly for this reason and because of the time required to replace fuses, which with the older types of equipment were more frequently blown, that the automatic circuit breaker came into quite general use. On the larger equipments, however, where the circuit breakers had to be set for 1000 amps. or more, it was found difficult to provide space for them in a position where the arc resulting from a short circuit would be free from danger of grounding to some part of the car. As a substitute for the circuit breaker in this heavier class of work, many different forms of fuses have been tried, but none has proved thoroughly reliable, with the exception of a fuse composed of thin copper ribbon enclosed in an insulating chute and surrounded with enough iron to provide a magnetic field. This copper ribbon fuse has been quite generally used on the larger equipments for the past few years, and has given excellent satisfaction. The same type of fuse is applicable to smaller equipments, and in many cases it may be found superior to the circuit breaker, as its reliability is a strong point in its favor. A circuit breaker should have frequent inspection, and in case of several repeated short circuits it may be so injured as not to finally extinguish the arc without an amount of flame that may alarm the passengers.

CAR WIRING

It is a matter of favorable comment that the car wiring is now receiving much more attention than formerly. Those familiar with the character of work formerly done will readily testify to the advantages secured by eliminating the dangerous practice of attaching the wires by staples or other means to any convenient place on the under side of the car, and often without regard to the movement of the brake levers and compression of the springs of the loaded car. The best recognized practice is now to install all wiring in iron conduit. If properly done, with the ends of the pipes fitted with bell mouths or other provision to avoid abrasion of the wire, the car wiring should prove the most safe and permanent part of the electrical installation.

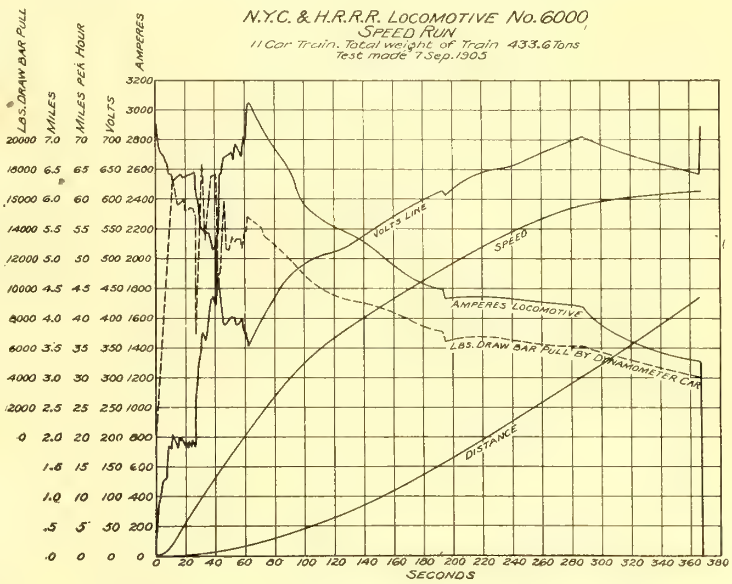


FIG. 3.—SPEED RUN CURVES OF NEW YORK CENTRAL LOCOMOTIVE

FIG. 4.—ELEVEN-CAR TRAIN USED IN NEW YORK CENTRAL ELECTRIC LOCOMOTIVE TESTS

The suggested improvements in wiring apply with even greater force to the lighting and heating circuits, as these circuits have generally been given less attention than the motor circuits. As a source of fire, the lighting and heating wires are dangerous on account of their location in the roof or sides of the car, their inaccessibility for inspection and the fact that current is often left on these circuits when the cars are in the car house.

While many of the preceding remarks have been based more particularly on the experience with direct-current apparatus, the essential principles apply equally to the alternating railway equipment.

ALTERNATING-CURRENT APPARATUS

During the past year there have been several installations of alternating railway equipments, and the outlook is very promising for this class of equipment under conditions advantageous to its use. Considered wholly from a technical standpoint, there is no question but that alternating-current motors can perform any service now done by direct-current apparatus, but the choice as between alternating and direct current should not be made without a full consideration of the direct and indirect expense incident to either type of equipment.

NEW YORK CENTRAL ELECTRIC LOCOMOTIVE

As the street railways and the steam railroads are now becoming so closely identified, a reference to some of the recent tests of the New York Central electric locomotive will not be out of place. This locomotive has now run over 21,000 miles with trains of varying weights. The maximum speed attained with a train weighing 278 tons, including the locomotive, was 71 miles per hour in a distance of about 4 miles. With the locomotive alone, the maximum speed was 85 miles per hour, with the probability that the speed

would have been 100 miles per hour had the run been twice the length.

The accompanying curves show tests made with an eleven-car train, including the New York Central dynamometer car, which were made for the purpose of checking the results obtained from the speed-torque characteristics of the motor.

Fig. 2 shows an acceleration test, all the records of which were taken with automatic recording instruments. The draw-bar curve was taken by the dynamometer car, with no damping device or dash-pot to control the fluctuations on the recording pointer. The comparative steadiness of the pull of the electric locomotive will appeal to those who have seen a dynamometer record, without the damping device, taken from a steam locomotive.

Fig. 3 shows the curves of a speed run over the test track with the same train. The notch in the curve at about 190 seconds is caused at that point by the locomotive leaving an additional strip of third rail which was fed from some distance away.

The total weight of this locomotive is 97 tons, of which about 70 tons is on the drivers. The nominal rated power is 2200 hp, although the output during acceleration has often exceeded 3000 hp. The accompanying Fig. 4 shows this locomotive with the eleven-car train attached. The weight of the train, including the locomotive, was 433 tons.

RECORD DATA

In conclusion, I would call attention to the benefits that may be derived, both from an operating and manufacturing standpoint, from a record system covering the mileage of parts and detail cost of maintenance of the car equipment. The records of the power and sub-stations, which are more easily kept, seem to be fairly complete, but of the car equipment, the records do not seem to be generally available in such form as to permit a comparison of the relative merits of any particular method of operation or quality of material. If a uniform system could be standardized and the records submitted at each association meeting, they would be a valuable source of information and a further incentive to improvements in the design of apparatus and the methods of operation.

CONSTITUTION AND BY-LAWS OF THE AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION

The following is the final form of the constitution and by-laws adopted Sept. 27. The changes from the form published in the STREET RAILWAY JOURNAL for Sept. 2 are indicated by printing the new words introduced in italics and the words stricken out in brackets []:

CONSTITUTION

NAME AND LOCATION

I. a. The name of the association shall be the "American Street and Interurban Railway Association."

b. The headquarters of the association shall be located in the city of New York.

OBJECTS

II. The objects of the association shall be as follows:

a. The discussion and recommendation of methods of construction, management and operation of street and interurban railways, and of safeguarding the interests of the same.

b. The establishment and maintenance of a spirit of co-operation among the members, and the encouragement of friendly relations between the companies and the public.

c. The acquisition of experimental, statistical and scientific knowledge relating to the construction, equipment and operation of street and interurban railways and the diffusion of this knowledge among the members.

MEMBERS

III. The membership of this association shall consist of two classes, as follows:

a. Active members, consisting of American street and interurban railway companies, or lessees, or individual owners of street and interurban railways. Each member shall be entitled to one vote, which shall be cast by the properly-accredited delegate.

b. Associate members, consisting of individuals, *co-partnerships and corporations*, who are [or have been at some time] actively identified with street and interurban railway interests, and other persons who in the opinion of the executive committee have had experience of such a nature as to render desirable their connection with the association. The privileges of the associate members shall be similar to those of the active members, excepting that they shall not be entitled to vote or hold office, nor shall they have the privileges of the floor unless permitted by the association.

AMENDMENT

IV. This constitution may be amended by a two-thirds vote of the members present at a regular meeting, provided the proposed amendment shall have the approval of *two-thirds of* the executive committee, and provided that a copy shall have been sent to each of the active members at least thirty days prior to the date of the meeting at which the proposed amendment is to be acted upon.

BY-LAWS

ELECTION OF MEMBERS

I. Every applicant shall signify his desire to the secretary, enclosing the requisite fee. All applications for membership shall be referred to the executive committee, a two-thirds vote of the members of the executive committee by ballot being necessary to election. In case of rejection, the membership fee shall be returned. The executive committee shall report at each meeting the names of new members elected.

OFFICERS

II. a. The officers shall consist of a president, vice-presidents equal in number to the number of affiliated associations, a treasurer and a secretary. The officers shall assume their duties immediately after the meeting at which they are elected.

b. The president *and* vice-presidents [and treasurer] of the association shall be elected at the annual meeting of the association. All such elections shall be by ballot, and a majority of the votes of all members present shall be necessary to an election. The secretary *and treasurer* shall be appointed by the executive committee, *and both offices may be filled by the same person.*

PRESIDENT AND VICE-PRESIDENTS

III. The president shall be the chief executive officer of the association. He shall preside at the meetings of the association and of the executive committee. In the absence of the president, any duties devolving upon him may be performed by one of the vice-presidents.

TREASURER

IV. The duties of the treasurer shall be to receive, safely keep and account for all moneys of the association; to keep correct accounts of the same, and to pay all bills approved by the president. He shall make an annual report to be submitted to the association. He shall give a bond to the president in such sum, and with such sureties, as shall be approved by the executive committee. He shall be paid a salary fixed by the executive committee.

SECRETARY

V. The duties of the secretary shall be as follows:

a. To take minutes of all proceedings of the association and of the executive committee, and to enter them in books proper for the purpose.

b. To conduct the correspondence of the association.

c. To read minutes and notices at all meetings, and to present papers and communications if the authors wish it.

d. To collect and file for the benefit of the members information and statistics regarding matters relating to the purposes of the association.

e. To receive applications for membership, and to lay such before the executive committee.

f. To attend to the publication of the proceedings of this association; and, in conjunction with the secretaries of the affiliated associations, to the publication of the proceedings of such affiliated associations.

g. To send notices to all members of the association at least thirty days before each meeting, mentioning papers to be read and any special business to be brought before the meeting.

h. To perform such other duties as may be required of him by the constitution and by-laws, and such duties as may be assigned him by the executive committee.

The office of the secretary shall be maintained at the headquarters of the association. He shall be paid a salary fixed by the executive committee. [He may or may not be in the employ of an active member of the association.]

THE EXECUTIVE COMMITTEE

VI. a. The entire charge and management of the affairs of the association shall be in the hands of an executive committee, which shall consist of the president, the vice-presidents, and one member appointed by each of the affiliated associations. The executive committee shall make arrangements for carrying out the objects of the association.

b. The executive committee shall hold a regular meeting before each regular annual meeting of the association, and shall hold such special meetings as may be necessary. Such special meetings may be called by the president or any five members of the executive committee. *A majority of the members* [five members] of the executive committee shall constitute a quorum at all meetings.

The secretary shall give such reasonable notice of all meetings as the committee shall by vote prescribe, and all such notices shall, *as far as practicable*, specify the business to be brought to the attention of the committee at such meetings.

c. The executive committee may assign to its allied association, the American Street Railway Manufacturers' Association, the management of the exhibit features of the annual conventions, and it may arrange with the said Manufacturers' Association the details of such entertainments as may be given in connection with the annual conventions of this association.

d. The executive committee shall present a report to each regular annual meeting of the association, and shall include in such report the names of members elected during the year, and its recommendations for the future work of the association.

MEETINGS

VII. a. Regular annual meetings of the association shall be held at such time between the 15th day of September and the 15th day of December, in each year, as the executive committee may decide to be best suited to the locality in which the meeting is to be held; the time to be decided upon and each member notified of the selection by the 1st day of May in the year in which the meeting is to be held. Special meetings may be held upon the order of the executive committee. Notice of every meeting shall be given by the secretary, in a circular addressed to each member, at least thirty days before the time of the meeting. Fifteen members shall constitute a quorum at any meeting.

b. At all meetings of the association discussion shall be limited to active

members, provided, however, that special privileges may be accorded others at the will of the meeting.

c. At any regular or special meeting, executive sessions may be held. Such sessions shall be open to active members only.

ORDER OF BUSINESS

VIII. The regular order of business shall be:

1. Reading of minutes of last meeting.
2. Report of the executive committee.
3. Address of the president.
4. Report of the treasurer.
5. Reports of standing committees.
6. Reports of special committees.
7. Reports from affiliated associations.
8. Reading and discussion of papers.
9. General business.
10. Election of officers.

COMMITTEE ON SUBJECTS

IX. In order to secure continuity of work and uniformity of general purpose, a committee on subjects shall be appointed each year by the executive committee. The function of this committee shall be to suggest topics for the work of the American Street and Interurban Railway Association and its affiliated associations for each year in advance.

The committee shall consist of one member from each of the affiliated associations and a number from the American Street and Interurban Railway Association equal to the total number from the affiliated associations. The committee, at each annual meeting, shall present its plans for the coming year.

VOTING

X. All votes except as herein otherwise provided shall be viva voce, and in case of a tie, the presiding afficer *shall* [may] vote.

READING OF PAPERS

XI. All papers read at the meetings of the association must relate to matters connected with the objects of the association, and must have been previously approved by the executive committee.

AFFILIATED ASSOCIATIONS

XII. This association shall do all in its power to promote the welfare of other associations organized with its approval to investigate technical matters connected with street and interurban railway construction and operation. To this end it will, in the following way, and in others which may be determined by the executive committee, assist in the work of such affiliated associations:

a. By *authorizing the formation of* [granting charters to] and approving the constitutions of such associations.

b. By admitting to the executive committee a member from each of such associations.

c. By granting financial assistance to such associations [for specific purposes.]

d. By editing, printing and binding the reports of the proceedings of such associations.

e. Through its secretary and committee it will assist in arranging for conventions, suggesting suitable subjects for investigation; it will file information for reference and distribution, and in every way endeavor to stimulate interest in all of the affiliated associations.

PAPERS, DRAWINGS, ETC.

XIII. All papers, drawings and models submitted to the meetings of the association shall remain the property of the owners, subject, however, to retention by the executive committee for examination and use, but at the owner's risk.

FEES

XIV. Active members shall pay an admission fee of $10 and annual dues payable in advance based on gross earnings from railway operation during the preceding fiscal years [ending June 30th], *of the respective companies*, as follows:

Gross Receipts.	Annual Fee.	Originally Proposed.
Under 50,000	$15 00	$25.00
Between $50,000 and $100,000	25.00	
" 100,000 " 250,000	50.00	50.00
" 250,000 " 500,000	75.00	100.00
" 500,000 " 1,000,000	100 00	150.00
" 1,000,000 " 2,000,000	150.00	
" 2,000,000 " 3,000,000	200 00	250.00
" 3,000,000 " 4,000,000	250.00	
" 4,000,000 " 5,000,000	300.00	350.00
5,000,000 " 6,000,000	350.00	
" 6,000,000 " 7,000,000	400.00	
" 7,000,000 " 8,000,000	450.00	500.00
8,000,000 " 9,000,000	500.00	
" 9,000,000 " 10,000,000	550.00	
" 10,000,000 " over	600 00	600.00

Associate members shall pay in advance an annual fee of $5.

ARREARS

XV. No member whose annual payment shall be in arrears shall be entitled to vote.

WITHDRAWAL

XVI. Any member may retire from membership by giving written notice to that effect to the secretary and the payment of all annual dues to that date, but shall remain a member, and liable to the payment of annual dues until such payments are made, except as hereinafter provided.

EXPULSION

XVII. A member may be expelled from the association by the vote of two-thirds of the members present at any regular meeting of the association, upon the written recommendation of the executive committee.

RULES OF ORDER

XVIII. All rules not provided for in these by-laws shall be those found in Roberts' Rules of Order.

AMENDMENT

XIX. All propositions for adding to or altering any of these by-laws shall be laid before the executive committee, which shall bring them before the next regular meeting of the association, if it shall consider such course desirable; and it shall be the duty of the committee to do so, on the request, in writing, of any five members of the association.

[The form of charter to be granted by the American Street and Interurban Railway Association was omitted entirely.]

MEETING OF THE CLAIM AGENTS' ASSOCIATION

The meeting of the Claim Agents' Association was held at Room 1032, Land and Title Building, the private office of Mr. Rhoads, claim agent of the Philadelphia Rapid Transit Company. The meeting was originally scheduled for Tuesday morning, but as that was the time selected for the meeting of the executive committees for discussing the question of reorganization, it was decided better to adjourn the meeting of the Claim Agents until Wednesday morning. In consequence, James R. Pratt, of Baltimore, was appointed representative of the association at the meeting of the executive committees, and the Claim Agents adjourned to inspect the offices and methods of the company at the main office at Eighth and Dauphin Streets.

The convention reassembled in Mr. Rhoads' office Wednesday morning. In the absence of Mr. Dibbs, president of the association, who has left street railway work, E. W. O'Connor, of Savannah, was elected temporary chairman. The roll call was then taken and it was shown that fifty companies were represented at the meeting. Mr. Renaud, of the New Orleans Railway Company, presented a report on the meeting of the executive committee in Philadelphia on June 12, and Mr. Pratt, of Baltimore, rendered a report of the meeting on Sept. 26. Upon motion made and seconded, it was agreed to accept the proposition of the parent association to unite in the new organization. As this will involve certain changes in the by-laws of the Claim Agents' Association, it was decided to appoint a committee on by-laws to draw up such changes and provisions as will be required by the new plan. It was also decided to increase the number of officers so that the executive committee should be seven, to correspond with the other associations.

The regular business of the association was then taken up. Mr. Feeney, claim agent of the Public Service Corporation of New Jersey, spoke about the interesting articles on the subject of street railway fakirs which had appeared in recent numbers of "Pearson's Magazine." He said that these articles had been of considerable assistance to all street railway companies in enlightening the public as to the corrupt methods of this class of swindlers. He believed that it would be most appropriate if the association as a body should extend a vote of thanks to the publishers of the magazine for this service, and also to the author, Theodore Waters. This motion was seconded and carried.

Chauncey S. S. Miller, secretary and treasurer of the Casualty Company of America, then addressed the meeting. He referred to a movement which had been initiated last summer in New York to secure co-operative action on the part of all companies which had been swindled by fraudulent accident claims, and stated that a meeting was to be held next month in New York to consider the advisability of taking further steps to advance this cause. He invited the assistance and co-operation of the Claim Agents' Association. The subject was referred to the executive committee.

Two papers were then presented to the association upon accident claims, one by E. W. O'Connor, claim agent of the Savannah Electric Company, the other by James R. Pratt, claim agent of the United Railways & Electric Company, of Baltimore. These will be published next week.

The following officers were then elected: President, S. L. Rhoads, of Philadelphia; first vice-president, E. W. O'Connor, of Savannah; second vice-president, Henry G. Bradley, of Chicago; third vice-president, Andrew J. Farrell, of Buffalo; secretary and treasurer, B. B. Davis, of Columbus. Executive committee: the officers and William H. Renaud, Jr., of New Orleans; H. V. Drown, of Providence, and James R. Pratt, of Baltimore.

A vote of thanks was then extended to the Philadelphia Rapid Transit Company for courtesies extended during the convention, and the meeting then adjourned.

After the meeting the members were entertained at a banquet at the Bellevue-Stratford Hotel by the newly-elected president, Mr. Rhoads, of Philadelphia.

PROCEEDINGS AT THE PHILADELPHIA CONVENTIONS—I

PROCEEDINGS OF THE AMERICAN RAILWAY MECHANICAL & ELECTRICAL ASSOCIATION

MONDAY MORNING SESSION

The first meeting of the American Railway Mechanical & Electrical Association was called to order at 11 a. m. by President C. F. Baker, who introduced Hon. John Weaver, Mayor of Philadelphia.

Mayor Weaver.—It gives me very great pleasure as Mayor of Philadelphia to welcome you here to this convention. It seems to me that a convention of manufacturers and others who are interested in the carrying of the public must be of great interest and importance, and the results must be beneficial to the traveling public. We all know that you get some benefit from it from an economical standpoint, because the very best cars and the very best equipment of every kind is probably synonymous with the greatest economy. But what you and I suppose what every citizen in the United States is interested in is in having their welfare looked after, and I am quite sure that your meetings and the resulting exchange of views must result in great benefit to the traveling public. I do not know of any other organization that represents more closely the public of the United States. I suppose at some time or another the majority of all the men, women and children get into a trolley car, so that we can see that the majority of the American citizens are interested in electric cars and electric roads. The electric railway system is rapidly extending. Formerly we had the old horse cars on the streets. We now have electric cars, but they are not confined to the city; they go out from the city streets into the suburbs, and are even extending beyond the suburbs, because you have the great interurban roads that have been developed in the Middle West so successfully, and are now being developed so successfully here in the East. I have been told recently that a great many of the trunk steam railroads are thinking of putting in electrical equipment for carrying their local trade, and just what "local" means is a question, because the steam roads carry local trade for hundreds of miles.

I am very glad as executive of this city to welcome you, gentlemen, here to this convention. I trust you will have an exceedingly profitable time and a pleasant time, and if there is anything that the city of Philadelphia can do to make your stay more pleasant, I shall be very glad, as chief executive of this city, to do it. I welcome you in behalf of the citizens of Philadelphia. I give to you the freedom of the city—the keys are yours. Use them as you like, and after you are through with your convention I trust that when you leave here, wherever you go you will carry away with you some very pleasant recollections of this good old city of Philadelphia. (Applause.)

President Baker.—President Ely, of the American Street Railway Association, has kindly offered to give us a few remarks.

Hon. W. Caryl Ely.—I am sure we are all deeply indebted to Mayor Weaver for taking his time to come here this morning, and in behalf of the great city which he represents extending so beautifully as he has done its welcome and its freedom. About the key, of course, Mr. Mayor, we all understand that the key does not open up as much as it did awhile ago. (Laughter.) That is from what we read in the outside newspapers.

Mayor Weaver.—It opens the hearts of the citizens. (Applause.)

President Ely.—That is sufficient if it opened no more. Mayor Weaver is going to stay here, probably out of courtesy, while I deliver my remarks. I must, therefore, make them very short. In the first place, I wish to say, as president of the parent organization, that there has been a great deal of work done during the past year looking toward the closer affiliation and organization with the parent association, and the methods of work to be pursued by not only the parent association, but your organization and the others affiliated with the parent organization. What I wish to particularly impress upon your attention to-day is that there should be no misapprehension of the purpose of this move toward organization. It comes simply from the desire that there should be no unnecessary multiplication of organizations and to secure action by the existing organizations harmoniously and along well thought out and well developed lines. So the idea is that in some way, and in the way mapped and laid down, to get things together so that the lines of work to be pursued by the different organizations should be carefully thought out a year in advance, and that the investigation and the work devoted to the most important things that are involved in the street railway industry, should proceed in each organization so that it will supplement the work of the other. Particularly do I desire to impress upon you this fact, and it is a fact that may be absolutely relied upon, that there is not one in the parent organization, not one among these who desires in any way to do anything that will detract from the dignity of this organization of yours. You cannot be prouder of this organization than are the presidents of the companies and those who worked in the ranks of the parent organization. I could not more clearly illustrate my ideas upon the subject than to refer to the remarks of Mr. Beggs last year at St. Louis, when he was addressing your convention. His remarks present absolutely the ideas that animate the minds of those in the parent organization. Your work is of vast importance. As the Mayor said, probably at some time or another almost every man, woman and child in the country gets into and out of a trolley car, and the safety of that apparatus and the proper working of that apparatus and its adaptability for convenience and comfort are dependent upon the departments which you represent. Nothing could be more important than the apparatus which carries the people to collect the coin that makes the business go. Therefore, that method of work and that dignity of that organization, that autonomus organization which you have had up to now, no one intends to interfere with. The only thing is that we shall work together, and that the expenses attendant upon the running of the different organizations shall be paid at one time, to the end that the work does not fall into confusion, and that there may be no misunderstanding as to the value of the work and how much it costs. Upon that is determined what we may be able to do in these lines of work. So much has been said on this subject that probably nothing more is desirable from me at this time, but especially do I desire to emphasize the fact that no one wishes to interfere with the autonomy of your organization nor put a halter or bridle on it or curb it or ride it to death, or compel it to do anything which it does not desire of its own free will and volition to do. This matter will come up for action at these meetings that are to be held, and, therefore, it is greatly to be desired that each one here, each delegate, gives a careful reading to the proposed form of constitution and by-laws, and if there are any objections now is the time that they are to be heard. It is to be a square deal and a fair showdown all the way around. Nobody to be subdued, nobody is to be silenced, muffled or gagged, and we want everybody to talk, and out of that should come that which will be of immense benefit to these organizations, all of which are engaged in one work, although in different branches of it. I am glad to meet you all here again. Each convention is larger than the other; each convention brings some new faces, and I am happy to say many, many old ones. This work that has been done here by the Manufacturers' Association is simply superb. This exhibit, as one walks through it, reminds one of the finest departments of the largest expositions that have been held in this country. Nothing could be more beautiful, well arranged and adapted to inspection than the exhibits as they are arranged below. Where everyone pulls so true, to mention the names of individuals is invidious. All the members of the Manufacturers' Association, from the president down, have worked unremittingly for months, and to some of them has fallen a greater part of the work than to others. I have seen no evidence of shirking, but on the contrary everyone has stood forward to bear his full share. Not only is the Manufacturers' Association to be congratulated by us on the result that has been attained, but it seems to me that as it is one of the first accomplished results of the movement toward organization in our lines of work, it speaks well for the success and the desirability of the plan. I thank you, Mr. President, for the opportunity of saying these words, and I, in your behalf, extend to the Mayor your thanks and our thanks for his hearty welcome. (Applause.)

Daniel M. Brady, chairman of the Manufacturers' Association, spoke of his early association with mechanics and mechanical men and of his warm feeling for them. He welcomed the visiting members and spoke of the efforts to run the Manufacturers' Association on an equitable basis.

President Baker then read his address.

PRESIDENT'S ADDRESS

It affords me great pleasure at this, the third annual convention of our association, to extend to you all a hearty greeting. I note with keen satisfaction the goodly number of our members present; it certainly augurs well for the enthusiasm and success attendant upon our meetings. Since it seems desirable to dispense with the reading of the papers in order to give us an opportunity for a thorough discussion of the same, it hardly behooves me to take up much of your time with a long address.

We have found a cordial welcome extended to us here, and there is an atmosphere surrounding this historical "City of Brotherly Love," which should be conducive to a full attendance and effective work. It is my hope that this meeting will surpass the excellent record of the past, and that at its close we can congratulate ourselves upon its having been our best and most valuable convention. Although as an organization we are young, it has become a recognized fact, that our society has done and is doing much to increase the world's stock of useful knowledge in matters pertaining to electric railway operation and maintenance. The improvement shown each year may well indeed be a source of pride and pleasure to us, and it is to be hoped that our excellent progress may be continued. This can assuredly be brought about by earnest attention and free participation in the discussion of such subjects as may come before us.

The question of the reorganization of the parent association and its relations with our association has received considerable attention from the committee appointed for that purpose, and their proposed plans have been favorably commented upon by the technical press and the public at large. While the details of this change are as yet to be fully decided upon, the general plan will surely appeal to all of us as being for the best interests of all concerned.

The extension of the bounds of our association to admit of the inclusion of the members of the maintenance of way departments has greatly broadened the scope of this association, and will, I am sure, be of benefit not only to the association, but also to the individual members, whether they be of the mechanical, electrical, or maintenance of way department.

If I may digress for a few moments I would like to say a few words relative to my feelings when elected president of the association. In a society having a so widely extended membership as this it is impossible for the president to know, personally, very many of the members who may be in attendance at our meetings. This is a source of much embarrassment to the presiding officer, but is one which can be greatly lessened if each member, as the opportunity may offer, will present himself to the president, make his acquaintance and let him make his. This would apply with equal force to our secretary, whose very efficient work as the only permanent officer of our society and the one on whom the president has to depend in a great many ways, will be greatly enhanced by a large personal acquaintance of our members. It is the duty of each member to do all in his power to make such meeting a success socially, as well as an occasion of making and renewing acquaintances, for promoting good fellowship and for bringing out and distributing useful knowledge in their various departments.

One of the principal efforts of an executive officer of our railways and through him and his subordinates is to increase the difference between the cost of operation and revenue received. In this effort the departments represented by this association can, above all others, materially assist. There are numerous channels through which this may be accomplished; one of the most important, to my mind, is system and organization properly laid out and applied. Desired results may often be obtained and success in small matters made possible without the necessity of inaugurating anything that might be dignified with the term "system," as in such matters an officer would be able so to divide his time as to come in personal contact with much of the detail; but this can only be done where the organization is small, and where dependence must be placed on but few. In large companies covering considerable territory and employing many men, an executive officer is unable to go into much of the detail or have frequent personal contact with his men. In this case success in the management of property is absolutely dependent upon good organization and system. The larger the company the greater is the necessity for a proper and adequate organization, since the executive officer must depend to a greater extent upon his subordinates. Any system to be successful must clearly define the duties and measure of responsibility of each individual, so that if a failure occurs there will be no doubt as to who is to be looked to for an explanation and no difficulty in placing the responsibility. Lack of good system or absence of a good and reliable organization has caused many an executive officer to carry burdens and worries which might easily have been avoided, were the organization such that his subordinates could relieve him and thus enable the chief to devote more time to planning and systematizing his work. The details could then be more readily and satisfactorily carried out by his assistants, as scattered efforts are more often futile, and concentration is necessary for success in large matters. An organization and system of this kind is not brought about at a single stroke, but can only be the result of long and patient study of the conditions surrounding the department, the personnel of the men in the department, and the hearty cooperation of the subordinates upon whom the head of the department must depend for attention to the details. We have already taken a step in this direction in the report of the joint committee of the accountants' and our associations upon the standardizing of the blanks and forms used in these departments. That this can be continued to good advantage there is no doubt, but as local conditions vary so much it is extremely difficult, if not impossible, for any general system to be devised which will be applicable to all. We can only strive by earnest study and hard work to improve our organization and system of records and accounts in every conceivable way in order that we may approach as closely as possible the ideal. A quotation from "System" occurs to me as being particularly pertinent to this subject:

"No good system ever just happened; it was wrought out by the hammer of concentrated thought on the anvil of hard work."

This to my mind gives us the key note—concentration—and to admit of concentration it is necessary that the organization must be such as to permit of the details being taken care of by the subordinates, leaving the head of the department free for greater and more important matters I bespeak your careful thought and consideration of this matter, as I believe it well deserves the attention of each and every one of us, and to my mind can be easily made the means of a vast stride toward our goal

It is with a feeling of deep and sincere sorrow that I have to announce the heavy loss sustained by our association during the past year by the death of one of our most active and able members and officials, W. O. Mundy. Mr. Mundy was one of the original members of the organization, and, by his strenuous efforts, contributed very largely to the success of this society.

The high character of the papers and reports previously presented has been fully upheld in those to be presented this year. They are a credit to the association and also to the writers, and I sincerely trust that the discussion will be free and ample, that the greatest possible benefit may be derived from our convention.

E. W. Olds and Alfred Green made some remarks on the decease of W. O. Mundy, and deplored the loss to the association resulting from his death.

President Baker appointed a committee to draft suitable resolutions on the subject of Mr. Mundy's decease. The committee was composed of Mr. Olds and Mr. Green and one other to be selected by them.

Mr. Mower, secretary of the association, read the report of the executive committee, containing details of the management of the association during the past year. He also presented the report of the secretary and treasurer, in which was set forth that during the past year there has been added to the membership of the association 10 company members, 59 active members and 1 junior member, making at present 38 company members, 134 active members and 31 junior members. The New Orleans Railways, on account of passing into the hands of a receiver, lost its membership.

The financial report showed cash on hand Oct. 9, 1904, $403.55; dues received from company members, $760; from active members, $635; from junior members, $18, and miscellaneous resources, $30.98, making a total of $1,847.53. Expenditures: printing and stationery, $454; postage, $68; salaries, $500; annual convention, $109.25; expenses executive committee, $191; miscellaneous, $29.48, a total of $1,351.73; leaving a balance in bank of $495.80. There is outstanding on the books quite an amount from active members and junior members, and there is one company member owing the association at the present time. The bills payable amount to $100.04.

On motion, seconded and carried, the reports were accepted as read.

Mr. Adams, chairman of the committee on organization, said that Mr. Ely had outlined the principal thought in connection with that subject. In the plan submitted, the points that will affect this association are in relation to financial assisance. This organization is going to look to the parent association for support. This financial assistance, in the opinion of Mr. Adams, is one of the principal reasons for organizing. He also referred to the question of the printing of the reports of proceedings, which the parent association will take care of, and set forth the desirability of closer relations between the associations.

In answer to a question by Mr. Green as to whether this association will elect its members as usual, President Baker said that is for this association to determine. It would make its own constitution and by-laws, and this would be left largely the same as now, with possibly a change in the name. He further said it had been suggested to call it the American Street Railway Engineering Association.

Mr. Green expressed the opinion that the constitution of this association as it now stands should not be changed, in reply to which Mr. Adams said he thought the constitution could be kept virtually on the same lines.

Mr. Olds, of Milwaukee, said that under the proposed plan the membership of this association would not be restricted to the

companies who may belong to the parent association, but that the individuality of this association would be retained. He expressed the idea that the wish was to work absolutely in harmony with the parent association.

Mr. McCulloch, of St. Louis, said it was not the intention in the plans suggested to diminish the authority or standing or prestige of the subsidiary organization. In regard to the membership, he said that the members were to be the railway companies themselves, and also such associate members as should be elected, and that there was no reason why anyone interested, or who had formerly been interested, in street railway business should not become a member of the association and have all the privileges of membership, except voting and holding office.

Mr. Simmons commented upon the remarks of the Hon. W. Caryl Ely, expressing the thought that they should wipe out all feeling of any desire to curb these associations in their power to do good. Mr. Simmons also spoke of the amount to be subscribed for the partial support of this organization by the main association, which can only be determined as events proceed. He said that the scheme of raising funds is to have each company pay in proportion to its gross receipts, as the larger companies are going to derive far greater benefit than the smaller ones, the large company having at present a dozen different men representing different departments, while the small company will have but one man present.

W. E. Harrington moved that the subject matter under discussion be placed in the hands of the executive committee. This was seconded and carried.

A recess was then declared.

MONDAY AFTERNOON SESSION

President Baker called the convention to order at 1 o'clock.

Charles Hewitt, engineer of the Philadelphia Rapid Transit Company, extended an invitation to the delegates to visit the power houses and stations of the company, and mentioned that perhaps the most interesting station, on account of the newness of the installation of turbines and the high-tension alternating current, would be the Second and Wyoming Streets stations in the lower part of the city.

C. H. Hile, superintendent of wires, Boston Elevated Railway Company, presented his paper on "Power Distribution." (This paper will be found on page 560.)

L. P. Crecelius, of St. Louis, asked Mr. Hile about his experience with lightning trouble at terminal points, where the overhead feeders joined on to the underground feeders, and what scheme, if any, he had for protection at such points. He said that was one of the weak points in connection with the cable overhead construction. He asked particularly whether Mr. Hile used lightning arresters to avoid electrolysis in the cable.

Mr. Hile replied that they had installed on every cable two lightning arresters, one at the station end and one at the terminal end, wherever there is a terminal. Where the current comes in on the overhead wire they install a lightning arrester, and their experience had been that they had very little trouble. He could only recall three instances in which it was believed that the underground cable was injured due to lightning; whether it was owing to the good fortune of having the lightning arresters in use or not he could not say. Some extra lightning arresters were also installed on the terminal poles. On iron poles it was the practice to make the ground connection by running an insulated wire to the track system down the iron pole.

Mr. Crecelius thought that there would be some trouble from induction in this practice. He also inquired how Mr. Hile connected his equalizers, and whether the circuit breakers acted automatically in case of trouble on any particular section.

Mr. Hile replied that the circuit breakers acted automatically at the power station only, that the feeder system or section might include one feeder or a half dozen feeders, depending on the size of the section, and if it happens to be a feeder section, fed from more than one station, it meant more cables in that section, and the company depended on circuit breakers to cut-out at the station to protect that section. They do not always do it, however, In that case, if the section is badly disabled, the first thing to do is to clear the section, which can quickly be cut dead at the power station, and get the crew on the ground, jump in with the other section and throw out the feeders which were disabled.

Mr. Crecelius remarked that in order to accomplish that, it would be necessary to have a good system of communication and a good record of locations so that the repair crew could know where to cut-out.

Mr. Hile answered that the company had complete plans which showed every detail of location. Copies of these plans are kept at the power station, at the headquarters of the operating department, and at the headquarters of the department having charge of wires and conduits. An attendant is also kept constantly at the telephone. In case of trouble the crews are directed to go to the point of trouble and cut out the injured cable. The cables are identified by numbers so that the company does not depend wholly on the knowledge of the crew, although the crew is supposed to know. The records which are kept show that the crew was called to throw such a switch and cut out such a cable; it reports back so that a complete record is kept of everything that it does.

H. H. Adams, of Baltimore, asked Mr. Hile what he considered was a good distance for the installation of lightning arresters on overhead construction.

Mr. Hile replied that he could not answer the question off-hand, as much depended on local conditions. In hilly districts he would advocate a lightning arrester about every mile, or three-quarters of a mile. In certain districts of the country, especially in the West, where lightning is a pretty serious consideration, he considered the use of lightning arresters as very important. He considered that the character of the country and the location had a great deal to do with the question, and that no definite rule could be laid down.

Mr. Adams agreed with the previous speaker, that the desirable location of lightning arresters was largely a question of local study. He said that for the past three years he had kept a record of his equipment that had been injured by lightning, and had inserted a pin on a map of the system at such points. He had found that crossings and at corners there is more likelihood of trouble from lightning than at other places.

Mr. Crecelius stated that he had serious doubts about the performance of lightning arresters without a well-grounded wire. He believed that it would be desirable to use wooden poles at terminals, to avoid the inductive resistance introduced by iron poles.

Mr. Hile replied that he thought this suggestion was a good one, where there was much trouble with lightning. He believed good results would also follow from a good earth ground independent of the system.

Mr. Adams referred to a particular case bearing on this question, from his experience during the past spring. He said his company had a line which ran out into the country, and on which there was considerable trouble from lightning. They went over the grounds, and where they had track grounds they put in a good ground plate and doubled the number of arresters and very materially reduced the trouble. In other words, it seemed to be a question of more arresters, but that line was equipped with wooden poles.

E. A. Sturgis, of Worcester, said that his company had had a good deal of trouble with lightning, and had overcome it by forming underground connections and putting in more arresters. He asked Mr. Hile for particulars in regard to the changing load at the Boston power stations. As he understood it, the load swings from one station to another by a variation in voltage.

Mr. Hile replied that technically that was so. A heavy load on one station tends to lower the voltage of that station, and the other stations get all the benefit of the high voltage and ease up the pull on that station, even though having the heavier load.

Mr. Hanna asked Mr. Hile his experience in regard to cement-lined conduits, in which he said he was much interested.

Mr. Hile replied that his company had some 76 miles of cement-lined iron pipe ducts, although it had not laid any cement-lined iron pipe conduits since 1895, and is not contemplating laying any more. He could not say that these pipes have ever injured the cables. The main objection he always felt to them was the fact in the case of any cable trouble, the cement-lined conduit seemed to distribute the trouble widely on account of the iron rings and the iron casing of the pipe.

Mr. Hanna replied that for some time he had tried to discover some way of using cement-lined conduits so as to avoid the burning of the cables. They found that the cement-lined conduit undoubtedly damaged the cable. They had requested some chemists to examine the pipes and cable about two years ago. These chemists had not yet made a report, but they had found enough to know that not only does a cement-lined pipe greatly increase electrolytic troubles but there is also an actual chemical action on the lead, due to the cement, which is strongly alkaline. He had hoped that some way had been found of putting a covering on the lead sheath, or something of that nature to keep the cables from coming in contact with the cement. Their principal trouble had been in parts of the city where the drainage had not been very good.

Mr. Charles Hewitt said that in Philadelphia practically the lines are tied together with heavy copper cables, which connect one-half of the stations without any reference to the feeder sections. If the tie lines are connected into the bus-bars on two stations which are near together, one station will cut out inside

of 5 minutes. Stations 10 miles apart will work perfectly on a tie line, as the point of greatest drop will travel up and down the cable, depending on the load created by the cars, but with stations near together, say a mile or 2 miles distant from each other, a tie line connecting the bus-bars together would probably be impossible.

Mr. Hile remarked that his company had stations tied together, but that the ties connect into the feeder sections. This keeps the voltage adjusted, and no trouble has been experienced from bucking, except in cases where there was a bad ground in one station, which would throw the other station out.

Hugh Hazelton asked if Mr. Hile could give any information in regard to the amount of amperes carried on a cable of any given size.

Mr. Hile replied that ordinarily he would expect a 500,000-circ. mil cable to carry continuously about 500 amps. or 600 amps.; a 1,000,000-circ. mil cable about 900 amps. or 1000 amps., and a 2,000,000-circ. mil cable about 1600 amps. or 170 amps. The average load on his company's copper would perhaps not equal 200 amps. for 500,000 circ. mil, and while the momentary loads would run pretty high, they were not sufficient to give any serious trouble. The copper was laid out more with respect to the voltage drop than to the current-carrying capacity.

In reply to another inquiry in regard to iron pipe conduits and the precautions taken to prevent electrolysis and arcing from the lead sheath to the iron pipe, Mr. Hile said that his company had considerable 3-in. iron pipe, which was used as connections to the poles, and that iron pipe was also used to cross bridges and at certain places in the street. In those cases where there was trouble on the cable creating electrolytic conditions, it was customary to cut the lead and insulate it. He described in detail the company's practice of dividing the lead sheath into insulated sections, and said that he could not recall an instance where a cable breakdown had resulted from this cutting.

Hartley Le H. Smith then referred to the point brought out earlier in the discussion with reference to tying stations together. He thought that the success of this practice depended upon the extent of the compounding used. If the series winding was strong enough, the station would not operate that way. If, however, the series winding helps to hold the electromotive force up, but is not strong enough actually to raise it, as the load becomes heavier the station will operate smoothly. For this reason he did not recommend considerable compounding.

Paul Winsor, of Boston, said that their machine characteristics are practically flat, the machines being compounded for a rise of potential. With a large distance between installations there was no trouble. He thought it possible to over-compound when the distance between stations was considerable, so that the drop in voltage from the stations was large. His company is running two stations within 200 ft. of each other, all one station, but with the machinery in different buildings, and he did not know of any case where the machines are as close to each other running that way, and he did not have any trouble.

H. Le H. Smith thought that if machines are so adjusted that they will simply hold their electromotive-force without raising it or lowering it with the alteration of the load, and if the stations are near each other they are in a state of unstable equilibrium, or near it. On the other hand, if the distance between the stations is reasonably large, then it amounts to about the same thing as if the machines had a drooping characteristic.

Mr. Hewitt inquired if the machines referred to by Mr. Winsor were not practically shunt machines with the compound wiring practically cut out.

Mr. Winsor answered that they were not; that one station had direct-current machines, and that all are compounded and running practically flat. The other station contains 1000 to 1200-kw direct-connected to 15 units, and they are all compounded the same way.

Mr. Hewitt remarked that the machines in use by his company are compounded by about 50 to 75 volts, and they maintain practically a flat voltage line. He thought the question of these tie-lines without taps was simply a question of drop. If two stations are tied together with sufficiently large copper, and these stations are compounded, no matter whether they maintain the flat line or not, the stations will buck. He did not see how it is possible to prevent it, unless the drop in the tie-line is sufficiently great so that the point of greatest drop will never reach the bus-bar, but run along the line.

After some further discussion on this point President Baker announced that the next paper to be discussed was on "Power Station Load Factors."

L. P. Crecelius, chief electrician, The United Railways Company, St. Louis, then read his paper on "The Power Station Load Factor as a Factor in the Cost of Operation." This paper will be found on page 563 of this issue.

H. Le H. Smith said he thought the subject of the load factor at stations had not received sufficient consideration, that it was to a considerable extent neglected absolutely, and yet it was one that was most intimately concerned in the efficiency of the station operation. The load factor before the meeting was the ratio of the average load to the maximum load; he did not think that to be the ratio most significant in showing the efficiency of the station. In his opinion the ratio between the actual load which the machines have had to the load they would have had if they operated at the rated load has the greater influence in the station operation. It is not realized, either, to what an extent that ratio alters. This ratio shows the average steam consumption of the engine, a thing that is usually neglected very largely; it also shows the electrical losses in the machine, although these are rather insignificant.

Mr. Crecelius remarked that the establishment of a new definition for load factor was a subject that he could not say much about. In his paper he had considered the load factor as the ratio between the average and the maximum load.

Charles Hewitt stated that in Philadelphia they had six storage batteries, five of them being located in sub-stations and used for facilitating the distribution of the load and for steadying the load, that is, for obtaining regulation. The sixth battery is connected directly with one of the stations. He could not give in percentage the load factor of the stations in Philadelphia, but thought it was about 70 to 75 per cent, that is the average of the various stations. They had a practice in Philadelphia of maintaining a full load on every engine throughout the day, by means of the tie-lines which have been referred to, but they transpose the load from one station to another during the day. In that way, no matter what time of day it may be, or what the load may be, the engines which are running are running at practically their most economical load. The storage batteries no doubt assist very greatly in accomplishing that, and the effect of the batteries is very strongly noticeable in the operation of the station. He thought the merits of the storage battery lay more in assisting to maintain a good load factor, and in making it possible to transpose the load from one station to another, than in reducing directly the cost of production per kw-hour.

Richard McCulloch, of St. Louis, called attention to a difference in the two papers. In Mr. Hile's paper the load factor is based on a period of operation of 18 hours, while in Mr. Crecelius' paper the load factor is figured over a period of 24 hours.

Mr. Smith referred again to the relation between the two load factors which had been mentioned. He said that the ratio of the average load to the maximum is a measure of extent to which the machines are standing idle in the stations. It also has a relation to the labor item and is really an index of how often the engines are run. The other load factor is a measure of how economically the engines are working when they are running.

G. S. Lawler, superintendent of the power distribution of the Boston Elevated Company, in a written communication, said that the load factor of a system varies with the system and depends to a great extent upon the habits of the people served by it. The cost of operation is greatly affected by the load factor, and when a comparison is made of the cost of operation of two railway systems, it is essential that the load factor on which each is run should be known; also whether this load factor was obtained by the use of a storage battery. If so, the efficiencies of the battery should be taken into consideration. However, knowing the load factor does not always tell the whole story, as the momentary fluctuations may also have considerable effect. Therefore, unless the characteristics of the system are known they cannot fairly be compared. The methods of raising the load factor in the larger stations as used by Mr. Crecelius is the one used by Mr. Lawler. He had not been fortunate enough to be able to obtain corresponding figures for his system which show results as clearly as do those given by Mr. Crecelius, although his figures tend the same way. That was due to the fact that the load factor varies with the time of the year, and they make most of their repairs not when the wear and tear is the greatest, but when the load is light, that is, during the summer. Therefore, the maintenance account is light when the load is heavy and heavy when the loads are light. On this account their total expenses may not vary with the load factor, and the results of the various methods of operation are somewhat concealed. Of course when one station out of a number is shut down, the transmission losses of the district fed by this station are increased, and unless there is considerable difference in the economy of that station over the remainder, they must be careful that the increased transmission losses are not greater than this difference. Again, these transmission losses are not the only ones to be considered, because there are also the stand-by losses and the losses due to cooling down and starting up fires again for the station taken out of service. Where it is necessary to use the auxiliary stations for morning and evening, the losses may be considerable, but if the

station is only operated during the evening peak, these stand-by losses may become of less account. These stand-by losses plus the increased transmission losses may amount to considerable, and the real saving by this method of operation may not be as great as would be apparent at first sight. One thing that would favor the keeping in service at reduced load of the auxiliary station, would be its value in an emergency, for it would be immediately available to carry an increased load. This applies to fairly modern machinery, and not to antiquated machinery, which is very frequently found in systems which are the results of gradual growth. The old machinery should be run as little as possible, and therefore only during the peak loads. In this case, as it may be considered very cheap machinery, the fixed charges are small, and as it only runs for a few hours, its efficiency while running would not be very important. Again, where there are a number of units in a station, and a number of stations are used on the system, the cost of operation is not so dependent on the load factor as where only a few units are in use, for it is fairly easy to keep all machines in service during light hours loaded up economically by shutting down as occasion requires, and banking unrequired boilers. The machinery remaining in service will be running just or almost as economically as during the heavier loads. In this case the thing that varies most with the load factor is the cost of labor, and as the amount of labor during the day shifts is fixed by the peak loads, this amount would be nearly a constant no matter what the choice between the two methods. While it was important in order to keep down the cost of operation to watch closely each piece of apparatus, that it may operate efficiently, he believed that the method of operation of the stations is equally as important and may mean considerable to the yearly operation expense account.

After further discussion on this subject and also upon the different methods of employing storage batteries, the president announced that the association would now consider the report on controlling apparatus.

CONTROLLING APPARATUS

J. S. Doyle, superintendent of equipment, Interborough Rapid Transit Company, New York, chairman of the committee on "Controlling Apparatus," then presented his report on this subject. This report will be found beginning on page 565 in this issue.

Paul Winsor stated that the Boston Elevated Railway Company had put on 40 surface cars with multiple control, but that was done temporarily because the company found that the platform controller was not large enough to handle the cars.

E. W. Olds, of Milwaukee, said that his company was having constructed at the present time 50 controller equipments which were especially designed to take care of the large amount of current required in a four-motor equipment. It was proposed to use one of the K-types of controllers with two contactors in the circuit, the idea being that the controller contacts will be made before the closing of the main contactor system. By this method the main circuit is opened and closed underneath the car so that no case of short circuit can occur in the controller. He had found that most of the so-called controller accidents are caused not by the failure of the controller, but by some short circuit in the other apparatus which causes so great a flow of current that the ordinary cylinder controller will not break the arc. The wiring of this new Milwaukee controller is such that one side of the armature will be always positive, and the reversing is done in the fields. By this method it is possible to protect each motor with its own individual fuse, so that should a short circuit occur in the motor or in the wiring the individual fuse of that motor would blow, cutting out the motor.

Mr. Olds referred to the fact that Mr. Case, of the General Electric Company, was familiar with the new type of controller.

F. E. Case said that practically the only thing he could add was that it is merely a partial step in the right direction, as he believed that full contactor control, with the apparatus all located under the car, is the proper method. In the process of getting at it gradually the placing of the principal contactors under the car is the right thing to do, and that ultimately the railway men would look at it in that light. He thought it a proper thing, perhaps, to get at it gradually, as this plan would be more convincing than to go at it hurriedly. In the event of a mistake having been made, which he considered improbable, it would be easy to dissociate the two parts and go back to the plain cylinder control by merely omitting the additional contact.

W. D. Wright thought that they were all agreed that the removal of the controller from the front platform was a desirable step. Last summer his road had considerable controller trouble on the open cars. This year there had not been as much, and as an experiment they had two open cars running, on which the controllers had been swung around outside the dash. That gave more clearance on the platform. The motorman handled the apparatus in the new position about as well as in the old position. Putting the controller outside the dash necessitated building the bumpers out a little. He asked Mr. Olds if the fuses he spoke of are in a position where it can be readily ascertained if they blow, and what type of fuse he used.

Mr. Olds remarked that they had decided to adopt the enclosed fuse, which is on the no-arc principle, and that they are placed underneath the center of the car in a box by themselves. He anticipated very little trouble in locating a blown fuse. The fuses they are using are of sufficient capacity so that they will not blow on an ordinary overload; it would take a short circuit to blow them, and the circuit breaker or main fuse will take care of the overload.

Mr. Pevear, of the General Electric Company, in reply to a question, said that the controllers described by Mr. Olds will be exactly like the ordinary K-type controller, except in the fact of its altered position.

Mr. Olds remarked that the method they are putting in is to be used only on the city equipment with four 40-hp motors. On their interurban equipment they use the type M controller. On the city equipment they use the K-28 type of controlled, modified to meet the changed conditions.

George H. Hill, of the General Electric Company, said that the difficulty with a cylinder controller was not due to its improper design for the duty which it has heretofore been called upon to perform, but to an increase in the severity of the conditions. These conditions have approached gradually, and to them has been added the further objection of lack of space under the car which has made it difficult to produce a satisfactory small multiple control equipment. The size of cars on city lines is gradually increasing and that will help matters out. The problem of furnishing full multiple unit equipment for double-truck cars in city service is feasible.

Mr. Doyle, of New York, remarked that the maintenance cost was in favor of the multiple unit system.

R. C. Taylor, of Brooklyn, thought that in the discussion of the controller question one of the principal factors was overlooked—the multiple unit control was being mixed up with the drum control. The multiple unit controller, however, could be a drum control, or contactor, or any other form, provided it is big enough to do the work. All that was the matter with the controller at the present time is that it is not big enough for the work. He thought the operating men who are in charge of the equipment should create a demand for a good controller, and it would be supplied. He believed the controller should be put under the car.

Edward Taylor, of Brooklyn, stated that his company had built and was operating in Brooklyn a new form of multiple-unit control. The main thing in designing this controller was to make it simple and yet effective. The main principle of the apparatus was a simple solenoid which is operated by a rapid switch, which notched the controller up a step at a time. The rapidity of this movement was effected by a throttling device or limit set at any predetermined point. In connection with the controller the circuit breaker was operated automatically, as was also the air-brake equipment, thus making an automatic air out of the straight-air system. The point borne in mind in designing this control system was to have the normal position safety, so that in case any connections were broken, or any of the circuits interrupted the apparatus would go to the stop position. All parts were released by springs or by gravity, not depending on electric circuits. For instance, if the car should be running along with the controller on and the brakes off, and the pole came off, the controller would be turned off, the circuit breaker would open, and brakes would be applied. An original device was also used in connection with the operation of the magnets. Heavy currents were used at the start to insure a strong pull on them. Later, when the magnets were in operation, high resistance was automatically put in circuit, which reduced the running current to as low as one-tenth of an ampere on the entire apparatus. A special feature of a controller of this sort was that cars could be run singly in the city or in congested districts and could be operated together over the suburban lines. By placing a control apparatus on the trailers it was possible to operate the train from the trailer or motor car. This avoided the necessity of shifting the motor car to the head of the train at the end of the line. The experimental apparatus had cost considerable to construct, nevertheless the company estimates that if it was building a large quantity, this controller could be built with the money that would be realized by taking off the other apparatus and the less amount of wiring which would be used.

Mr. Olds stated that as he understood it, this K-11 controller was placed under the car, on a two-motor equipment. He thought that the work was along the right lines. Such a controller must necessarily reduce the number of parts and consequently reduce the expense, and he believed that the apparatus as described had considerable merit.

On motion of Mr. Olds a vote of thanks was passed to the authors of the papers presented, after which the meeting adjourned.

TUESDAY MORNING SESSION

On Tuesday morning F. G. Simmons, of Milwaukee, chairman of the committee on way matters, read a brief synopsis of his report, with conclusions. W. Boardman Reed, of New York, opened the discussion. He reviewed the troubles that have been experienced with all types of joints since the first tramway days. He thought enlarging the surface of contact under the head of the rail and under the base of the rail would, if it were practicable, in a large measure overcome the difficulty, but to get this increased surface, as is shown in one of the papers, is not practicable unless both the joint-plates and the rails are machined to a perfect fit. The day of the ordinary joint-plates, therefore, it seemed to him, was about past.

A peculiar trouble had been experienced with the joints and the rails on surface lines in the borough of Manhattan. The rails on these lines were laid on cast-iron yokes, perfectly rigid, in lieu of ties, the yokes being spaced 5 ft. between centers, and the ends of the rails or joints supported on the yokes. Nine-inch girder rails, 107 lbs. per yard, with 36-in., 12-hole angle-bar joint-plates, were used. At joints which were hardly loose enough to be noticeable, there was a fracture of the head of the rail, the break beginning about 2 ins. from the joint, at the gage line, and extending diagonally across the head for a distance of from 12 ins. to 18 ins. One theory of the cause of this trouble is that the joint became slightly loosened and the hammer blow of the wheel pounding upon the head of the rail finally causes a fatigue of the metal, so that it gives way at the point of least resistance. It was first thought that this was due to extreme brittleness of rails. That this contributed in a large measure, he had no doubt, but, at the same time, analyses of the sections broken off did not show any great amount of segregation of elements or any great excess in either manganese or carbon.

Joint-plates that support the rail by the base as well as the head, overcome, in a large measure, many of our troubles, and could these plates be made to fit the rail accurately there would, he believed, be no further trouble with joints.

But, in his opinion, success cannot be obtained as long as dependence is placed on the supporting of the rail by contact of surfaces which resemble sandpaper. There is always sufficient motion to finally wear off the sand.

Rail manufacturers have done much to lessen our troubles by increasing the length of rails from 30 ft. to 55 ft. or 60 ft., but they can do little more in this direction. The limit of length has been about reached, not only on account of the difficulty of handling in the mills, but also on account of the difficulty in handling on the street. He believed, therefore, that it behooved the construction engineer to follow on along the same lines as the rail mill, and if the rail cannot be made longer before it is in place, lengthen it by welding the ends of the rails together.

Good results have been obtained in the welding of rails, or the making of continuous rails, by electric welding and by the so-called cast-iron weld. The most serious objection to either of these processes is the amount of machinery required. Though either process is practicable on large jobs, neither of them would be practicable on small jobs, for the expense of getting the plant in operation would be prohibitive.

Thermit welding has been recently introduced into this country, and would seem to offer many advantages. The process is so simple that any track gang can do the work, and, as stated in one of the papers, all the necessary tools and even the material for several joints could be carried in one wheelbarrow. The expense is rather high, but any road that could afford to use a solid roadbed and 107-lb. rail could afford, he believed, to pay $5 or $6 a piece for perfect joints.

The objection is made to welded-joints that in case of changes in the track layout the joints can only be cut out. Of course, this means the loss of the joints, but he could not see that it meant anything else, for rarely, in the case of a new layout, are we able to make the new work fit to the existing joints. This objection, therefore, would not appear to be very material.

He was not familiar with Nichols joint, but it would appear, from what he had seen of it, to have some very excellent points. The sand surface mentioned before is covered over and a greater bearing surface is given both under the head, on the top of the base and under the base of the rail. The riveting should hold the plates in place. We know, however, that there is a certain amount of shrinkage in spelter. Would this not tend to leave some space, and consequent looseness, between the joint-plate and the rail? Would the spelter resist the hammering pressure, especially when not confined? Spelter is used with success for the bedding of wearing plates, but in this case it is confined by caulking where exposed, and even then the wearing plates do get loose. It is considered good practice, when using spelter between two surfaces, to bring these surfaces together, either by bolts or wedges, immediately after the cooling of the spelter. The machinery necessary for the Nichols joint, for sand blasting, reaming, riveting and pouring of the spelter, is almost as formidable as that used for either the cast-iron or electric weld, and this, it would seem, would militate against its general adoption, except, possibly, again, on large jobs.

Cast-welding has been used longer than either of the other methods. If the rail is properly treated, previous to the pouring of the metal, and the welding is done with the atmosphere at the proper temperature and when there is not too much humidity, and if the cast metal is of the proper mixture and poured at the proper temperature, good results are obtained, but it seems quite difficult to have all of these conditions favorable. As a result, there is a considerable proportion, oftentimes, of failures of cast-welded joints.

Electric welding has certainly given magnificent results in many places where it has been tried. Buffalo offers one of the best examples of this method of rail fastening, and were it not for the cumbersomeness of the machinery necessary, he knew of no better method for the treatment of joints.

He was one of the first to weld joints commercially with thermit in this country, but, unfortunately, in neither of the places where thermit welding was done was the construction such as to give it a fair trial. In the first place, the yoke spacing is about 5 ft. centers. On one line, where 7-in. rail, 107 lbs. per yard, is used, the joints are suspended, so that had it not been for the fact that a line of ducts was laid underneath the end of the yokes and extending to within about 4 ins. of the base of the rail, there would have been an excellent opportunity for a fair trial of the thermit weld, but this small space between the base of the rail and the top of the duct line prevented proper access to the molds, and in a large proportion of cases the molds were evidently not properly applied or properly luted, so that there was a loss of more or less metal when the joint was poured. Something like fifty portions of thermit were used. In some four or five cases there was a failure owing to the inexperience of the workmen and proper care not having been taken in the luting, and, in one or two of these instances, in consequence of the molds not having been properly made. These failed joints were repoured, and at the end of the work forty-five joints were left in what was supposed to be good condition. This work was done in about July, 1904. All of the forty-five joints held until some time early in the spring of 1905, when there seemed to be several failures. With the coming of warm weather more failures developed, so that out of the forty-five joints there were about thirty-six good ones. Pieces were cut out where the joints had failed and examination made of the failed joints. It was found in each case that the defective joint had been caused by improper handling of the material or tools. In some instances the metal had been lost, so that the thermit only came an inch or two above the base of the rail. In other cases there was no adhesion between the thermit and the rail, showing that the rail had been improperly cleaned or not properly dried. Of the thirty-six joints that were intact in April, 1905, all are at date of writing in good condition. The result, though somewhat discouraging, was still sufficiently satisfactory to warrant him in recommending that thermit welding be used on about 5 miles of track that is now being constructed in the borough of Manhattan. This being new construction, the rail is exposed and there is every opportunity to properly apply the molds.

The second experiment made by him in 1904 was made under such conditions that he had little confidence that it would be a success, and yet the thermit people were anxious to make a trial. In this case the rail was 9-in. girder rail, 107 lbs. per yard, laid on yokes, with the joints supported. It was therefore impossible to get any metal whatever underneath the base of the rail. The mold was so made as to cover the top of the base of the rail and the web up to the head. This did not leave sufficient metal of the rail itself connected to withstand the strain, and as a result the rails broke on the web.

Mr. Winsor, of Boston, asked Mr. Reed whether there had been any bad effects from the heat on the head of the rail.

Mr. Reed replied that there had not. It gets to a very low cherry heat. Cars had been operating on one minute and a half to two-minute headway, a little over a year, and it would be difficult to find some of the joints.

Mr. Clark asked Mr. Simmons what the percentage of poor joints was in cast-welding.

Mr. Simmons said they had one company, now out of existence, that did very poor work. They had a loss probably of 3 per cent on their work. Another company, which they considered the best cast-welding company in the market, did the major portion of their joints, and on these they have had a loss approximating 1½ per cent to 2 per cent. For the past three years they have owned their

own apparatus, and welded all their own joints, possibly 10,000 in the three years. They have not lost one joint nor had one bad joint out of these 10,000.

Charles H. Clark, of Cleveland, said they had a company cast-weld for them on a 6-in. rail, and out of about 350 joints, the next spring they knocked off fifty-two of them and welded them with electricity.

Mr. Simmons said possibly there were adverse conditions—a poor foreman or poor workmen. He had never had such experience.

H. M. Sloan, of Chicago, said he was a great advocate of a cast-weld. He thought he had cast for less than 2 cents a pound on a 6-in. rail with 85 lbs. of metal. He had cast at a cost of $1.17 per joint, but could not always do this. In estimating the cost of a cast-joint they always figured $2, but it rarely cost over $1.60 for a 7-in. rail with 100 lbs. of metal.

Mr. Voynow, of Philadelphia, called attention to the fact that if you take the weight of the rail, multiply it by two, and add 10 per cent, you get the weight of the cast iron that it is necessary to use in order to get a cast-welded joint.

Mr. Simmons, in making a cast-weld joint, figures 75 per cent of good pig iron and 25 per cent of soft scrap.

Mr. Sloan said there was one thing he possibly omitted in the cost of a cast-welding. His road being a small proposition, he was able to make temporary cross-overs and work in day time. He had cast with twenty men 185 joints a day. As to going along at night with a wagon and casting a few joints, that was impracticable. With this first weld he spoke of, where they poured the metal on either side and depended on a union of the metal to hold the joint, he discovered no amalgamation above the joint holes. When they changed to the next method he designed the mold to extend over a space only 4 ins. long at the top, or just sufficient to take in the bolt holes that were put there to help hold the joint.

Mr. Clark, of Cleveland, said there were 2000 joints in Cleveland welded with a cast-joint. He did not believe there was one good one left now.

Mr. Reed said there was in the borough of Manhattan a considerable amount of 7-in. 108-lb. rail welded with cast iron. They had some 9-in. 107-lb. to 109-lb. rail welded with cast iron. Generally speaking, they have had good results. The work was done, part of it, in 1899 to 1901. A 7-in. rail on Third Avenue under the elevated structure, where the work was evidently done under good atmospheric conditions, gave excellent results. The 9-in. rail on the so-called Boulevard on the Amsterdam Avenue line they have not had as good results with, but he should say far better than the average results. He did not believe there were now 5 per cent of the joints that were welded at that time but that were in good condition. A lot of old 7-in. rails, very nearly worn out in 1899 and 1900, welded with cast iron went to pieces. Regarding the price, they made a contract to do that work. He did not recollect the exact figures, but somewhere between $4.50 and $5 a joint. Perhaps in Cleveland, they welded an old rail instead of new. He thought it would make a great deal of difference.

A. W. Pratt said, in reference to cast-weld joints, in the city of Newark some 15,000 or 20,000 joints have been welded on that system. Out of that number he did not think there were very many that were bad. Some of that work was done on new track and some on old rail. They cast-welded some old 4½-in. rail some thirteen years ago, and it was taken up this last summer. On Market Street, in the center of the city, from the Pennsylvania Depot to the foot of the Court House hill, they cast-welded Trilby rail that they put down new, and one could not see where the joints were. In reference to the cost of the joints when they cast about three years ago, the cost ran from $3.23 to $3.48, not allowing anything for maintenance. That is the mere cost of labor and material on a 7-in. joint. In reference to the shrinkage of the spelter in a zinc joint, and also the flowing of the metal, he would like to ask if any experiments have been made to determine whether anything of that nature existed. It appealed to him as being the most perfect joint in railway practice.

Mr. Voynow said there was quite a dispute among not only practical engineers, but many scientists, whether zinc shrinks or expands after cooling. Some experiments on the zinc castings seemed to show sometimes a casting would shrink and sometimes it would slightly expand. That experiment is a delicate and complicated one. It is not as easy as it looks. As to the flowing out under hammering, the hammering can occur only between the rail and the metal when there is a space left. When there is no space left between the metal and the rail, hammering cannot occur. These joints have been in some streets in the ground for the last four and a half years, and he had not noticed any difference from their condition when they were put in. There were two breaks in the rail, and these occurred on account of a flaw. He thought the impression should be corrected with reference to the cost of closing and opening of the street. It had been mentioned in the paper that it costs $1 to open and close a street. That is not so. Opening and closing some streets may cost that, but it depends on how the street is paved and how the ties are placed. Sometimes the cost will run up to $10 or $12. In Philadelphia they had cast-welded joints and were making new cast-welded joints for rails that were past repair. Where they cannot repair the joints, they are cast-welding them, and it seems that for such a condition cast-welding is almost the ideal process. The cost per joint is approximately what Mr. Simmons had stated in his paper. Of course, under some conditions it runs higher.

J. M. Larned, of Pittsburg, reported 5000 cast-welded joints in Pittsburg that have been cast-welded for two or three years. It cost $4 a joint. It was a 9-in. rail that was cast-welded. The total cost of the joint ran up in asphalted streets to about $10. The average cost was about $7. They had as many as 100 men at work, and thought eighty joints was a pretty good day's work.

Mr. Sloan thought paving ought not to enter into the cost of any joint, because pavements differ so.

E. Stütz, of the Goldschmidt Thermit Company, pointed out that welding portions for a 5-in. rail would cost considerably less than for a 9-in. rail. In the report the conclusion was based on a comparison between a 9-in. rail, in Mr. Pellissier's paper, and the price for the cast-welding as he understood it of a 5-in. rail. On a 5-in. steel rail it would cost about $3.30 for the thermit part. The outfit is extremely simple and inexpensive.

Mr. Clark, of Cleveland, told of the thermit welding of from 2000 to 2500 joints on his track this year, and gave interesting particulars of the methods used there in doing this work on a large scale.

H. F. A. Kleinschmidt, superintendent of electric welding for the Lorain Steel Company, upon invitation spoke a little on that process, saying in part: "There are a few things in connection with our process which I would like to call your attention to. One thing is the elimination of the holes in the old rail. We have found that the old bolt holes cause a great deal of trouble, and in our process we can lengthen the bars to any extent to get beyond the bolt holes. Another advantage is that we do not go below the bottom of the rail. It is not necessary to excavate below the rail. It is just as easy to weld a joint that comes on top of a yoke as it is to weld a joint that is suspended. Another advantage is that we stand behind our joints and guarantee them. Any poor workmanship which is due to our men we make good. We are welding in the neighborhood of 1200 joints a week at the present time. Our equipment, as you see by these cuts, is pretty good sized, and it looks as though it might be cumbersome. The machines have their own motors. Those who have used the process find, as far as the equipment is concerned, that it does not give them as much trouble as they might think. I am ready to answer any questions you might ask. I think if there is any one who would like to know any particular point I would be glad to enlighten him as far as I can. We have one of our welding equipments at work in Camden, N. J., and if there are any interested I would like to meet them and have them go over and see the process."

MAINTENANCE AND EQUIPMENT OF ELECTRICAL EQUIPMENT

The committee on maintenance and inspection of electrical equipment, of which William Pestell, of New York, is chairman, was then called upon to report. Mr. Pestell reported in substance as follows:

In considering the above subject we have tried to take into account all the factors that enter into the operation of equipment working under different conditions. We have therefore written to all of the railway companies in the United States asking for information regarding details of their operating conditions and the methods pursued in caring for their equipment. From the information thus obtained we shall be able to deduce conclusions as to the best manner of handling equipment under the various conditions of urban, suburban and interurban service. We have been fairly successful in obtaining this information, and when it is complete it will furnish a means of determining how the different conditions affect the maintenance account. The committee ask for further time to carry on this work, as they believe the information when once obtained and properly tabulated will enable us to not only draw conclusions as to the best of the various systems now in use, but to segregate the best points of each of the systems and to devise therefrom a system complete and of economical value to us all. In this connection the accountants would be of incalculable value, as, after we were able to outline the salient points of the best apparent system, they would be able to put it in concise form so that it could be handled with the minimum amount of labor. We would call your attention to the fact that the list of questions as submitted appeals to many as being en-

tirely too much in detail, and in many respects irrelevant to the subject. On careful examination, however, you will note that none of the points included is such as can be lost sight of in a careful consideration of the subject. The comparison of the cost of maintenance of the equipment of one road with that of another is only fair when all the elements entering into its operation, the track over which it operates, character of service and the equipment itself are known. The fact that we do not all of us have this information at hand indicates that we are not careful enough to consider all of the elements necessary to obtain the most economical results in the maintenance of our equipment. When we consider the vast amount of money invested in our equipment, the depreciation and cost of maintenance, we realize the importance of an adequate system for following up and caring for the various details in connection with it.

One point that shows up more clearly than any other in tabulating the answers to questions submitted is the utter lack of standardization of materials. It seems to me that a permanent committee should be appointed by this association to consider and suggest ways and means of standardizing various parts of our equipment. This has been attempted before, but results can only be obtained by working continuously at it, and we trust that this convention will take some steps toward starting the work of standardizing equipment.

After some discussion on standardization by R. C. Taylor, of Brooklyn, and others, Mr. Pestell explained that his idea was not standard equipment itself so much as standardization of the parts —the brake-shoes and things of that kind. He thought we should very soon be getting to work on that sort of thing. We have now thirty or fifty different types of brake-shoes. In the big consolidations of roads to-day the storeroom is filled with different kind of brake-shoes, and hardly any one knows just what to send out for any part of the line to take care of the equipment. It takes a long while to get any one standard kind in service. The association should take the matter up with a view to getting some standard that we can all use, similar to the Master Car Builders.

Mr. Doyle mentioned some of the great economies made possible on the Interborough lines in New York by virtue of the standardization of equipment there.

W. H. McAloney, of Denver, agreed with Mr. Pestell in his suggestion. He thought it one of the most important offices of this association that the standardization of the parts be taken up and carried out to the limit. Such standardizing would not mean that everybody use a 40-hp motor, or any particular size or style of motor, but it would mean that, for example, for a given horsepower motor the association would recommend a certain gear seat and width, so that the equipment carried in the storeroom even for different types of motors would be the same, consequently the stock would not be so large. That same plan could be extended to the journal boxes with the different types of trucks.

R. B. Stearns, of Chicago, thought this a movement in the right direction. On the elevated lines in Chicago there has been a good deal of standardization, but in the possible event of a cooperation or interchange of all the lines there would be a disastrous condition of affairs in the storeroom. As far as his particular locality is concerned, he was heartily in favor of some move tending now to start this thing going so as to get on a standardization basis.

In regard to the suburban roads of Chicago, one road has already entered the city over the elevated lines, and it is not any question but that in a short time there will be absolute necessity for further interchange, and those companies certainly feel that they ought to get the benefit of a consensus of the opinions of all the intelligent men who are interested in this subject in other parts of the country. If it does not come sooner or later in some substantial manner, similar to the way the thing was brought around by the Master Car Builders, there will be a local standardization in Chicago similar to what is going on in New York. He would very much favor some more radical move in this direction.

Mr. Olds told how the standardization of journal boxes and brake-shoes had been going on in Milwaukee for nine years, and told the dimensions of the present standards.

Mr. Pestell referred to Mr. Olds' remark, and said that he doubted if many others are doing the same thing. If this matter had been taken up in the same comprehensive way by an order of men like this nine years ago, instead of having Mr. Olds' standard in Milwaukee and some other standard in Chicago, another in Boston and another in New York, he thought there would have been uniform basis. For that reason he believed this association should appoint a standing committee on standardization, appointing one member for a year or two years, another for three or four, and so on, to make recommendations at the annual meetings.

Mr. Olds said that was in his mind when he got up. Standardization is a matter of great importance. We realize that we are advancing and that methods that are used to-day will no doubt be obsolete to a very great extent in some parts, but there are parts that can be standardized, and there is no reason why we should not do it. He said that he was in full accord with Mr. Pestell's suggestions.

A motion was carried to appoint such a standing committee.

Mr. Winsor, of Boston, wanted to find out if any of the members were working on a mileage basis of inspection. The Boston Elevated has always inspected its cars once in so many days. He is trying to work out a mileage basis of inspection.

Mr. O'Brien, of St. Louis, described his system. He gets the mileage from the auditor's office and he sends out reports to the different foremen on the different equipments when it is time to watch for low bearings. One type of equipment will run a longer mileage than another. They find it very satisfactory and not very expensive. They have one girl in the shop office who keeps track of the mileage and sends out these reports.

A very interesting discussion between Mr. O'Brien, Mr. Winsor, Mr. Doyle and Mr. Stearns on the plan of inspecting and overhauling by mileage then took place.

President Baker then announced that the president of the Philadelphia Rapid Transit Company had extended the courtesies of its power stations and shops, and had invited an inspection of the subway.

He then appointed as a nominating committee Mr. Olds, Mr. Pestell, Mr. Green and Mr. Hile, with the privilege of choosing themselves a fifth member.

The morning session adjourned.

TUESDAY AFTERNOON SESSION

President Baker called the meeting to order at 2:10 o'clock, and announced that the paper on "The Power Station," by Fred. N. Bushnell, chief engineer of the Rhode Island Company, of Providence, R. I., was before the meeting for discussion. This paper will be found on page 583 of this issue.

L. LeH. Smith remarked that Mr. Bushnell had a good deal to say in his paper concerning superheated steam, both for reciprocating engines and for the later style of mover. Mr. Smith supposed that few of the members knew as much about superheated steam as they would like to know, and he was rather astonished to hear in connection with some of the latest stations that had installed the newer apparatus which was expected to operate only at its highest efficiency with superheated steam, that in some instances they were operating without the superheaters; it was extremely interesting to have the heat efficiency of a modern station, as stated in the paper, in which the greatest apparatus is used with the steam heated, but in his opinion the efficiency stated is something which is not at all extremely high; for instance, he knew of an old station, which has been operating for a dozen years, that has a heat efficiency that is extremely near the one which is stated in the paper, and what made it more significant is that in the station referred to they are using a fuel which is high in heat units, and hence expensive. The older station, to which he referred, which has an over-all efficiency almost as high, uses inexpensive fuel with low heating values; so that in the case of operating the old station with old engines, and without any superheating, the expense would be less than in the new station. Another thing which he thought well worth studying, which was referred to in the paper, were the remarks on the heat losses through the stack. In most stations, as stated in the paper, there is a temperature at the base of the stack of over 400 degs., and in certain known instances it was as high as 800 degs., although that is extreme. The author, the speaker said, stated that it is usually considered that you have a high efficiency when you have temperature that is lowest, and states that that is often a mistake. The speaker said that he thought the author of the paper was correct in that statement. He had just recently had an experience of that in a station where the variation of the load on the station makes an alteration of steaming wide enough to have a temperature variation at the stack of perhaps 150 degs. or 200 degs., but they found they were operating most economically at the rush hours, when they had the highest temperature in the stack. The reason was that under these circumstances the excess of air was notably lower than when the station was working on lighter loads.

Some discussion followed by Messrs. Green and Smith, on superheated steam and cylinder lubrication.

L. P. Crecelius remarked that he thought that the experience with superheated steam was confined more to men operating steam turbine stations. In that case, the question of cylinder lubrication does not enter to the same extent as in the reciprocating engines, and a great deal higher temperature can therefore be maintained in the steam. He would like to hear from someone operating a steam

turbine on that question. There was no question about the economy of superheated steam, and the limitations imposed upon it, for reciprocating engines, were the troubles one gets into in regard to the lubrication of valve movements and different parts exposed to this increased heat. He said that by referring to the tests of steam-generating apparatus, one can see that the efficiency curve will continue upward with the superheat.

William Pestell offered a few words in connection with the regulation of auxiliaries used in power plants. He entered a turbine plant a short time ago where auxiliaries were driven by steam engines as well as by motor drive, and what struck him particularly was the circulating pump for the condenser running at over 400 revolutions in the case of the electric-driven unit, and in the case of the steam-driven unit at about 175 revolutions, the same vacuum being maintained in both cases. These were surface condensers; there was very little difference in the temperature, and the vacuum was something over 28 ins., and it struck him there must be a great deal of power lost all the time in taking care of so much water. The pumps were designed to take care of 50 per cent or 75 per cent overload, and worked all the time at that rate, whereas in the case of the engine-driven unit, the pump could be regulated in accordance with the load factor on the turbine as the load changed from hour to hour.

Paul Winsor asked if any of the members had experience with centrifugal pumps for boiler feed water. He thought that the station could be cut down somewhat if they could get rid of the ordinary reciprocating pump. These latter pumps require much attention in the way of new valves, etc., in the course of a year, and the expense of maintenance is considerable.

C. O. Mailloux remarked that he had seen in Europe last summer a 40-hp centrifugal pump of the multi-stage type used for water feed, against a pressure of something like 140 lbs. The manufacturers of the pump were ready to undertake to furnish the pumps to feed against any desired pressure for any purpose whatever. He understood that similar outfits would be obtainable in this country before long. The idea of using such pumps has been brought to the attention of American engineers, and it was not unlikely that they would be in use here. He called attention to the use of graphite for cylinder lubrication, especially at high temperatures.

Mr. Green thought that as the graphite went into the cylinders, it would deposit itself in the cylinder, and practically all of it stay there; he did not think the graphite would be carried away with the condensed steam. The question of operating steam plants with economy in the matter of lubrication was an important one, and it is a question upon which engineers are devoting a great deal of study at the present time. Some engineers can take a plant and operate it for just one-half the cost for lubricants per 1000 kw-hours that others can.

Mr. Mailloux replied that in gas engines the use of graphite has eliminated the difficulty Mr. Green referred to, where the deposits of carbon choked up the cylinders so as to necessitate frequent removal and cleaning of the pistons; as a matter of fact, the graphite enabled the same engine to work for a longer period without any attention whatever. It was natural to expect that graphite would stand higher temperatures. One might consider that the lubricating properties of graphite might increase, rather than decrease, with increasing temperatures, and it was for that reason, combined with the good reports he had heard of graphite when used in connection with gas engines, that he thought it was worth the while of station managers and operators to experiment with it. It was conceded by all that in all ordinary lubrication graphite is at an advantage. He had used graphite many years ago in lubricating street car axles with considerable success.

L. R. Nash, of Savannah, thought he could throw a little light on the question of the use of graphite compounds for cylinder lubrication in reciprocating engines. Something more than two years ago a plant in which he is interested made a trial of a graphite compound; he thought it was called "Perfecto." The trouble with most graphite is that it does not remain in suspension, but in the case he referred to, the suspension of the compound was perfect and there was very little deposit to it. The results had been extremely satisfactory up to two months ago, when he last heard from the plant. The cylinders very shortly after the use of the graphite compound began to take on a high polish. Further than that, the cost of lubrication was very much reduced. The compound cost something more than twice as much as a good grade of cylinder oil, but the quantity used was something like 25 per cent, so that the cost of lubrication was not more than 50 per cent of the cost with cylinder oil. He said it was the opinion of some engineers that sooner or later this process of lubrication will result in the accumulation of graphite on the cylinder walls so that a cutting will begin. He had watched the plant in question with particular interest to learn if anything of that kind had happened, and there had been no evidence of this up to two months ago. He thought that in the case of cylinders running with that compound for two years, that if there was any trouble to be feared there would be some indication of it in that length of time.

A. H. Warren, of Brockton, said he could confirm what Mr. Nash had said. They had been running for eighteen months their engines with the graphite compound, and had found a very material saving in the cost of lubrication, and the cylinders are the best looking cylinders he had ever seen. There has been no cutting; there is a slight deposit on the cylinder head, but that has not bothered them in any way.

President Baker remarked that the experience in Boston for the last two years had been the same as described by Mr. Nash. Their cylinders are more highly polished; the cost of maintenance reduced materially, and the cost of packing rings, bull rings, etc., has been materially reduced since they started the use of this compound. They have about 1.5 per cent to 2 per cent of graphite in a high-grade cylinder oil. They had not had so much success with it in connection with superheated steam, and he did not know whether the fault lay in the condensation of the cylinder oil with which the graphite is compounded. The consistency of the lubricant is like a thick grease, with the graphite floating in it.

President Baker then stated that the paper on "The Track Brake," by F. F. Bodler, master mechanic of the United Railroads of San Francisco, was before the meeting. This paper is published on page 590 of this issue.

Paul Winsor remarked that he was much interested in reading the paper on "Track Brakes" until he came to the last sentence, which read: "It ought not to be used on curves, switches or crossings, but should it be used, about the only damage resulting would be a split shoe." He stated that a large portion of his road is made of curves, switches and crossings (laughter), and he did not see how it would be possible to use such a brake.

Edward H. Dewson said, as to applying the brake on curves, so far as the magnetic brake was concerned, there was no difficulty if it was given lateral motion enough so that it followed the track. The effect of the magnetic pull is to hold the brake-shoe to the rail, and it naturally would follow the track. In the case of a wooden shoe pressed down there would be no such tendency, nothing to cause it to follow the rail, and possibly it would slip off on the pavement and be destroyed.

H. V. Schrieber said he was in Pittsburg a couple of weeks ago, and understood they were meeting with success in the use of the magnetic track brake. He referred to the fact that they used the brake on the West Penn road, having taken off the air brakes on the interurban cars and put on the magnetic track brakes.

J. W. Bridge said that he could verify what had just been said in connection with the magnetic brake used on the West Penn road, with which he was connected. They had removed quite a number of air brake equipments and replaced them with the magnetic brake on account of the large number of dangerous curves which they have. They have a hand brake, used in connection with the magnetic brake, which operates on the same levers, and they secured very good results from the brake. The use of the magnetic brake had almost entirely overcome the difficulties from flat wheels.

Mr. McAloney asked for further information regarding the trouble with air brakes.

Mr. Bridge replied that the air brakes had been removed on account of the extremely dangerous grades. At Connellsville they go down a grade 14 per cent, right in the heart of the town, and they had two or three runaways, when the car slid down the hill, narrowly averting several bad accidents. The cars were examined, and the brakes found in good condition. The grade was so severe that when the car got the least start it was almost impossible to control it. Another condition which made the track a little more dangerous was the proximity to the coke ovens, the smoke from the ovens making a sooty deposit on the rail, and it is almost impossible to stop the car on the track. They found they needed something to grip the rail in addition to the pressure on the wheels.

The president then announced that the Question Box would be discussed. The Question Box will appear in the Oct. 7 issue of this paper.

In connection with question No. 14, "Do You Use Felt Wicking or Waste Packing with Oil in Your Car Journal Boxes?" Mr. Alfred Green said that in his opinion in order to get the best results in journal boxes it is necessary to use a good quality of waste. In packing journal boxes everything depends on the way the waste is taken care of or soaked before it is put in the journal box, and the manner in which it is put in the journal box, and in order to get the best results out of the journal box strict attention must also be paid to the brass. The brass should be made so that the outer edges of the brass do not touch the axle from the

time it goes in until it is taken out, so that one should practically carry the bevel back about three-quarters of an inch, so that when the brass is worn out the edge is still away from the axle. The reason for this is that the edge forms a regular scraper, and takes the oil off the axle, and does not allow it to go up under the brass. Therefore, one gets a hot brass.

Another thing is that the waste should not go above the center of the axle; in packing a journal box, especially of the old type, where a change had been made from felt to waste for journal packing, he would recommend cutting out the two little shoulders in the bottom of the box, put there to support the felt, which gives an opportunity to put the waste in the proper form. Another difficulty in regard to the felt wick is that it cannot be changed on the road; one must wait until the car comes into the house or jack up the body of the car enough to release the brass, and drop the box back to get the felt out. One thing which is very essential to keep in mind in connection with the waste is that it should be thoroughly soaked before it goes into the journal box.

C. O. Mailloux said grease was an excellent thing where power costs nothing, but where power costs something it should not be thought of. Those who used it would be deterred from so doing if they made dynamometer experiments and measured the current required to perform a certain schedule time. He found that in ordinary street car work the portion of train resistance which is due to journal friction is, after all, a very small quantity. It is less than 4 lbs. per ton in almost all cases, and consequently the improvement which would be effected by varying the viscosity of the lubrication could not be very great, but the moment one departs from the fluid lubrication to one which is semi-solid, like grease, a marked difference will be found; the train resistance increases very greatly.

In connection with question No. 16, "What is an Economical Figure for Lubrication (per 1000 car miles) of a 20-ton Car Equipped with Four 40-hp Motors?" Mr. Green said that it was a question entirely dependent on the men who are operating the road, on which factor the cost depended almost entirely. J. S. Doyle, of New York, remarked that they operated at 19 or 20 cents, and he would like to hear from the men who operated at a cost as low as 8 cents and 11 cents per thousand car miles.

W. J. McAloney, of Denver, said that it appeared that he was the highest priced man in the costs for lubrication. A short time ago he made a special accurate test on five different cars, the results of which in pints and cost were given.

Three years ago, when they used grease, the entire cost for lubrication, including the motor bearings, journal bearings, gear cases, air compressors, etc., cost 40 cents per 1000 car miles, which is a pretty steep figure, but 28 cents, the present cost, is also a steep figure. Even if oil should cost 40 cents and grease a less figure, it would be still more advantageous to use oil, from the fact that so many armatures were saved that were formerly lost by the use of grease. The cars are kept in service. They do not lose one armature now where they lost ten before with the old grease lubricant.

J. W. Bridge remarked that the cost would depend entirely on whether the motor in use was a modern type or old type motor. The old type is arranged for grease lubrication, and certainly could not be run as economically as some of the modern type motors, arranged solely for oil lubrication, He could not see how the figures could get down to 11 or 12 cents with that type of motor.

Mr. McAloney suggested that time would be saved if it was understood, as he thought it was, that the discussion emanated from the fact that they wished to lubricate the old types of motor with oil that were formerly lubricated with grease.

W. Wallerstedt remarked that he knew that they run mixed trains on some of the roads which had given the figures of cost, using both trailer cars and motor cars, and probably in giving these figures they had not separated the cost of motor car service from the trailer car service, and in that way they would get lower figures.

C. O. Mailloux remarked that the direction in which engineers must look for the increased cost of lubrication presents two principal points, namely, they must seek to maintain the quality of the lubricant and maintain the quantity. Lubrication costs money, because the lubricant deteriorates in quality and diminishes in quantity. The deterioration in quality is due to the presence of dust and cinders and other impurities. The deterioration in quantity is due to leakage.

Mr. Green replied that a high cost of lubrication per 1000 miles does not come from any dust or dirt, but from the losses of oil in the car house and the imperfect method of using it.

Mr. Wright remarked that when it was attempted to cut down the amount of oil to the minimum it was very necessary that each drop of oil should reach the journal. He gave figures obtained from a lubricator so designed that each drop would reach the journal. There was no waste when the car was standing. The amount of oil to which he referred was used only for lubrication of the journal bearings.

J. R. Cravath said that the road which reported 8 cents per 1000 miles was the Metropolitan Elevated Railroad in Chicago. If the members would look a little further on in the Question Box they would see the type of oil-feed apparatus this company is using: a brass pin in a hole, a few thousandths of an inch larger than the pin, size being varied according to the season. Another thing that had much to do with the figures was that they are offering a bonus to the different foremen for the best oil record.

Mr. Olds said that regarding the 11-cent man, as he understood it, those figures came from Kansas City, and he wished to say a word. He thought the figures were not made upon a test with the old type of motor, but with the newer type of motor, with the bearings packed with wool waste and lubricated with oil. He gave further detailed results obtained by Mr. Smith of that road. Mr. Olds said he fully believed in the oil bearing. That it not only reduced the cost of lubrication, but that it lengthened the life of the bearings.

J. W. Bridge, of the West Penn Railway, described and submitted a sample of the oil cup devised on that road.

The nominating committee then presented the following nominees for office:

President—H. H. Adams, Baltimore, Md.

First Vice-President—F. G. Simmons, Milwaukee, Wis.

Second Vice-President—J. S. Doyle, New York.

Third Vice-President—Paul Winsor, Boston, Mass.

Secretary and Treasurer—S. W. Mower, Detroit, Mich.

Executive Committee—W. S. Twining, Philadelphia; Fred. N. Bushnell, Providence, R. I.; W. Boardman Reed, New York, and A. D. Campbell, Seattle, Wash.

On motion, the report was received and the secretary authorized to pass the ballot of the association for the nominees, which was duly done.

President Baker expressed, in a few well-chosen words, his thanks to the members for their co-operation during the term of his administration.

President Adams, First Vice-President Simmons, Second Vice-President Doyle and Third Vice-President Winsor each acknowledged the honor of their election to office, and promised to do all that lay in their power to advance the interests of the association.

On motion of Mr. Olds a vote of thanks was extended to the retiring president, Mr. Baker, the motion being carried by a rising vote. The third annual convention then adjourned.

PROCEEDINGS OF THE AMERICAN STREET RAILWAY ASSOCIATION

WEDNESDAY MORNING SESSION

The twenty-fourth annual meeting of the American Street Railway Association was held at the Philadelphia Museum, Philadelphia, Sept. 27 and 28, 1905.

W. Caryl Ely, president of the association, called the meeting to order at 11:15 on Wednesday morning.

The president stated that an address of welcome was to have been delivered by the Hon. John Weaver, Mayor of the city of Philadelphia. Mayor Weaver had been under the impression that the address of welcome was to have been made on Monday morning, and he had made such address to the members of the Mechanical and Electrical Association. In the absence of the Mayor, the members of the American Street Railway Association might consider that the words of welcome addressed to the affiliated associations would apply to the parent body. President Ely then delivered the following annual address:

ADDRESS OF PRESIDENT ELY

For the third time the selection of the place of annual meeting has been made by the executive committee solely with the desire to locate it at the place deemed by all to be the most desirable from the point of view of the association as a whole. The merits of Philadelphia as a place of meeting were so conspicuous as to force themselves unaided upon the attention of the executive committee. Yet notwithstanding the fact that pursuant to the new method of procedure, the tent of the association has been pitched here purely of our own volition, the courtesies and attentions which have been and are being showered upon us by the president and other officers of the great company which has in its charge the street railway transportation interests of the city, and of the chairman and officers and members of the manufacturers' and local committees which have assisted in making all the arrangements for the meeting, could not have been exceeded had

they been solely responsible for our being here. The conditions here for the holding of such meetings as this are almost ideal. The fine hotel wherein our headquarters are located, together with the other hotel accommodations of the city, are ample and convenient in that regard. These buildings of the Philadelphia Commercial Museum and their accessories are splendidly adapted to the purposes of the exhibits. Philadelphia herself possesses attractions to every patriotic citizen scarcely equaled by my other city. Her early history as the first meeting place of the Continental Congress, the birthplace of the Declaration of Independence, the glorious part played by her and her sons in the War of the Revolution and as a meeting place of the Federal Congress, are enforced upon our attention almost at every turn. She seems to have preserved more of the landmarks of the early days than any sister city. To us in our particular line she appeals not only by reason of her almost superlative position as a manufacturing city, but also as the place where the immortal Franklin conducted the experiments which perhaps may be characterized as the foundation of electrical science. Manufactures incidental to transportation are here conducted upon a large and interesting scale, and the electrical transportation interests of the city are large and intensely interesting, but to crown it all at this particular juncture in the affairs of this association, when we are about to take steps that will bind us all together in one harmonious set of organizations, working for the common good together along well-defined and coherent lines, what place could be more fitting for our meeting than the City of Brotherly Love?

In the general field of electric railway work, the events of the last year have been noteworthy. The work of electrification of certain portions of some of the great steam railroads is progressing, and although the projects under way have not yet been completed, nevertheless the continued investigation of the subject has served to make more clearly apparent the relations that ought to obtain between the steam and electric railways of the country, in order that the public, as well as the companies themselves, may realize the greatest benefits from their operation.

Many of the larger steam railroad systems are changing their policy regarding the construction of electric railways from one of active and in some cases bitter opposition to either passive acquiescence or quiet assistance. This is an approximation to the conditions that ought to and some day surely will prevail.

The ideal railroad situation, both from the point of view of the companies and the public, would comprise a heavy long-distance railroad doing the freight and through passenger business, aided by a light interurban railway with frequent stations upon which the suburban and interurban passenger business would be transacted, and in connection with these two factors the street railways within and adjacent to the intermediate and terminal cities would perform the functions of ordinary street railways, as well as those of bringing to and taking from the depots of the first-mentioned systems travelers and their baggage. In this equation we have three factors, each of which supplements the others, and if such a system could be conceived as having been constructed at one and the same time with reference to the relations existing between them we would there have exhibited the ideal transportation system, calculated to serve the convenience and economy of the railroad companies and the public in the very highest degree. Possibly this ideal system may not be hoped for, but a modification of the attitude which has been heretofore exhibited by the managements of nearly all the great steam railroad corporations toward street and interurban railways may do a great deal to procure for all concerned the benefits outlined.

The consolidation of small properties into large and strong organizations continues, and may well be said to be the order of the day. We think it must be conceded that the public and the companies themselves have been benefited in every instance. These large organizations have the means with which to employ men of greater skill and experience in the mechanical and operating departments; to provide better tracks and equipment and give better service than would be possible upon small weak properties.

The standard of transportation employees is continually being raised, and all railway organizations are giving greater attention to the proper instruction of employees, thereby insuring better service and greater safety to the public. The instruction car and other educational apparatus are now becoming regular features of the equipment of many of the large companies, wherein all motormen are required to demonstrate their proficiency in the operation of such equipments before they are given charge of cars. In many cases such instruction is supplemented by schools, where lectures are given on technical and popular subjects by men of prominence.

The conditions attending street and interurban railway employment are continually being improved. The business is becoming established and recognized as one offering solid and substantial rewards to the men who take it up as a profession and life work. Nevertheless it is a far cry to perfection. Much remains to be done, in the accomplishment of which it is difficult to conceive a more potent instrumentality than this association when reorganized and readjusted with reference to its affiliated organizations and all others interested in street and interurban railway work.

In the line of technical investigation, the work of the Electric Railway Test Commission at the St. Louis Exposition is of great value. The testing began at St. Louis in the middle of June, 1904, and was continued there until the middle of November, when the corps was transferred to Anderson, Ind., where the tests continued until the latter part of March, 1905. Immediately upon the completion of the tests the commission proceeded with the editing of the report. It was expected that the printed report would be ready for distribution before this meeting, but by reason of the large amount of work done and the care required in the preparation of the published volume, it will not yet appear for some little time. It will comprise a bound volume of about 500 pages octavo, and it is believed will be of great value as a contribution of fact concerning some of the things that have been long embraced within the realm of almost pure conjecture. The importance of such investigations, and indeed of all the measures now being taken toward securing the facts concerning everything involved in our business, and making them available for all, instead of locking them up in the breasts of a few, cannot be overestimated.

Notwithstanding the rapid advance in the state of the electric railway art, I think it will be conceded by all that the ratio of advance has not been what it should have been, nor indeed anything like what it would have been if those engaged in the business had been brought properly in touch with each other through the medium of some recognized authority which was at one and the same time the repository of the experience of all, a common investigator and classifier of facts and experiences, accessible to all for advice and assistance and always ready to furnish desired information. Causes must be revealed before defects can be finally remedied, and the ascertainment of cause depends upon thorough, careful, long continued and scientific investigation.

With the growth of interurban roads, the necessity is becoming more and more apparent of their owning, if not all, at least a greater portion of their own right of way. It is especially important where high speeds are desired, as it is practically impossible to make fast time within the limitations created by vehicular traffic and the location of the ordinary highway. All now agree that wherever practicable private rights of way should be acquired in the first instance of widths ample for the accommodation of double tracks, and in many cases it is considered desirable to grade the right of way and locate the first track and construct the bridges with reference to the future accommodation of a second track. The experience of the steam railroads with double and single-track construction is being repeated by the electric interurban railroads. There is practically no difference between them, except that of motive power. In all other things it would seem that good, common judgment would dictate that we avail ourselves of the long experience of the steam roads. Double tracks are much simpler, easier and safer of operation, and the increased fixed charge occasioned by the double track is, in the judgment of experienced operators, more than compensated by the saving in despatchers, signal men and other like employees, and the injuries and damage accounts, to say nothing of the greatly increased carrying capacity.

In the consideration of this branch of the case are involved proper traffic agreements between interurban and city roads, and the laying of T-rails in cities where practicable to accommodate the deeper flange and broader tread of the wheels of the interurban cars. It is interesting to observe the growing tendency on the part of municipal authorities to recognize the good to be derived from the installation of T-rails in paved city construction. There is also a noticeable recognition of the value of adequate terminal facilities for interurban roads in cities. In some places union depots are being constructed for the handling of passengers, freight and express, and especially is this true in the Middle West.

The convenience of passengers, especially commercial travelers, in the Middle West has brought about the adoption by the interurban railway companies of Central Ohio and Indiana of a coupon book, which is known as the Ohio Interurban Coupon Book, and is recognized upon a number of connecting lines. This is not only proving a convenience to the public, but is having a tendency to regulate fares upon a better basis, which in a number of places have been fixed too low in the beginning, due no doubt to the misconception of the cost of electric railway work which has so generally prevailed in the past. The element of mystery has been pretty well eliminated from the electric railway business, and it will be difficult for anyone to successfully demonstrate the possibility

of a lower rate of fare than 5 cents in cities, or from 1½ cents to 2 cents a mile upon first-class, well-constructed and safely-operated interurban railroads.

While speaking of the features of safe operation, it seems proper to mention as a subject worthy of careful consideration the standardization of wheels for interurban practice. In many places steel or steel-tired wheels are being adopted. The best operators agree that they should be productive of good results.

It is pleasing to note that the adoption of safety devices is becoming more general. The first great burden upon the directors, as well as the operating officers of street and interurban railways is the safety of the passengers entrusted to their care. The elimination of the grade crossings of steam railroads, the installation of block signals and other automatic signals, safety gates, etc., indicate that in electric railway practice, as in steam, the minds of all traffic managers are on the alert to conserve the safety of the traveling public.

Progress is being made in the problems involved in practical operation of single-phase electric railways. While the manufacturers and engineers have been experimenting in these matters for several years, it is only within the present year that railroads have been equipped with this system. The motors and equipment are so designed that the cars may be operated on the standard 500-volt direct-current system in cities, and on 2200-volt single-phase alternating current between cities. The principal advantage gained is that no rotary converters are necessary in sub-stations, stationary transformers being alone necessary, thus decreasing costs of plant and superintendence. The principal disadvantage which has developed has been the poor acceleration, but this defect is now being remedied. The further progress along this line of development will be watched with great interest, especially when considered in connection with the problems which are attendant upon the electrification of the steam railroads.

It will be remembered that at Detroit three years ago much time was consumed in the consideration of the question of steam turbines, and much doubt was expressed concerning them. The progress in the installation of the steam turbine in railway-generating stations affords another notable illustration of the rapid progress in the electric art. The Philadelphia Rapid Transit Company has recently installed turbine units of 6000-kw capacity each, and the Pennsylvania Railroad electric lines on Long Island are operated by stem-turbine units of 5500 kw, while the plans of the New York Central in the neighborhood of New York include 60,000 kw of steam turbines in units of the same size as that of the Philadelphia Rapid Transit Company. The devotion of so much of the time of the St. Louis and of this convention to the subject of power is not to be taken as an infringement of the prerogative of the Mechanical and Electrical Association, but it is to be attributed to a desire manifested by the managers to follow up the subject continuously to some definite conclusion.

The matter of fire protection in car houses has received a great deal of attention from street railway companies and insurance companies during the past year. Tests of sprinklers have been conducted at Cleveland, Ohio, and Newark, N. J. The Newark test was attended by W. Boardman Reed, engineer of maintenance of way and buildings, New York City Railway Company; Albert H. Stanley, general superintendent, Public Service Corporation of New Jersey, and H. S. Wilgus, engineer of way and structures, Brooklyn Heights Railroad Company, representing this association. The question of insurance of street railway properties is closely linked with the important question of fire protection. For several years attempts have been made to establish a system of insurance that would comprise exclusively street and electric railway risks. It is a subject of the greatest importance, and the belief is becoming general that a great saving can be effected in this item of general expense. On the reorganization of this association there will undoubtedly be established an insurance committee, which in connection with the Accountants' Association, will thoroughly investigate this matter, and undoubtedly make a report that will be of great value to all concerned.

With this brief general resume of the progress of electric railway work during the past year, I will leave the subject and come to those that in their nature are fundamental; those that affect the every-day life of the corporations, and in their last analysis practically determine their rights to exist and to hold and manage their property and enjoy the legitimate profits therof. At this juncture it may be interesting to note the magnitude of the interests involved in street, interurban and elevated roads at present included in the electric railway industry. In the United States in the year 1904 there were operated 993 roads, having a total of 30,187 miles of track, operating 75,904 cars and representing a total capitalization of about three and one-quarter billions of dollars, while in Canada there were 42 roads with a total of 900 miles of track, 2639 cars and a total capitalization of sixty-nine and one-half millions of dollars. In addition to these figures, there are to be considered the roads in Mexico and certain of the colonies of the United States. When considered in connection with billions of invested capital, the questions alluded to above become of all-absorbing interest and importance to this association. For many years past there has been evidenced in this and similar organizations a disinclination to discuss such questions, or even investigate them to any great extent. Within the past two years, however, there has appeared a growing desire in this association for the investigation of such questions, and the collection of accurate data and information concerning them. With a view of ascertaining the subjects uppermost in the minds of the men engaged in the practical consideration of the problems to-day surrounding electric railways, I have within the past few months addressed inquiries, both oral and written, to many thoughtful and able men, and am now able to state that from nearly every one there has come a response pointing out the necessity for information and the facts. It may be of interest to you if I quote from one of the letters written by an officer of this association, one who is the active manager of an important property, and by reason of business association intimately acquainted with the operation of a number of other railway properties. My correspondent writes as follows:

I hope and believe that the association will be reorganized at the coming meeting along the lines which have been suggested and which have recommended themselves to the executive committee, and the Bureau or Department of Statistics and Information, which I have considered would be of the greatest benefit to member companies, will be promptly organized and work begun, so that the information obtained by it would be soon available for use.

In the Middle West and on the Pacific Coast public opinion is being very rapidly crystallized by individuals presuming to represent public interest, to the end that municipal control and ownership of public utilities may soon become an issue in municipal and State politics

A great mass of erroneous information is being recorded and published, which is tending to influence the public mind, and which, if not refuted in some manner by a recognized association or authority by the publication of correct and verified information, will tend to seriously affect invested interests in these utilities. It seems to me that it is within the reasonable scope of our association to cause to be circulated and widely published statements of facts that will controvert statements made by these self-constituted censors of the public good.

Others of wide experience, several of whom are perhaps in closer touch with public sentiment and what is going on in the world along these lines than any other individual members of this association, have said to me in substance: "The question is up; it will not down at our bidding; one side of the case only is being presented and argued, and the arguments in favor of the proposition are largely based upon alleged propositions of fact that are either erroneous, or concerning which a gross misconception prevails." Our side of the case has never been presented, nor indeed has any publication of the facts as we know them ever been made to the public. The forum resounds with the cries of agitators and demagogues, aided by many honest but misguided or misinformed men, while among the representatives of the vast interests which are thus injuriously threatened silence prevails. Some have indeed taken the position that a wave of sentiment is sweeping over the land that is founded upon error and will dissipate itself. That it is founded upon error we all believe, but at present the indications are that there is pretty nearly an unanimous sentiment in favor of taking means to assist in correcting the misunderstanding which seems to prevail.

At the meting of the New York State Street Railway Association, held at Lake George last June, the feeling was pretty nearly unanimous that the subject should be taken up and thoroughly investigated, and that association determined to actively assist this association in its investigation in any way in which it might be called upon. In the most interesting paper there presented by Henry W. Blake, editor of the STREET RAILWAY JOURNAL, the author said:

It is now apparent that a serious wave of agitation in favor of municipal ownership, so-called, is sweeping over the country; that the principle is un-American and contrary to our theories of government which have so far proved so successful. * * * What has been or can be accomplished in this direction under autocratic, bureaucratic or socialistic governments is not the question in America unless we adopt one or the other of these forms of government. The question is, can or cannot municipal ownership and management be more successful under our present forms of State and municipal government than the system which has operated so successfully in this country? So far, the education of the American people upon the subject of municipal ownership has principally been academic, theoretical, haphazard and unbusinesslike, generally conducted by those who have no practical familiarity with the subject.

I must content myself with this brief quotation from Mr. Blake's admirable and very exhaustive paper, and commend the same to each and every one of you.

At the twenty-eighth convention of the National Electric Light Association, at Denver and Colorado Springs last June, an ex-

haustive report upon the subject of municipal ownership was read by Arthur Williams, of the New York Edison Company. The report is confined to the question as affecting electric light properties, but its bearing upon railway interests is clearly evident, and the pamphlet of nearly 200 pages abounds in statements of fact that if given thorough and wide publicity, would undoubtedly do much to change the feeling in the minds of the ordinary property-owning citizen and voter in our great municipalities. Mr. Williams, among other things, refers to the statement which has been given general circulation, that electric lighting in Chicago costs something less than $60 annually per arc lamp, and then shows from an exhaustive presentation of the figures and facts involved in that case that many important items of cost are deliberately omitted in the Chicago lighting accounts, notwithstanding that the omissions, as he states, have been frequently brought to the attention of the municipal authorities. Some of the items are the rental value of the offices occupied by the lighting department; services rendered by other departments of the city government, including the legal department, and that through which supplies are purchased; the paving of the streets for original subway work, as well as for repairs, which is done by and charged to the street department; water, taxes, insurance, interest and depreciation.

Mr. Williams further calls attention in his valuable report to the consular reports upon municipal ownership, issued by the Department of Commerce and Labor of the United States Government during the month of May. He says that they seem to have been referred to by the press of the country as favorable to municipal undertakings, but that he has been able to find little, if anything, in them which justifies this view. That making no allowance for the omissions usually found in municipal bookkeeping, with very few exceptions they appear rather to support the opponents of municipal ownership and operation.

Since reading Mr. Williams' report I have read the consular reports referred to, which comprise the reports of United States consular officers upon the subject of municipal ownership from 1897 to 1905. Even the brief examination which in the time allotted to me I have been able to give these reports, convinces me of the correctness of Mr. Williams' conclusions, and I commend the pamphlet, No. 2256 of the Daily Consular Reports, to the careful attention of those present.

Within the last year the Mayor of a great Middle Western city has called to his aid the manager of the street railways in the city of Glasgow, who has made an investigation and report. While the contents of the report have not been made public, it is my understanding, and those of others who have conversed with the expert, that the opinion of the expert, Mr. Dalrymple, is not favorable to municipal ownership of street railways in the cities of this country under existing municipal conditions.

Let us pause for a moment and reflect upon the fact that in the neighboring city of New York, according to statements in the Metropolitan press, one of the great political parties is contemplating prosecuting the coming municipal campaign upon the principle of municipal ownership of street railways and other so-called public utilities. From figures obtained from the presidents of the different railroads in the city of New York, it appears that there are approximately 34,000 men employed in street railway work in that city. This number of men constitutes nearly 6 per cent of the total vote cast in the last Mayoralty election in Greater New York, and more than 50 per cent of the plurality received by the successful candidate. If an average wage of $60 a month is assumed, these men are paid and receive more than $24,000,000 per annum. These figures are the more remarkable when it is considered that all, or nearly all, of these 34,000 men have fathers, brothers, and others eligible to vote who are more or less dependent upon them.

I think there could be little doubt concerning the probable tenor of a report from Mr. Dalrymple upon the desirability or non-desirability of this proposition in Greater New York.

However, it is not my purpose to now enter upon a discussion of the doctrines involved in the question of municipal socialism. The foregoing are intended as mere allusions, made in order to attract your attention to the importance and desirabliity of investigation along certain lines intimately affecting the interests which you represent, and brings us to the question of the reorganization and reformation of this association and those associated with it. I take it that it will not be necessary for me to make any extended statement at this time concerning this matter. The proposed new constitution and by-laws have been sent, together with a letter from your president, carefully explaining their purpose and all that has been done in relation thereto, to all members of this association, and also, accompanied by a communication from the membership committee, to all non-member electric railway companies, throughout the countries which are within the jurisdiction of the association. This proposed form of constitution and by-laws will now be brought before you for final action. They embody the result of two years' careful and thoughtful work, and it is believed by your executive committee and a large number of others who are prominent in the association, that they are well adapted to bring about an organization which will be of great value. There are many questions of detail that will remain to be settled after their adoption, and I desire to say now, once and for all, that there is not in the mind of any of those who are responsible for the proposed changes a thought in derogation of the autonomy or dignity of any of the affiliated associations. It is intended that in a well-defined and intelligent way the work of all the associations shall be carefully laid out in advance, so that by harmonious and correlative work the greatest advantage may be secured from the united efforts of all. In determining the work to be done the various committees will be consulted, so that the final programme will represent and constitute the common judgment of representatives duly accredited from each of the organizations. In behalf of the parent organization, any intention to weaken or unnecessarily interfere with any of the affiliated organizations is expressly disclaimed.

It seems proper to say that it is intended that there shall be a well-equipped general secretary's office, where will be properly collected and cared for, information concerning electric railway properties and questions which may hereafter seem of such importance to the association as to require investigation. The accumulation of such data will be systematized, and the members of the association will from time to time by announcements and notices be made conversant with the resources of the secretary's office, and in every way encouraged to call upon the secretary for information.

It is also intended that a great deal of work shall be done by small compact working committees, whose records shall be kept on file in the office of the general secretary, and that he shall be secretary ex officio of all of said committees. However, I find myself in danger of going too much into detail, and I will conclude my reference to this subject by saying to you that I heartily believe that the adoption of the new forms of organization and their careful working out will result in unqualified benefit to all.

The first product of the reorganization has been the Manufcturers' Association. It has succeeded almost beyond the most sanguine expectations of its promoters, and the exhibit which has been assembled here affords the very best justification of the change that has been made. Splendid as this exhibit is, it has been assembled here without any expenditure of time or money on the part of any of the officers of this association. The Manufacturers' Association not only pays its way, but it has provided this hall, which is our meeting place, and in other ways is contributing to the comfort and convenience of the members of our different associations. I did not feel that I could close these remarks without referring specially to the gentlemen who, by their unremitting efforts, have assembled here this really beautiful and complete exposition of articles used in electric railway work, and provided so generously for our entertainment and pleasure. I feel, however, that I ought to warn you not to devote too much time to the examination of these exhibits, lest you be caught in the predicament of the friend of Mr. Dooley, who, to use that gentleman's language, "wint to th' Cintinyal in Philydelphy an' los' th' use iv his legs thravelin' fr'm th' display iv mohair shawls to th' mannyfacthry iv open-face watches."

In concluding, I wish to return my sincere thanks to all the members of the executive committee, and many others, both in and outside of this organization, but interested in its work, for the invariable courtesy and patience with which they have met many trying situations that have arisen during the past year, and with which they have always met my requests for assistance. I trust that when you leave this place it will be with a feeling that this, the twenty-fourth annual meeting of this association, has been its crowning achievement. I thank you again for the invariable forbearance which has been shown to me as your presiding officer, and bespeaking a further continuation of it, I await the pleasure of the convention.

The next business was the approval of the minutes of the last meeting, and they were approved as printed.

The secretary then presented the report of the executive committee. This report consisted of the minutes of the various meetings of the committee held during the past year, on Feb. 3 and 4, June 12 and 13, and Sept. 26. On motion of W. P. Read, of Salt Lake City, the report was accepted and ordered to be filed.

The secretary then presented his annual report.

REPORT OF SECRETARY AND TREASURER

In substance the report of Mr. Penington is as follows:

New members since last meeting:

Chattanooga (Tenn.) Rapid Transit Company.
Cleveland & Southwestern Traction Company.

Columbus (Ohio), Dayton, Springfield & Urbana Electric Railway.
Dubuque (Ia.) Union Electric Company.
Fairmont (W. Va.) & Clarksburg Traction Company.
Fitchburg (Mass.) & Leominster Street Railway.
Hampton (Va.), Newport News & Old Point Railway & Electric Company.
Lansing (Mich.) & Suburban Traction Company.
Macon (Ga.) Railway & Light Company.
Madison (Wis.) Traction Company.
Manila Electric Railroad & Light Company.
New Haven (Conn.) Consolidated Railway Company, of New Haven.
Philadelphia & West Chester Traction Company.
Richmond (Ind.) Street & Interurban Railway Company.
Sheboygan (Wis.) Light, Power & Railway Company.
Spokane (Wash.) Traction Company.
Wellston (Mo.), St. Louis, St. Charles & Western Railroad Company.
Tacoma (Wash.) Railway & Power Company.

The number of members Sept. 20, 1904, was 196; eighteen new members have joined, six have withdrawn, and two have been suspended for the non-payment of dues, leaving 206 members at this date.

The financial statement showed cash on hand Sept. 20, 1904, $7,646.56; receipts to Sept. 15, 1905, $5,278.29; expenses to Sept. 15, 1905, $6,192.65; cash on hand Sept. 15, 1905, $6,732.20.

Mr. Penington concluded his report as follows:

As the executive committee of this association desires a technical man to act in the capacity of secretary, also a man who can devote his entire time to the work of such office, this is, in all probability, the last year I shall serve the association as secretary. In looking back over the past ten years I can truthfully say that I have filled the office of secretary to the best of my ability. Of course, there have been errors made, but "to err is human," as everyone knows. I wish to take this opportunity of thanking the many friends, old and new, whom I have made during the years of my work for their kindness and assistance, and, in case I have been unfortunate enough to have gained the ill will of any, I sincerely trust that it has not been lasting. I hope you will call upon me at any time in case I can render any assistance.

President Ely spoke of the fidelity with which Mr. Penington had performed his duties, and he was sure that no one who had ever come in contact with Mr. Penington during the ten years of his work cherished any feeling toward him but that of respect and warm friendship. The president stated that suitable resolutions would be reported by a committee appointed for the purpose, expressing the feeling of the members with regard to the service of Mr. Penington, with the hope that when Mr. Penington looked upon these resolutions he would know that they emanated from the hearts of his friends.

On motion, the report of the secretary and treasurer was received and filed.

The president stated that a number of letters had been received from different persons expressing their regret at being unable to attend the meeting. The president further said that he wished at this time to express the thanks which he owed to the members of the executive committee and many other gentlemen connected with the association for their very kind and valuable suggestions made to him, at his request, concerning the remarks in his address. The president stated that the next business would be the report of the committee on the reorganization of the association. As this was a very important matter, it seemed proper that it should be presented in its entirety, so that all might understand thoroughly the great amount of work and thoughtful investigation that had been bestowed upon the question of reorganization.

The secretary then read the minutes of the various joint conferences between the representatives of the parent association and the allied organizations.

At 1 o'clock the association took a recess until 2:15 o'clock.

WEDNESDAY AFTERNOON SESSION

The president called the meeting to order at 2:15 o'clock.

The president stated that he had addressed a letter in his official capacity to the presidents of the different street railway associations and clubs, asking for suggestions in regard to the plan of reorganization of the association. He was pleased to state that in every instance he had received replies, many of which were very interesting. The writers approved of the idea, and suggested that it might be possible to arrive at means whereby the work of the State associations might match in with the work of the American Street Railway Association and its affiliated organizations. Some of these associations had formally designated delegates to represent the associations at this meeting. Among them the New England Street Railway Club had designated E. E. Potter; the Ohio Interurban Railway Association had designated Fred W. Coen and Harry P. Clegg; the New York State Street Railway Association had designated J. H. Pardee; the Massachusetts Street Railway Association had designated Messrs. E. P. Shaw, F. H. Dewey, R. S. Goff, E. E. Potter and H. C. Page.

The president stated that he had written letters of invitation to attend the present meeting to all the past presidents of the association and had received letters of regret from D. F. Longstreet, Robert McCulloch, J. M. Roach, C. B. Holmes, Thomas Lowry, Henry M. Watson and H. M. Littell. Some of these gentlemen had taken occasion to refer to the matter of the plan of reorganization in a very commendatory way.

The president stated that he had also sent an invitation to some of the members of the different State Boards of Railroad Commissioners and had letters of regret from some of them; also from the president of the National Association of Railroad Commissioners. He was pleased to see a general manifestation in the interest of the work of the association on the part of the members of the different State Boards of Railroad Commissioners.

The president stated that the executive committee decided it would be a good thing to secure the attendance at the meeting of Henry L. Doherty, of the National Electric Light Association, who had been chiefly instrumental in bringing order out of chaos in the work of that association, and whose efforts had produced results which were very gratifying to the men in that branch of the business.

Mr. Doherty addressed the meeting and said that he had never realized so keenly the scope and perplexity of the street railway industry until faced with the responsibility of delivering an address upon the association work which it demands. The wide scope of this work not only dictated the necessity for wise planning of the individual company organization, but an equally wise and comprehensive organization of the association. The work in the street railway field required a knowledge of thermodynamics, mechanical engineering, electrical engineering, legal matters, materials, amusements, municipal engineering, and especially regarding paving, proper relations with State and municipal authorities, the newspapers and the general public. The association, to administer benefits to the fullest extent of its possibility, must be comprehensive, and therefore probably complex and expensive.

Mr. Doherty referred to the fact that proposed changes in every organization are apt to meet with opposition from chronic objectors to progress. These persons forget that while all changes are not improvements, yet all improvements are the result of changes, and for better results changes must be made. He would suggest that the association be known as "The American Traction Association," because such title seemed to be comprehensive. He urged the necessity of well-located, well-equipped permanent headquarters under direction of a permanent secretary. The entire organization of the association should be primarily intended to protect and develop the interests of existing properties, and ample funds should be provided from these properties to properly maintain the organization.

He believed that it was recognized that the industry is so complex in character that it is impossible to consider all matters of importance in one short annual session. It was also evident that all officers or employees of a company could not be absent at one time, yet there was practically no earnest worker in a traction company, from the president down to the laborer, who would not be benefited by some convention scheme or other plan that by increasing his knowledge or acquaintanceship with other men in the same line of work, his labor would be rendered more valuable to the company. He considered the following divisions of self-evident value: Traction electrical engineering; accounting; park and amusement superintendence; transportation superintendence; traction law. He considered that the adoption of a "question box" on a comprehensive scale was the most valuable adjunct in any association work. He referred to the great value of the question box in the National Electric Light Association and the Ohio Gas Light Association. It had been arranged that all information collected by means of the question box shall be put in the hands of a competent revision committee, and from it a very comprehensive hand book would be evolved. Information held by one man can in this way be made common to the entire fraternity, and the field of research and experimental work can thus be reduced to that portion which is unknown to all.

Mr. Doherty further said in planning the reorganization of the association that it was well to keep in mind that a special wave of antagonism seems to be passing over the country against corporations, and this wave of antagonism was particularly directed against quasi-public corporations. The corporation is held up as the tool of the rich for the oppression of the poor, while the reverse was really true. In the superficial treatment of the press

and platform, the theory which gave the corporation birth is lost sight of. Some enterprises, by their very nature, can only exist by the employment of immense amounts of capital. Ability to incorporate is simply a legal means of co-operation. If such co-operation is not provided for, the undertakings requiring considerable capital would be only open to the few men who are possessed of the required capital, and these enterprises will exceed the capital available in large amounts. Therefore the possessors of large amounts of capital could make these enterprises as productive as their greed might dictate. Legalized incorporation is simply a means for co-operation on the part of capital, which enables the men of moderate means to join their interests and render their capital as productive as that of the man possessed of great wealth. Ability to incorporate is not essentially necessary to the rich, but absolutely essential to others.

Mr. Doherty further said that sooner or later those who want to see the truth prevail rather than sensationalism must take steps to give the voter the reasons why the ability of incorporation should be increased rather than lessened. Industrial associations for this reason should arrange provision for communication and co-operation among themselves. A marked tendency toward more rigid control on the part of municipal and State authorities was evident. The State or city now presumes to prescribe the service rendered by quasi-public corporations, fix the rates and assess them for taxation. Owing to faulty tax laws, individuals and firms, and corporations other than quasi-public corporations, can escape their just burdens of taxation by securing through concealment or otherwise, low assessment values on their property, while the quasi-public corporation, if compelled to pay taxes and fix rates on the same valuation, is bound to secure either inadequate rates or unjust taxation burdens. For this reason the quasi-public corporations must explore the resources of political economy to provide and enforce honest taxation of all property. He mentioned this simply as an example why more intimate communication should exist between organizations such as the Ohio Gas Light Association, the American Street Railway Association and the National Electric Light Association. As a conclusion to his remarks, Mr. Doherty made the following recommendations, based on many years of experience in association work:

First.—Listen to the recommendations of your active workers with a receptive mind.

Second.—Do not forget the fact that improvements cannot be secured except by changes.

Third.—Do not criticise unless you can see positive harm, and then sparingly, unless you can offer some better suggestion.

Fourth.—Do not oppose the man who is trying to do the work, but support him. Put a premium on interest in association affairs and work in behalf of association advancement.

Fifth.—Accept and act favorably upon the recommendations of workers aiming to secure organization upon higher and broader lines. If the plan suggested by them cannot be executed, delegate authority to either your officers or a special committee chosen by your officers to reorganize under some comprehensive plan which they may adopt and for the success of which they are willing to accept the responsibility. Give them full power to take all necessary steps, fix initiation fees, dues, accept new members, etc., and thus save waste of the most valuable thing required to secure progress, viz., time.

The president expressed the thanks of the association to Mr. Doherty, and stated that at a proper time a resolution expressive of such thanks would be adopted and spread on the minutes.

The secretary then read the proposed constitution and by-laws of the American Street and Interurban Railway Association. Since the proposed constitution and by-laws were printed in the Street Railway Journal for Sept. 2, a meeting of the executive committee has been held, at which a number of changes have been embodied in it. The revised constitution and by-laws are published in full on page 610 of this issue.

The president declared the subject of the adoption of the proposed constitution and by-laws to be before the meeting for consideration.

After some discussion as to whether the bond of the treasurer should be given to the association or to the president, and whether the annual fees should be based upon the gross receipts for the fiscal years "ending June 30," or "for the fiscal year of the respective companies whatever the date might be," the wording given on page 610 was adopted.

C. S. Sergeant, of Boston, called attention to the fact that it is provided in article 2 of the by-laws that the vice-presidents shall equal in number the number of affiliated associations, and in article 6 it is provided that the executive committee shall consist of the president, the vice-presidents and one member appointed by each of the affiliated associations, and that it was provided further that the executive committee may admit affiliated associations, which he understood to mean new associations, and the question raised in his mind was at what time can they be admitted. If they could be admitted only at an annual meeting he saw no trouble, but if they were to be admitted at any other time he did not see how the vice-presidents could be made to correspond with the number of affiliated associations.

Mr. Beggs answered that the admission of affiliated associations could only occur at an annual meeting, and that there would be no trouble on account of the points raised by Mr. Sergeant.

H. H. Vreeland said that it had been evident to every member of the association for a number of years that some change was necessary in the form of organization and the method of conducting the business of the association. A great change had come in connection with the properties which the association originally represented. At the time of its organization the association had to do with horse cars and horse car problems. There has been a very rapid evolution from that, and business had advanced in every direction save that of the methods of conducting the affairs of the association. It was recognized, when the association met in New York City some years ago, that it would be impossible for the association to go ahead under the then existing method of holding meetings in cities to which it was invited by the local street railway companies, as such companies were required to assume practically all the expense of entertaining the association. At the New York meeting it was first suggested that a Manufacturers' Association, similar to those associations which have been in existence for many years in connection with steam railroad organization, should be organized, to take charge of the exhibits at conventions and the entertainment of the association, so as to place the association in a position to go to whatever city it was thought best in the wisdom of the executive committee to hold its convention. A year passed without any action, but there was a great deal of discussion. Many of the members took the position that something intangible would slip away from the association if they let any one take the management of the exposition and the entertainment of the association except the railroad company in the city in which the meeting was held. Fortunately, better judgment prevailed, and the association to-day had an allied organization which had arranged at this convention an exhibit and entertainment such as the association never had before in its history. This had been done without any expense to the association or to the railroad management of the city. This has placed the association where it should be—in a position so that it can go to any city in the United States to hold its conventions, irrespective of any question of the ability of the local railway companies to entertain the association or any question of disposition to do so.

Mr. Vreeland said that the time had now come when a decided change should be made in regard to the method of running the association. It had been evident to everyone who had been connected with the association for some years past, that if the companies were paying only $25 a year in dues they were not getting more than $25 worth of value out of it. Everyone had an opportunity of considering and discussing the changes proposed, as the question had been up for the last two or three years. Mr. Vreeland referred to the fact that the organization of the American Railway Association, with which he had been connected for a number of years, and its affiliated associations, is identical with the plan proposed here, and that in the case of the American Railway Association it had produced the very best results. Instead of some one in the East groping on a proposition and another man on the Pacific Coast groping on the other end of it, they took all questions up and endeavored to establish a uniform standard. Among other things, they have established a uniform standard time for the United States for the operation of railroads, and have established a uniform system of rules and regulations for the operation of trains and telegraph orders, so that an engineer in Maine could run an engine in California or in any other State. The business of the American Street Railway Association should be conducted in such manner as to be of similar value to the members. There must be a change if the association was to go on; it could not go on as it had been doing. The proposed plans had been considered at very great length, the committee had had the judgment of experts, and the association was now presented with a plan under which it could go on and work along higher lines, produce better results, and keep pace with the development of the industry.

President Ely said that sometimes an erroneous impression prevailed concerning the thought that underlies such work as this. On behalf of those who have been laboring on the proposition, the present executive committee and the past executive committees and others, he wished to disclaim any idea of doing some academic or theoretical thing. What they desired to get was something intensely practical; they had been moved largely by monetary considerations. The plan presented had a commercial purpose. The questions of what was going to be secured by the plan, what it

was going to cost, and where the money was to come from with which to defray the expense, were three hard business propositions that have exercised the minds of all who had worked upon the subject. The personnel of the executive committees for the past two years who had worked upon the problem was that of men who had little time for sentiment; it was a hard business proposition, pure and simple. A great deal of time had been devoted to the consideration of the schedule of dues, and consideration was given to the number of companies in the different classes and what they would pay under the new plan. The benefits derived by the companies in the different classes and the amount of dues they would pay had been very carefully weighed. The larger companies, it should be remembered, are the ones that can get along the best without such an association. The larger companies have so much revenue that they can afford to hire experts to determine every question that perplexed the minds of their managers, but the smaller companies cannot do that. The small companies have imposed in the past upon the good nature of the large companies in securing information from them; the large companies cannot stand that any longer—the burden involved is too great. Mr. Ely said that a gentleman who has a great system of street railways wrote him recently that it could well afford to pay the association for a proper bureau of information to supply the information that was asked from his company $1,000 a year in addition to the dues, and that money would be saved to his corporation in that way. President Ely referred to Mr. Goodrich, of Minneapolis, who had told him that he always tried to give the information that was asked for, and to give careful thought and study to the preparation of it, but he said that the heads of departments were very busy, and although he turned these requests for information over to them, coupled with the request that they receive careful investigation and reply, he knew that much went out which was not satisfactory to him. It is not the larger companies that are benefited most by the association, but the small companies. Going half-way down the list, from the companies with a gross income of $50,000, to those with an income of $500,000, $1,000,000 and $2,000,000, those are companies that have problems that are of sufficient importance to require thorough expert investigation, the same as those which confront the $10,000,000 companies, but while they have the demand for such information they have not the revenue to make the special investigations. Therefore, the companies in the middle of the list will receive more benefit than the large companies. It resolves itself in this kind of co-operation to the point it always does—where you get men enlisted together to work co-operatively for the mutual good—that those with the largest resources contribute the most,—those who could best get along without such co-operative work, join in the work for the benefit of others. It seemed to him that the list of fees would be found to be well balanced.

At the close of Mr. Ely's address Frank G. Jones, who temporarily occupied the chair, put the motion to adopt the new constitution to a vote, and the proposed constitution and by-laws, as amended by the executive committee, and further amended by Mr. Beggs' suggestion, were adopted.

The secretary announced that the Engineers' Club and the Manufacturers' Club, of Philadelphia, tendered to the officers and members of the association the privileges of the respective club houses for this week.

Chairman Jones announced the appointment by President Ely of the following committee on nominations: Messrs. Parsons, of Philadelphia; Vreeland, of New York; Sergeant, of Boston; Stebbins, of Columbus, Ohio; Read, of Salt Lake City.

Chairman Jones announced the appointment by President Ely of the following committee on resolutions: Messrs. Allen, of Utica, N. Y.; Rigg, of Reading, Pa.; Smith, of Omaha.

H. J. Davies, of Cleveland, stated that in line with the suggestion in the address of the president and the recommendation of the executive committee, he wished to move the appointment by the president of a standing committee of five upon insurance and fire protection. The duties of this committee shall be to gather statistical information and to study the subject of fire insurance, and more particularly the protection of street railway property against loss by fire and the consequent loss to business. The more important part of the duties of the committee would be the subject of the better construction of car houses and better protection against loss or damage by fire, as the loss to the company, owing to interruption of business consequent upon fire, is much greater than the amount which is likely to be collected from any insurance company after a fire. Fire protection is more important than fire insurance. Properly protected car houses can be insured at a much lower rate than car houses as they now exist, as a rule. A reduction in rates would follow naturally the better protection of the houses. The rates on car houses at present are much too high. Reports from more than 400 street railway companies of the amounts paid by them for insurance in the past ten years, and the amount of losses sustained, indicate that the losses have been less than one-third of the amount paid for insurance, so that there has been great profit in the insurance of railway property to the insurance companies. This committee could verify the figures and gather information which will be of benefit to every member of the association, and there would be presented to the committee plans for the insurance by street railway companies themselves of their own property at actual cost.

Chairman Jones put the motion, that the president of the association appoint a standing committee of five, to be known as the fire insurance committee, and the motion was carried.

The meeting then adjourned.

GENERAL VIEW OF NORTH EXHIBIT HALL AT THE PHILADELPHIA CONVENTION, LOOKING SOUTH

THURSDAY MORNING SESSION

Vice-President Beggs called the meeting to order at 11 o'clock, and stated President Ely was engaged on other business in connection with the affairs of the association.

The first business of the meeting was the reading of the paper on "Notes on the Design of Large Gas Engines with Special Reference to Railway Work," by Arthur West. In the absence of Mr. West, J. R. Bibbins extracted the paper. This paper will be found on page 592.

Chairman Beggs, in calling for discussion on the paper of Mr. West, said he was one who thought that great economies would be brought about in the production of power through producer gas engines, and therefore papers such as that of Mr. West were extremely interesting. Some three or four years ago, at a meeting of the association, he had stated that he thought it would be possible to reduce the cost of power at least one-half by the use of gas engines. He, therefore, hoped that the members would discuss the paper very freely.

C. O. Mailloux suggested that the paper by J. R. Bibbins on "The Application of Gas Power to Electric Railway Service" might be read and both papers discussed at the same time.

Mr. Bibbins then presented his paper. (See page 594.)

Chairman Beggs, in calling for discussion on the papers, stated that on behalf of the association he wished to express thanks to the authors for the valuable work which they had put upon the preparation of these papers, and he hoped that the papers would draw forth some discussion and inquiry.

C. O. Mailloux, of New York City, thought the names of the authors which appeared in these papers were sufficient guarantee of the merits of the papers. Mr. West for many years had been engaged in the designing of steam engines of the Corliss type, and was considered at the time he left the steam engine field, if he had left it, one of the best authorities in the designing of steam engines; hence, in going into the designing of gas engines, he brought with him a most valuable experience. He said that Mr. Bibbins had for a long while given much study to the gas engine, and had been connected with the gas engine since it had become a factor. There was too much meat in these papers to be discussed in detail, but there were one or two points which showed in themselves the progress the gas engine is making. At the last convention there was a reference to the subject of gas engines, and he had taken a part in the discussion. He called attention last year to the fact that from the data at hand, the evidence went to show that the two lines in the diagram of comparative costs crossed at a value corresponding to $2 or more per ton for coal. That meant for any value of coal corresponding to about $2 per ton, the two systems, the steam plant and gas plant, were about equal. This year Mr. Bibbins gives a diagram where these two lines cross at $1 per ton. He thought that was a very significant fact. It showed that the cost of the gas engine power must have been greatly reduced in some way. Either that has been brought about by reducing the cost of the machinery itself or the cost of its maintenance, or by increasing its efficiency, and it would be very interesting to him, in fact he considered it the most interesting feature of the entire paper, if Mr. Bibbins would give out of the vast fund of knowledge which he possessed on the subject some clew as to the reasons which have brought about that result. If that ratio kept on we might reasonably expect to find that these two lines in the course of another year will start at zero and cross at some point near zero in the cost of coal. The line representing the cost of power by gas engines has been flattened; there is a smaller angle with respect to the axis of the cost of coal. While in most systems a lessening of expenses is largely due to the reduction in initial cost of equipment, to better methods of manufacture, and to a simplifying of the apparatus itself, yet he was interested in knowing whether the increasing efficiency of the engine and the reduction of repairs and maintenance, may not have had a great share in reducing that cost.

Mr. Bibbins replied that he did not quite understand to what diagram Mr. Mailloux referred, whether it was to a paper presented by Mr. Bibbins to the Ohio Gas Light Association.

Mr. Mailloux replied that he had reference to a lecture on the subject given by Ralph D. Mershon, before the New York Electrical Society.

Mr. Bibbins replied that he was not quite familiar with the assumption taken in the paper by Mr. Mershon, but assumed that Mr. Mershon worked up his diagram for an electric lighting plant, in which the load factor on the system is barely 25 per cent, usually lower than that. If reference was made to his assumption in the last sheet of the report, it would be found that he had taken a load factor corresponding to an average plant, which is 66 per cent. That is really the greatest factor in determining the exact crossing of these two lines. He was not familiar with the prices which Mr. Mershon used in preparing his diagram. The costs he had used are shown in the assumptions and they are quite recent. It will be noticed on the diagram that the lowest set of figures referred to the cost of fuel only. There, of course, the gas plant has a great advantage. In the second set of figures the cost of fuel is represented added to the cost of operating. He had estimated the cost of operating, labor supplies and repairs at 0.5 cents per kw-hour. Without looking for absolute definite information he was obliged to take the same figure for both plants, and he had shown that it was very possible in the gas plants that these items might be still less.

Mr. Mailloux remarked that the price was high.

Mr. Bibbins answered that such was the case, but as he had taken them for both stations the comparison was not unfair. The other set of diagrams takes into account the fixed charges. The present cost of anthracite coal brings it well within the range of power plants generally. For instance, it is possible to obtain in Cleveland and Buffalo, which are comparatively central points, pea anthracite coal at $3.12 per ton; No. 1 buckwheat coal at $2.45 per ton, and No. 2 buckwheat coal at $2 per ton. This, it could be seen, brings the anthracite producer plant well within the range of ordinary purposes. Where plants are located in the bituminous field or adjacent thereto, there would be no question about their economy.

Charles Hewitt, of Philadelphia, said that he well appreciated the difficulty of preparing diagrams such as Fig. 10, as he had attempted on several occasions to prepare similar diagrams. He didn't, however, think that these should be accepted without some question and some comment. He was not prepared to question Mr. Bibbins' line of cost for the gas plant, but the line showing the cost per kw-hour for the steam plant seemed to him to be open to question. Whether the diagram represented the comparison between two particular plants or not, he could not say, as he had not had an opportunity to read the text of the paper. If it did, all that he could say was that the steam plant indicated in the diagram is very uneconomical. Anthracite buckwheat coal runs between 11,000 and 12,000 heat units per pound of coal. Fig. 10 shows that this coal would run from 6.5 lbs. to 8 lbs. per kw-hour. The poorest plant with which he was personally familiar showed better results than that. He was familiar with plants running non-condensing which showed 4.5 lbs. of coal from year's end to year's end. The consumption will run as low with good coal as 4¼ lbs., seldom over 4¾ lbs., and the average for the year will be 4.4 lbs. to 4.5 lbs. Running condensing with the same quality of coal, it is perfectly possible to run at 3.5 lbs. of coal. The saving in coal with the gas plant is sufficiently large, it seemed to him, without magnifying and without putting a curve in the diagram which shows an abnormally inefficient plant. Mr. Hewitt further said that the same result was shown in Fig. 15, in which, it seemed to him, the difference between the cost of operating the steam plant and the cost of operating the gas plant was magnified. Thus, with coal at $2.50 per ton, the diagram shows that the cost of operating the plant would be over 9 mills per kw-hour. He was perfectly familiar with plants which are running at 6 mills with buckwheat anthracite coal, including all operating costs and repairs, but not the interest on the plant. It is a very uneconomic plant that will run the year through at 1 cent. So that it seemed to him that if the diagram in question is intended to represent the average results throughout the whole country, it is very high for the steam end of it, and therefore magnifies the difference between the two lines, assuming the cost for the gas plant is correct. He expressed himself as not being quite clear in regard to the table for operating costs for the London Metropolitan Boroughs. Thus Table IV. gives the cost for fuel, supplies, labor, repairs and works, and then the total for eleven plants; but the total did not agree with the other items, or with the total of 2.8d., which Mr. Bibbins had quoted. He also wished to know what is meant by the cost of "works," which is by far the largest item.

Mr. Bibbins replied that the records of the British power plants are uniformly expressed in "works cost." Unfortunately, the head of the table has simply "works" instead of "works cost." That includes the four items: fuel, supplies, labor and repairs, without any fixed charges or management expenses, and corresponds to what in this country we call "operating expenses." It will be noticed that this paper is expressed in pence instead of cents, and therefore the cost, as he quoted them on the platform, was 2.8. Just below operating expense in the per cent of works cost, he had taken the works cost as 100 per cent and shown the distribution of expenses in the operating cost. The management expense increases that amount by 29 per cent in the case of the steam plant and 23 per cent in the case of the gas plant.

As regards Fig. 10, he was somewhat apprehensive that that diagram would be misunderstood, and therefore had taken pains to mention that it referred to a non-condensing plant. The equip-

ment at St. Louis consisted of the three-cylinder vertical gas engine belted to a generator and an engine of similar capacity. It could not be expected to get the same economy out of these two plants as out of the large central station, not from the fact that the equipments were not equally comparable, but it must be borne in mind that the results were obtained with a non-condensing plant. He thought it was safe to say that the relative coal consumption between steam and gas plants would be about two to one. In the present case the ratio is higher, as the steam station is now condensing. He asked if that answered the question.

Mr. Hewitt replied that he did not raise any special question about the curves, except to state that it seemed a high line for the steam cost. The intermediate line in Fig. 10, B.HP., it seemed to him, would be a fairer average line for stations running with anthracite coal. Non-condensing stations using anthracite coal can be run for 4.5 lbs., and are so run, and that is one-half of the difference shown on the two lines in question.

Mr. Bibbins replied that, assuming 4.5 lbs. of coal at the calorific value quoted by Mr. Hewitt, 11,000, that would bring the comparative efficiencies in about the ratio mentioned, two to one. It would be noticed from Table III., which gives the results from the Walthamstow station, that the average consumption was 1.78 lbs. of coal per kw-hour for twelve days' operation, or, as stated further on, about 2 lbs. of coal for anthracite coal, including extra coke for banking and raising the steam required to blow the producer. As to the diagram showing the comparative costs of steam and gas, Fig. 15, he had probably erred in the matter of assigning a cost of .5 cent for the three items: labor, supplies and repairs. That, however, did not affect the relation between the two, and he preferred to assign that equal value, in order that any particular quantity might be applied to other data. It would readily be seen if any advantage could be obtained in the gas plant that the power gas line would be lower, and consequently the intersection of the two would be nearer the cheaper grade of coal.

Mr. Mailloux inquired if Mr. Bibbins was able to give any information as to whether a change in the size of the plant would have any effect on the relative arrangement of these lines.

Mr. Bibbins replied that that was a difficult question to answer definitely. There was one point which had a bearing on it, and that was the fact that a small gas engine will show an efficiency quite comparable with a large one, therefore the choice of the larger engine is determined mainly by the capacity necessary in the plant running with the view of obtaining ordinary higher economy. He didn't see any reason for the change in the relative costs of these various items in the smaller plant, provided the same number of units was used. The number of units, of course, has an immediate bearing on the operating cost.

Mr. Mailloux said he did not think the question had been fully answered. He had intended to add to his remarks that the question of cost of installation, it seemed to him, had quite an important bearing on the upper line of total costs, and he would presume that the smaller plant would have a much higher cost per kw-unit than the larger plant, as is found to be the case with steam plants, at least within certain limits. In the present connection he would also like to ask Mr. Bibbins to give information as to whether the cost per kilowatt of gas engines had not been considerably reduced within the last year.

Mr. Bibbins replied that he agreed with Mr. Mailloux that the smaller plant would cost more per kilowatt, even though the same number of units were installed. At the same time the relative uneconomy of the steam plant will increase much more rapidly with small units, and this fact might readily more than balance the increased capital cost. The producer in smaller sizes is much more efficient than the boiler, and the same is true with the engine, although it is impossible to tell whether the same relation will hold. He didn't think he was in position to give Mr. Mailloux any correct data as to whether the cost of gas engines had been reduced in the last year; that was something which was not in his field.

Mr. Mailloux suggested that the floor should be given to L. C. Marburg, representing the Allis-Chalmers Company.

Mr. Marburg said regarding Table VII., he would inquire if the overload capacities had been taken into account in comparing the relative cost of the steam engine and the gas engine. He thought from the price given for the steam engine plant that it is evident that a reciprocating steam engine could be obtained which would have a 50 per cent to 100 per cent overload capacity momentarily. He understood from Mr. Bibbins that the way he rated the gas engine is on the basis of 10 per cent overload capacity only. That might explain the point brought up by Mr. Mailloux as to the relative cost per kilowatt in the case of the steam engines and gas engines as given in the paper.

Mr. Bibbins replied that the gas engines were rated at a 25 per cent overload capacity. The steam engine would have a greater overload capacity.

Mr. Marburg answered that that naturally would explain why on the curve given as to the relative costs for steam engine plant and gas engine plant the advantage is in favor of the gas engine at such a low cost of coal as given.

Mr. Bibbins stated that Mr. Marburg probably misunderstood the matter; that Table VII. applies to the tender in the European plant, and it has no bearing on the diagram he had prepared. The diagram was prepared from the assumption shown in Table VI.

Mr. Marburg replied that in that table the price of $40 per brake-hp was given again. It would naturally be of interest to know what the overload capacity was.

Mr. Bibbins replied that the basis for an overload capacity in the case of the gas engine was 10 per cent. It was possible to assign an overload capacity in the same way on the steam engine. To take the steam engine at such capacity will give its best economy at about 80 per cent load, as is normally the case. He had taken the engine so that it would give its best economy at the average load of 75 per cent of the full load. If we take the engine on the basis of 10 per cent below its maximum the steam consumption would be much higher, although the fixed cost would be considerably reduced.

Mr. Marburg remarked that it would seem impossible to obtain a load factor of 66 per cent if the overload capacity of the machine is so small. That is a good load factor for a reciprocating steam engine.

Mr. Mailloux said that the point which Mr. Bibbins made, it seemed to him, was largely influenced by the form of steam motor used and its efficiency curve. One could see at once that it would be quite different in the case of steam turbines, which have a notoriously flat efficiency curve, and it seemed to him that if the comparison were made with the steam turbine it would be found in the first place that the line of cost for steam power would be much flatter for a smaller angle than it now is, and in the second place, the cross line would go further up. In the case of the comparison of the gas plant predicated as the basis of the calculations of the steam turbine plant, the line at which the two would cross would be more nearly at $2.

Mr. Bibbins inquired if Mr. Mailloux was assuming only 10 per cent overload in the two cases.

Mr. Mailloux said that he did not think it would be necessary to make an assumption in the case of steam turbine, because the efficiency curve is so nearly flat for three-quarters of its range. That if it was assumed that the normal capacity was 10 per cent of the stalling load, that the comparison would be still more favorable to the turbine, and this would force the point of intersection between two curves at same point at least as high as $2 per ton.

On suggestion of Mr. Mailloux, Mr. W. E. Winship was given the floor. Mr. Winship said he thought he could add a few figures on the gas-engine plant that might be somewhat interesting. They had installed for the Gould Coupler Company at Depew, N.Y., a gas-engine plant consisting of three Westinghouse vertical engines rated at 235 hp each, with Loomis-Pettibone gas system. The plant cost almost exactly $115 a brake-hp to install. They estimated that it would have cost $90 per horse-power for a steam plant, equivalent to the gas plant, excepting as regards coal consumption. In regard to the overload capacity, they figured that by installing a storage battery they could get the same overload capacity out of the plant. After the batteries are installed the plant will have cost about $130 per brake-hp, and for the same overload capacity as the steam plant. Their coal consumption, based on coal containing 13,400 B. T. U. per pound, has been on a monthly average 2.26 lbs. per kw-hour on the switchboard, with a load factor on the plant of roughly 50 per cent for twenty-four hours' operation. On a series of days when their load power was approximately 64 per cent or 65 per cent, the coal consumption went down to 2.02 lbs. as an average of the days when that condition existed. The lowest record for twenty-four hours' period of operation, when the load was especially good, was 1.79 lbs. of coal for a kw-hour on the switchboard. That load is very similar to what is used in street railway work. The peaks, when the load is heavy, are fully 60 per cent above the average, and when the peaks are lighter, they are fully 100 per cent above the average load. The conclusions were that with coal at $2.30 per ton, and with the plant operated for about fourteen or sixteen hours a day, the steam plant and the gas plant would have just balanced each other, but that with the twenty-four-hour operation the gas plant is more desirable. In regard to the reliability of the plant, he could state that it has been fully as reliable as any steam-engine plant that could have been put in. They had only had the valves in the engines ground once, with the exception of one valve, which they ground twice. They used the splash lubrication.

Mr. Winship further said that there are two points worthy of attention in any gas engine installation. There is a criticism which could be made in regard to the admission of the engines, especially where it is electric ignition. Some means should be provided for changing the igniters when the machine is in operation. The speaker did not know of any engine in which that is provided for. Another need is for some indicating instrument for determining roughly the heat contents of the gas. Of course, there are calorimeters by which the heat contents of the gas may be determined, but there is no rough and ready instrument to put in the gas producer house. The need for such an instrument is especially pronounced in bituminous gas plants where the color of the flame does not give any idea as to the heat contents of the gas. There ought to be such an instrument, and it did not seem to be a very difficult problem to design one.

Mr. Hewitt remarked that it might be of interest to some of the members to know the latest results in steam turbine plants which he had received only a few weeks ago from New England. As opposed to the 2.26 lbs. of coal, which Mr. Winship gave as the average for thirty days, the results show 2.4 lbs. to 2.6 lbs. per kw-hour with bituminous coal. The average is 2.5 lbs. for turbines as against 2¼ lbs. for gas engines. One of these plants has five units of about 1000 kw; the other has two units, and he thought in the latter case there were about 1500 kw using superhated steam.

Mr. Bibbins stated that in regard to changing the igniters, there is a system in vogue now which makes possible the changing of an igniter when the engine is running. In the plant in Philadelphia each cylinder is equipped with an igniter plug, which has two contacts, and either one may be thrown in or out by a little switch. There are four different sources of current for supplying the igniters, and each cylinder is provided with a double set of igniters. If one of the igniters gets into trouble the other can be quickly cut in. If any of the gentlemen present were sufficiently interested he would be glad to go to the pumping station with them and show them the gas engine in practical operation.

REPORT ON NOMINATIONS

The committee on nominations made its report at this point. John B. Parsons, chairman of the committee on nominations, presented the following list of nominees:

For president, W. Caryl Ely, of Buffalo.

For first vice-president, John I. Beggs, of Milwaukee.

For second vice-president, Calvin G. Goodrich, of Minneapolis.

For third vice-president, James F. Shaw, of Boston.

(Under the new plan of organization the members of the executive committee are made up of the officers and the presidents of the affiliated organizations. At a later period in the meeting, President Ely announced the following members of the executive committee: H. H. Adams, of Baltimore, on behalf of the Mechanical Association, and S. L. Rhoads, of Philadelphia, on behalf of the Claim Agents' Association. As the Accountants' Association had not yet elected a president for the ensuing year, the name of the member of the executive committee representing the Accountants' cannot be given until next week.)

On motion, the report of the committee on nominations was accepted, and the secretary was authorized to cast the ballot of the association for the gentlemen named, which was accordingly done.

In response to calls for a speech, President Ely remarked that if he should say that the action taken by the association in electing him again to the presidency was not gratifying to him, he would not be telling the truth, but when he said that he had devoted a great deal of time to the association for the last year, and considerable time the year before, and that he could see that there was a lot of work to be done during the coming year, to be commenced immediately, and that the members should have selected some other person as president to go ahead at the present time, for several reasons, he would also be telling the truth. He said that when his friends had come to him and said very nice and very pleasant things, he had grave doubts about whether they applied to him or not, and whether he really deserved all that had been said. He had said to these individuals that it seemed to him to be a time to put in a new man. The association had agreed upon a form of organization, and as he was not conceited, he thought there were a lot of men available from whom a selection for president could have been made, but it seemed to him that he had been caught with the goods on and could not get away, and, of course, he would stand. But there is a great deal of work to be done, and the new plan of organization cannot succeed unless hard work is put upon it and unless that work is participated in by all the leading members of the association. Everybody in the association must be called upon to co-operate.

President Ely believed that if every member of the association did his duty, the organization which would result in a couple of years would be so big and useful to every member that the common sense of all connected with the association would lead them to say, "Why did we not inaugurate this ten years ago? What were we doing?" He expressed his appreciation of the great honor conferred upon him. He would do his best with the assistance of the members, which assistance he trusted they would all give, and in conclusion, he desired to say that he appreciated the action of the association as a very great honor.

Mr. Beggs said that he wished to say a word of approval of the action of the nominating committee in the selection of Mr. Ely. As many of the members know, there were a number of gentlemen who in the kindness of their hearts approached him with the idea three days ago that he should be made the president of the association. He had taken the position that the incumbent of the presidential office at this juncture should not be changed; that the future of the association depended largely upon the work that had been under consideration for the past two years, and should be largely left in the hands of the head of the association who had been so intimately connected with it. Mr. Beggs appreciated the honor conferred upon him in selecting him as the first vice-president of the association. He wished to pledge to Mr. Ely his best support in assisting Mr. Ely in what was to be done. He understood fully the burdens which the president was assuming, and he desired to pledge to the association the best efforts he could give to its advancement. He did not know whether Mr. Goodrich was present at the session or not, but he was glad that Mr. Goodrich had been continued as vice-president in the association, and that those were coming into office who were familiar with what was intended to be accomplished under the new form of constitution and by-laws.

The president said that the choice of vice-presidents was an admirable one. Everyone knew from experience how wise and how able and how effectively Mr. Beggs worked. It was a great thing for the association to have services like his at its disposal. It was worth money to anybody to have John I. Beggs work for him. President Ely also said that Mr. Goodrich was a very able man and a splendid organizer, and from the talks he had had with Mr. Goodrich during the past year, he knew that his heart was in this work. The same was true of Mr. Shaw, the third vice-president. Although he had not been a member of the executive committee during the past year, he had several times, at the invitation of the president, left his work, and he thought the members could rest assured that the affairs of the association would be taken hold of in a way which would produce results. Outside of the official personnel of the organization there were a large number of gentlemen who were very much interested in the work who had been freely called upon during the past year, who had given very freely of their time and made most valuable suggestions. At some proper time in the future proper recognition should be paid them of their help, because they were very valuable men. As could be readily understood, sometimes a man working along lines like these has doubts as to the outcome of the plans which are made. He had been greatly strengthened during the past twenty-four months by the suggestions and by the expressions of men notable in the world of railway achievement, and he wanted to mention one. Yesterday he was at luncheon with Dr. Wilson, the president of the Commercial Museum. Dr. Wilson had invited Theodore N. Ely, who has charge of the entire motive power of the Pennsylvania Railroad, to take luncheon with him also. There was a short talk between them, and Theodore N. Ely requested a short statement from the president of what they were doing. Then Theodore N. Ely, who has been a member for years of the executive committee of the Railway Association, and also of different engineering societies, outlined what he thought as a rough suggestion, would be the plan they should have and what he said would be of immeasurable advantage to the association. If he had been reading the proposed form of reorganization carefully he could not have sketched and outlined it much better than he did. The suggestions he threw out were very pleasing to the president at that particular moment. Theodore N. Ely further said that there was no question in the minds of the men who to-day are directing the great railway systems, that the Master Car Builders' Association and the Master Mechanics' Association and the different organizations relating to steam railway work had been of immeasurable value to the steam railroads, and had put forward by years the time of arrival at the present standard of steam railroad work, and he said further that the wisest man, the man who can see furthest to-day, can see but a short distance and can form but a faint impression of the work the members of the American Street and Interurban Railway Association were engaged in. The electrical development is occupying and engrossing the attention of the foremost men in steam railroad work, and he argued great good to the railroad industry from this organization.

The president, in conclusion, said that if the members worked wisely and well, taking good advice and following it, and all co-operated, that in a year's time he believed the association could make an amazing stride.

The association then took a recess for luncheon.

THURSDAY AFTERNOON SESSION

President Ely called the meeting to order at 2:15 o'clock. At the afternoon session the papers on "The Single-Phase Railway System," by Charles F. Scott, and on "Electric Railway Equipment," by W. B. Potter, were read. Both of these papers are published elsewhere in this issue.

There was a lengthy discussion on these papers which will appear in a later issue.

On motion of W. E. Harrington the following resolution was passed:

Resolved, That a vote of thanks of the association be extended to the authors of the very interesting and valuable papers presented at this convention; and be it further

Resolved, That this association appreciates the courtesy of the manufacturers in permitting the preparation of the character of papers presented and the attendance of their experts in connection therewith.

On motion of Mr. Harrington the following resolution was also adopted:

Resolved, That all regular standing committees of this association shall hereafter consist of three members.

Mr. Beggs, who was appointed chairman of the committee to prepare suitable resolutions with reference to the services of Thos. C. Penington as secretary and treasurer of the association, offered the following on behalf of the committee:

Whereas, Thomas C. Penington, who has been the secretary and treasurer of the American Street Railway Association for ten years past, having severed his official relation because of the determination of the association to establish headquarters in the city of New York, and the necessity of continuous attention to its affairs by the secretary; therefore, be it

Resolved, That the American Street Railway Association does hereby record a minute of its earnest appreciation of Mr. Penington's fidelity to its interests, his devotion to its welfare and the eminently honest and satisfactory manner in which he has discharged the rusts imposed upon him; and

Resolved, That Mr. Penington's relations to the individual members of the American Street Railway Association have established friendships which will last through life, and they part with his services as an officer with the deepest regret and with lasting appreciation of his kindly thought and attention to themselves and their friends during the many conventions which have been held under his able assistance. Respectfully submitted,

JOHN I. BEGGS,
C. G. GOODRICH,
W. E. HARRINGTON.

The resolutions were unanimously adopted by a rising vote.

Mr. Beggs stated that for two years past there had been a committee of the association upon the matter of rates paid by the government for mail service on the cars of the members of the association. That committee had done nothing during the past year, and he therefore offered the following resolution:

Resolved, That a committee of three active members of this association be appointed to present to and urge upon the honorable Postmaster-General and the honorable committee on postal affairs of the Congress of the United States the necessity of allowing and providing for much larger compensation for carrying the mails on street and interurban railways, both for postal car and pouch service, and likewise the necessity of modifying the conditions under which such service is performed.

The resolution was adopted.

The president appointed as a committee on United States mail service the following-named gentlemen: John I. Beggs, of Milwaukee; G. Tracy Rogers, of Binghamton, N. Y., and P. F. Sullivan, of Boston.

The following report of the committee on rules was presented:

REPORT OF STANDARD RULES COMMITTEE

The standard rules committee respectfully submits the following report:

First—At the instance of the committee the secretary sent out a circular to all the members of the association, requesting suggestions applicable to the last report of the committee, together with any ideas which would enable the committee to make further progress in their work. The replies received indicated to the committee that the rules governing city lines had to a large extent been adopted.

Second—The committee finds a diversity of opinions and ideas in relation to the rules for the government of interurban lines, and they recommend the rules adopted by the American Railway Association for the operation of steam railroads, which are the result of years of study and experience, be adopted by interurban lines as far as practicable, and we further recommend that the secretary of this association furnish to each member a copy of these rules, and that the members of the association inform the standard rules committee as to the applications of those rules to the lines which they operate, making such suggestions and recommendations to the committee as will be of value in the prosecution of its work.

The committee further recommends that the work of the standard rules committee be continued, and that at least two members of said committee shall be operators of or familiar with the operation of interurban lines.

Respectfully submitted,

E. G. CONNETTE,
W. E. HARRINGTON,
ROBERT McCULLOCH,
JOHN J. STANLEY.

On motion the report of the committee was adopted.

The president appointed the following-named gentlemen as the rules committee: E. G. Connette, Richard McCulloch and E. C. Faber.

The president appointed as the committee on insurance the following-named gentlemen: H. J. Davies, E. W. Olds and T. C. Penington.

The committee on resolutions then reported a set of formal resolutions, in which the thanks of the association were extended to the American Street Railway Manufacturers' Association, its officers and members; to John B. Parsons, president of the Philadelphia Rapid Transit Company, and the other officers and heads of departments of that company; to the officers of the Philadelphia & West Chester Traction Company; to the passenger railroad associations for reduced rates; to Dr. W. P. Wilson, director of the Philadelphia Commercial Museum; to the officers of the Engineers' Club, the Manufacturers' Club and the Southern Club for courtesies during the convention; to Mayor John Weaver; to the citizens of Philadelphia; to the local press; to the local entertainment and reception committees; to the hotels; to the local and long-distance telephone and telegraph companies; to the local postoffice officials and to all the civic, social and business interests of the city of Philadelphia, who have contributed in so large measure to the success of the meeting.

The resolutions were unanimously adopted.

On motion of Mr. Bean the following resolution was adopted:

Whereas, The Accountants' Association will be in session until Saturday afternoon, Sept. 30, 1905,

Resolved, That this association do now take a recess until the close of the last session of said Accountants' Association, at which time this association will stand adjourned sine die.

The meeting then adjourned.

CONVENTION NOTES

The arrangements for the convention hall and exhibit features were most complete and showed great care and elaborate preparation on the part of the local committee of the Manufacturers' Association. The exhibits are referred to at greater length elsewhere and will be described in extenso next week. The convention hall was improvised from a gallery over the south wing of the museum and which formerly was used for storage purposes. Here a spacious hall had been partitioned off with double doors, and the wall lined with paper to intercept any sound which might penetrate from outside. On the three remaining sides a series of tall windows gave all the light and ventilation required. The hall was decorated with potted plants, and the platforms with rows of palms and potted flowers. Behind the speaker's chair was a floral design reading, "Philadelphia, 1905, Welcome." The hall was amply large enough to hold all those in attendance on Wednesday and on other days. A similar room was provided at the other end of the gallery for the accountants. The American and Mechanical Associations met at the west end of the building.

The badges this year were very tasteful. They were in blue and gold, and showed a double-truck car mounted upon a keystone, upon which was a representation of a Liberty Bell. The design was surrounded by two flags and surmounted by an eagle. As usual, five colored ribbons were used, blue for the American Association, brown for the Mechanical, orange for the Accountants, red for the Manufacturers, and white for the guests. Following the practice last year, every badge was numbered and an index was published, both alphabetically and by numbers, of the attendants at the convention. The index was published on different days and in several editions. Edition 1 covered the registration for the first two days, and edition 2, that of the first three days. In view of the large number of names recorded, the accuracy with which these names were printed is worthy of remark.

The Philadelphia Rapid Transit Company and the Philadelphia & West Chester Traction Company issued books containing forty-eight tickets to each attendant at the convention. These books were distributed by the respective secretaries and were greatly appreciated by the attendants.

The interchangeable coupon ticket books have been placed on sale in Indianapolis. They are good over twenty Ohio, ten Indiana and two Michigan lines. The book sells for $10, or at a reduction of 16 2-3 per cent. It cannot be presented for payment on a ride which calls for less than two coupons.

THE BANQUET

The annual banquet was held Thursday evening, Sept. 28, in the clover ball room of the Bellevue-Stratford, which had been exquisitely decorated for the event with palms and cut flowers. A touch of appropriate sentiment was happily secured by including on the stage at one end of the ball room, partly screened amid banks of palms, a perfectly constructed model of a New York Broadway car, as built by the John Stephenson Company. The model was loaned for the occasion by the J. G. Brill Company. Another touch of "localism" that was fully appreciated by the diners was the serving with the "Sorbet Transit" of a miniature trolley car. About 200 guests enjoyed the unusually fine menu provided.

The menu card was cleverly designed to represent the great conquest of Franklin in the field of electrical science and the modern application of electricity to the traction industry. The design included an artistic presentation of a figures of Franklin, acting as a medium for diverting the electric current from the clouds to a modern electric interurban passenger coach.

During the dinner John B. Parsons, president of the Philadelphia Rapid Transit Company, acted as toastmaster, and added much to the enjoyment and success of the evening by his happy and well-chosen introductions. Responses to the toasts were made as follows: "Franklin's Day and Ours," Hon. John Weaver, Mayor of Philadelphia; "The Association," W. Caryl Ely; "Our Canadian Brethren," George Tate Blackstock, K. C.; "Corporations and the Commonwealth," Thomas N. McCarter; "Street Railway Management," John I. Beggs; "The Trolley," Gen. Eugene Griffin; "The Ladies," James Rawle.

THE THEATER PARTY

Invitations to attend a theater party on Wednesday evening were extended by the Manufacturers' Association to all those in attendance at the convention. The entire seating capacity of the New Lyric Theater was secured and the attendance was very large. The play given was John C. Fisher's colossal production of "Babes in the Wood," and it was heartily enjoyed by about 1800 of those in attendance at the convention. No local hits were introduced in the performance, but the production was an excellent one, and this method of entertainment proved very popular, judging by the demand for tickets.

THE RECEPTION

The reception at the Bellevue-Stratford, on Tuesday evening, was the most elaborate ever held at a convention of the association. It was held in the ball room and adjoining foyers at the hotel, and was attended by a large number of the delegates and ladies. A list of the patronesses was published in our last issue, and included ladies whose husbands are prominent in Philadelphia railroading, manufacturing and social circles. The ball room itself was beautifully decorated, and an orchestra on the stage furnished excellent music for dancing, which was participated in by some of those in attendance. About half-past 10 an elaborate supper was served in an adjoining room, and most of the guests departed about 12 o'clock.

ANNUAL MEETING OF THE MANUFACTURERS' ASSOCIATION

The annual convention of the Manufacturers' Association was held on the afternoon of Sept. 27. Under the constitution of the association the terms of office of five of the members of the executive committee expired this year. Three of these were re-elected, and the committee now consists of: J. R. Ellicott, of the Westinghouse Traction Brake Company; John A. Brill, of the J. G. Brill Company; Charles Knickerbocker, of the Griffin Wheel Company; Charles K. King, of the Ohio Brass Company; George J. Kobusch, of the St. Louis Car Company; Charles C. Peirce, of the General Electric Company; Howard F. Martin, of the Pennsylvania Steel Company; James H. McGraw, of the McGraw Publishing Company; John W. Nute, of the St. Louis Car Wheel Company; Frank C. Randall, of the National Electric Company; Newcomb Carlton, of the Westinghouse Electric & Manufacturing Company; William Wharton, Jr., of Wm. Wharton, Jr., & Company; Fred S. Kenfield, of the Kenfield Publishing Company; E. H. Baker, of the Galena Signal Oil Company; E. M. Williams, of the Sherwin-Williams Company.

George Keegan was re-elected secretary of the association.

The executive committee, after the election, did not formally organize, but E. H. Baker, of the Galena Signal Oil Company, was elected chairman pro tem.

THE CHICAGO SITUATION

The public meeting campaign of Mayor Dunne, of Chicago, was begun last week. At the first of these meetings, held Tuesday evening, Sept. 19, at Lincoln Avenue and Roscoe Street, the Mayor unfolded his "contract plan," for bringing the companies to terms. In explaining why he had abandoned his plan to condemn the lines of the traction companies, according to his declared policy in numerous speeches during the city campaign, Mayor Dunne said:

"When I was making my campaign last spring I understood that the franchises had expired on only about 20 miles of tracks, of which the city could take immediate possession; that was the Adams Street line. After my election I appointed special counsel to look into the matter and they found that the franchises had expired on 130 miles of line, and that within two years franchises would expire on 114 miles of additional lines. They found that within two years 274 miles out of a total of 700 will be at the disposal of the city without condemnation proceedings.

"During the campaign we said we would offer the companies fair, reasonable, and full price for their properties. Although we have endeavored in every way to get these companies to place a price on their property, they have refused. We agreed that if we couldn't buy the properties we would condemn them. We advocated that proceeding, because we thought we had only a few miles of track at our disposal. We find that all we have to do is to take possession of these 274 miles of trackage, which cover the most populous districts of Chicago. These 274 miles will reach 1,100,000 people.

"We can dispossess the companies of these lines by placing a policeman at each end of the track on which the franchise has expired. That is the situation as I found it when I presented my message to the City Council July 5, proposing that a company be organized to build a street car system for the city. That plan has been before the people nearly three months. It has been calumniated and villified, but no defect has been discovered in it."

Mayor Dunne then read his message and commented on it. In reference to the referendum he declared:

"No ordinance shall ever pass, unless over my veto, which does not contain a provision that it shall be submitted to the people for their approval."

The Mayor said he favored his "contract plan" to a purchase of the companies' properties, as proposed in his "city plan," because it would be six months before the question of issuing the Mueller law certificates could be submitted to the people, and six months more to test their validity in the courts. To save delay he proposed the contract plan. Work could be begun at once, and the test of the Mueller law certificates could be had while the work was going on.

"The company I propose to organize is a constructing company," he said. "Every dollar it earns over the cost of construction and operation and the payment of 5 per cent on the money borrowed will go to the city. The City Council will pass on the plans and specifications, and on every contract made."

The Chicago City Railway on Tuesday, Sept. 26, submitted terms on which it asks a twenty-year franchise. The company agrees:

To interchange transfers and route through cars over Union Traction lines.

To rehabilitate lines with new cars and grooved rails, and to furnish service as required by City Council.

To accept a twenty-year franchise in lieu of all present rights and let the city purchase after a stated time.

To change all cable lines to trolley power, using underground trolley in State Street and down town if desired.

To sweep and sprinkle streets occupied by its lines.

To fill, grade, pave and repair 16 ft. of street occupied by its lines.

To make public reports of its earnings.

To pay compensation on a percentage basis, increasing with length of grant, charging 5 cents fare.

With an offer variously estimated to be equivalent to $30,000,000 or $35,000,000 in cash to the city, and providing for the termination of all rights under the ninety-nine-year act and ordinances, at the expiration of twenty years, General Counsel E. R. Bliss, of the City Railway Company, laid the entire traction proposition before the Council committee Wednesday afternoon, Sept. 27.

In the event that the city desires to own and operate the street cars at an earlier date, the ordinance provides that it shall have the right to purchase the lines at specified times, the Council to insert the dates, by paying the cash value of the physical property at the time of purchase and also the price fixed by arbitration as the value of the unexpired part of the franchises.

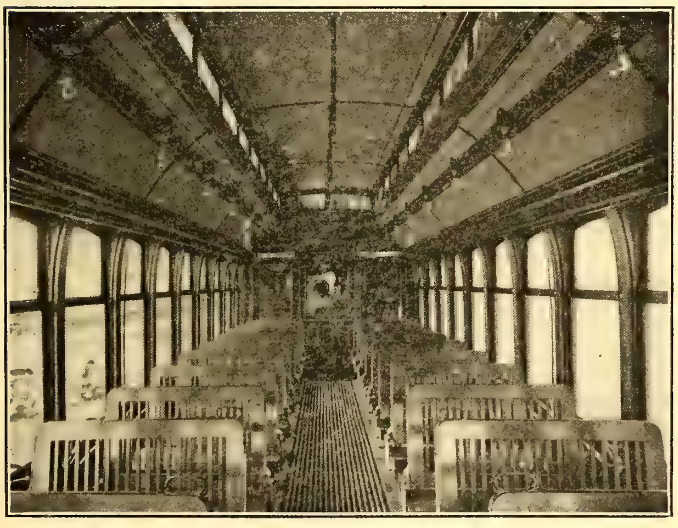
CONVERTIBLE CARS FOR SHREVEPORT COMPANY

The Shreveport Traction Company has lately received from the American Car Company several of the convertible cars illustrated, built under the Brill patents. Shreveport is the second city of commercial importance in the State, and does a large business in lumber and cottonseed oil. The convertible type mentioned is in considerable use in the Gulf States, where the climate is semi-tropical.

The sill step is a modification of the Narragansett type, and is wider than appears in the illustration, giving ample room for a secure foothold. The cover plates for the openings over these steps when the panels are drawn down may be plainly seen in the picture in their folded position. When the car is closed, these plates are raised flush with the floor and present an even surface. The value of this extra step will be at once recognized when it is

CONVERTIBLE CAR FOR THE SHREVEPORT TRACTION COMPANY, SHOWING TWO OF THE PANELS REMOVED

noticed that double trucks having equal sized wheels are used under the cars. With such trucks the car floor is too high to be easily and safely reached by a single step. The running board is the same height from the track as the platform step, and from sill step to car floor is same height as from platform to car floor. These heights are respectively 18 ins., 14½ ins. and 7½ ins. In the view of the exterior of the car two pairs of windows are shown raised at different heights, and a pair of sashes and panels are raised entirely into the pockets in the side roofs. The operation of raising and lowering the sashes is so simple that conver-



INTERIOR VIEW OF SHREVEPORT CAR

sion is practically instantaneous. The interiors are finished in golden oak, with three-ply birch veneer ceilings tinted a light green. The seat backs are provided with brackets between the backs and posts, which enclose the space and also provide hand grips for the use of passengers in entering and leaving by the side openings. The platform at front end of car is intended for use of motorman only, while that at rear end is long and of the "Detroit" type, divided with a hand rail.

The cars are mounted on Brill No. 27-G-E-1 trucks, having solid forged side frames and wheel base of 4 ft. and 33-in. wheels. Each car has a motor equipment of four 40-hp motors. The length over the body is 30 ft. 8 ins., and over the crown pieces, 41 ft. 4½ ins.; over the panel from the crown piece, 4 ft. 6 ins. at the front end, and at the rear end, 6 ft. 2½ ins. The width over the sills, 8 ft. 1 in.; width over the posts at the belt, 8 ft. 5 ins.; sweep of the posts, 1½ ins.; distance between the centers of the posts, 2 ft. 7 ins. The side sills are 2½ ins. x 7¾ ins., and the Z-iron sills, 6⅛ ins. x 8 3-16 ins. x 15-16 in.

THE NEW B. F. STURTEVANT COMPANY WORKS AT HYDE PARK, MASS.

As far back as 1901 the growth of the B. F. Sturtevant Company, formerly of Jamaica Plain, Mass., demonstrated the need of a new location, and a fire in that year which destroyed a large amount of valuable machinery naturally hastened the development of a new factory. This is now located about three-eighths of a mile north of the Readville station in the town of Hyde Park, and the plant comprises a group of buildings thoroughly representative of the latest ideas in production economy. The company manufactures heating and ventilating apparatus, industrial railway systems, general factory equipment, engines, dynamos and motors. The site consists of about 20 acres, with a frontage of 1300 ft. along the New York, New Haven & Hartford freight yards near Readville, occupied by about a dozen buildings, with an aggregate floor area of 9 acres.

An industrial railway system of 2-ft. gage connects all departments; spur tracks from the New Haven yards facilitate the movement of raw material and products; traveling cranes, pneumatic, electric and manual hoists and electric elevators are scattered throughout the works, and all machinery is motor-driven with the exception of the ventilating fans and air-compressor equipment. The building construction is of composite character, consisting of steel interior columns and main steel girders, with brick walls, timbered floors and plank roofs. Ribbed glass is used in all windows except those on the first floor. About 3800 Grinnell automatic sprinklers are in service; fire hose is stored in red-painted boxes for emergency use; self-closing fireproof doors are installed between many of the departments; fire pails are frequent in conspicuous places, and at night watchman service is maintained. Water at 90 lbs. per square inch is available from the Hyde Park system, and a 1000-gal. per minute Blake Underwriters' Line pump is in a house near the power plant.

The boilers in the power plant are of Stirling make, with a total rating of about 1000 hp, and the plant naturally contains mechanical draft apparatus and a Sturtevant economizer. The generating sets were built by the company, and are at present two in number, 100 kw and 250 kw. The power house supplies all the steam used in the different buildings, the steam pressure being reduced from 160 lbs. to serve different purposes.

All the electrical distribution is carried out upon the two-wire plan at 220 volts direct current for both power and lighting. General illumination is supplied by General Electric 110-volt enclosed arc lamps run two in series, and all special lighting is by 16-cp, 220-volt incandescents. The air compressor in the power house is a Laidlaw-Dunn-Gordon machine with compound steam and compound air cylinders, distributing air at 100 lbs. pressure throughout all the shops.

There are about 100 electric motors in the plant, varying in size from ¼ hp to 40 hp, all being of the company's own make. Both group and individual driving of machines are in use. All motors above 10 hp are equipped with General Electric circuit breakers, enclosed fuses being used in smaller sizes. Starting boxes and controlling switches are located either on posts close by the machines, or in the case of some connected motors, upon the machine frames. Practically all the motors used in group driving are hung from the ceilings. At various points in the factory where power is required for testing or other temporary purposes, plug boxes are installed upon certain of the vertical columns within easy reach of the floor.

Several motors are effectively used in the pattern shop and foundry. In the former, the flask shop band, cross-cut and splitting saws, boxing machine and the lathe are all driven by a 10-hp motor, while the carpenter shop or pattern making division proper is equipped with two 10-hp motors which operate two band saws, a buzz planer and a double surfacer, five lathes, a drill press, core box machine and wood trimmers. Both these motors are required in ordinary work, one serving as a possible relay in case of accident. In the foundry, two 20-ton electric traveling cranes are in regular use, one upon each of the runways, and the floor between the runways is served by 1½-ton electric traveling hoists with 10-ft. span, built by the company. The cupolas are two in number, of Whiting make, 56 ins. and 72 ins. in diameter. The former is supplied with air by No. 8 Sturtevant pressure blower driven by a 30-hp motor, and the latter by a No. 10 blower driven by a 40-hp motor. In the brass foundry, blast for the furnaces is supplied by a No. 3 Monogram blower, and the entire machinery, consisting of a spur cutter, a magnetic separator, a tumbling barrel and emery wheels, is driven by a 5-hp motor attached to the wall. In the core department is a Blake wire straightener, driven by a 5-hp motor.

All the elevators in the works are electrically driven. The

principal traveling cranes are all of Whiting make, with Sturtevant motors. Armature punchings and commutators are built up in the uppermost floor of the fan and heater shop, adjoining the testing building. The storage of commutators and parts is effected on divided pigeon-holes, numbered according to the shop scheme for quick reference. The armature baking room is 40 ft. square, entirely fireproof, and it contains two steam-heated baking ovens, fitted with sheet-iron doors and discharge ducts. At the other end of the building is the special storeroom for electrical supplies. The balance of this floor and of the intermediate floor below is devoted to winding, assembling and testing. The electrical designs are worked out in the office building.

Heavy testing is mostly carried out upon the first floor. Here is a testing plate 30 ft. x 60 ft., completely equipped with steam and electrical connections; engines may be run condensing or non-condensing, and efficiency tests, compounding tests and heat runs conducted. The winding department on the third floor is arranged conveniently with bench scales, reel frames, magnet connections at intervals of 20 ft., lamp banks and armature racks. Small traveling cranes and hoists are constantly in use on this floor, which is equipped with a floor plate for testing motors and blowers. A complete permanent switchboard forms part of the testing room equipment, and all direct-current voltages from 80 to 550 are available for testing, as well as alternating voltages up to 2500, the latter being used in insulation break-down tests. On the rear of this board are circular bus-bars, to which flexible cables may be clamped as may be convenient. Variation in voltages is obtained by operating motor-generator sets. Portable test tables and lamp banks are available; a water rheostat plant is located on the roof, and instruments are stored in the office, which is being equipped for curve tests upon samples of iron used in the machines. The foundry of the company supplies this material, which runs evenly most of the time, but which needs checking magnetically now and then.

The architects and engineers for the B. F. Sturtevant Company were Lockwood, Greene & Company, of Boston. The construction of the plant, including the entire industrial equipment manufacture, was carried out by the Sturtevant Company.

MINOR B. R. T. IMPROVEMENTS

Some very important improvements are to be made at the Ridgewood Incline and storage yard of the Brooklyn Rapid Transit Company. These are to consist of new steel, concrete and earth work, new track work on the elevated structure and on the surface, and some special work at Fresh Pond Road on the Lutheran line, which will require some tapping and blasting for new track. At the storage yard on the Lutheran line more than $100,000 will be spent in new track work, inspection pits, and a new inspection shop to cost $65,000, also a new bridge and considerable overhead work.

The rearranging of the Thirty-Sixth Street and Fifth Avenue terminal is progressing satisfactorily. The total cost of the improvements there will be in the neighborhood of $350,000. They include the arranging of the surface yard with inspection pits, the elevated yard with a new inspection shop, the boiler house with new retaining walls, also extensive alterations to the Union Station building and the building of a machine shop. Extensive work is under way at the Ninth Avenue depot of the company, located at Ninth Avenue and Twentieth Street, on the extension of the storage facilities, etc. All cars of the Seventh Avenue, Vanderbilt Avenue, Fifteenth and Court Street lines are handled at this depot, which in the past has been cramped for space. At present the capacity of this depot is only 200 cars. When the improvements are made there will be facilities for handling 400 cars. The total cost of these alterations and improvements will amount to more than $400,000, divided as follows: New tracks and rearranging of them, $65,000; excavating, $25,000; new sheds, $268,000; new shop, $25,000; new office and club house, $22,000.

The Brooklyn Rapid Transit Company Sept. 22, placed an order with the Baldwin Locomotive Works for 300 trucks, 150 sets, to be used on a new order for 150 cars of the convertible type, such as were first placed in use during the early summer and which have been described in the STREET RAILWAY JOURNAL. This is the second order that has been given for this new type of car. The placing of it will do away with many of the old type single-truck cars remaining in service, and will make 350 of this new type in all. The first shipment of the order for 150 will probably arrive in Brooklyn some time during January. One feature of the new car is the elimination of the dangerous running board. Another feature is the use of four motors instead of two as on the old car.

BOLAND INTERESTS PLAN NEW LINE FROM JACKSON TO DETROIT

Articles of association have been forwarded to the Secretary of State of Michigan by a new company which will construct and operate a second electric railway from Jackson to Detroit. The new company is known as the Jackson, Ann Arbor & Detroit Electric Railroad Company. It is planned to accomplish the purpose of the company by extending the Boland line, running from Jackson to Dexter. This line is now operated in conjunction with the Jackson & Battle Creek Traction Company. The officers and directors of the new company are: W. A. Boland, president; Charles W. Osborn, vice-president, and N. S. Potter, secretary and treasurer. The board of directors is as follows: W. A. Boland, of 31 Nassau Street, New York; Charles W. Osborn, with Russell Sage, of 31 Nassau Street, New York; N. S. Potter, of the Jackson City Bank; Hon. Silas B. Dutcher, president of the Hamilton Trust Company, of Brooklyn, N. Y.; Henry R. Carse, cashier of the Hanover National Bank and a director in other New York financial institutions.

SEMI-CONVERTIBLE CARS FOR CHAMBERSBURG, PA.

The Valley Traction Company, Chambersburg, Pa., has lately received from the J. G. Brill Company a number of semi-convertible cars. These cars have the patented "grooveless post" arrangement, which does away with the runways, or grooves, in the posts and the trunnions on the sashes, which were formerly employed. The sash stiles are made of brass, and there is a brass tongue-and-groove sliding connection between the two sashes, so that the lower rides upon the upper. When the tops of both sashes are abreast, catches which hold the upper sash in its lowered position are automatically released, and both sashes are conducted into the roof pocket by means of a pair of bow-shaped steel guides which extend from the top plate to the lower ventilator rail within the pocket. This very simple means of guiding the sashes into the pockets is a decided improvement over the old method, particularly as it does not require cutting grooves in the posts, and also reduces the width and depth of the roof pockets.

ONE OF THE FINE DOUBLE-TRUCK SEMI-CONVERTIBLE CARS USED IN CHAMBERSBURG, PA.

The seating capacity of the new cars is forty-four passengers, the seats being of spring cane and transversely placed, with the exception of four longitudinal corner seats. The seats are 36 ins. long, leaving a 24-in. aisle. Ash in natural color constitutes the interior finish, and the ceilings are of a soft porous wood and are neatly decorated. Removal sashes are used in the vestibule doors. The weight of a car and trucks with full electrical equipment is 42,840 lbs. Among the builder's specialties included in the equipment are angle-iron bumpers, "Dedenda" gongs, "Retriever" signal bells, ratchet brake handles, "Dumpit" sand boxes, etc.

The general dimensions of the cars are as follows: Length over the end panels, 30 ft. 8 ins., and over the crown pieces and the vestibules, 42 ft. 8 ins.; panel over the crown piece and the vestibule, 6 ft. The width over the sills and sheathing is 8 ft. 4 ins.; distance between the centers of the posts, 2 ft. 8 ins. The side sills are 4 ins. x 7¾ ins., and the end sills are 5¼ ins. x 6⅞ ins. The sill plates are 15 ins. x ⅜ in. The thickness of the corner posts is 3⅝ ins., and of the side posts, 3¼ ins. The trucks are of the Brill No. 27-G-1 type for fast and heavy city and suburban service, having a 4-ft. wheel base and 33-in. wheels.

FINANCIAL INTELLIGENCE

Wall Street, Sept. 27, 1905.

The Money Market

A decidedly firmer tendency characterized the money market during the week, rates for all maturities ruling substantially higher than those recently quoted, and from present indications a still firmer market is likely in the near future. The demand for funds from local sources has not been heavy, but the banks and other lenders continued to offer sparingly, even at the higher level. In addition to the usual outflow of funds to the interior for crop-moving purposes, which promise to be heavy for several weeks longer, the local institutions will be called upon to meet other heavy demands within the next thirty days. This week the syndicate payments on the Pennsylvania Railroad and the Atchison issues becomes due, but it is understood that the greater part of these obligations have been discounted. Provision must also be made for the Oct. 1 interest and dividend disbursements, and later the payment of an installment on account of the Japanese loan will have to be taken care of, besides several smaller issues now pending. Gold engagements at London for import to this side have been increased during the week, the total now amounting to $5,929,000, and it is reported that $5,000,000 additional gold is en route from Australia to San Francisco. The future movement of the yellow metal, however, depends largely upon developments in the exchange and money markets, and the opinion prevails that unless demand sterling declines sharply, or money rates advance to a higher level, further large engagements are unlikely at this time. The European markets continue firm, but practically unchanged as to rates. At London discounts are quoted at 3 per cent, Paris 2⅛ per cent, and Berlin 3⅜ per cent. The bank statement, published a week ago, was more favorable than expected, the banks sustaining a loss in cash of only $2,689,600. Loans decreased $9,381,300, and deposits decreased $13,157,400. There was also a decrease in the required reserves of $3,289,350, which resulted in an increase in the surplus of $599,750. The surplus now stands at $5,255,050, as against $26,251,025 in 1904, $14,569,300 in 1903, $3,236,625 in 1902, $16,293,025 in 1901, and $1,2442,600 in 1900. Money on call loaned at rates ranging from 3½ to 4½, most of the transactions being made at 4 and 4¼ per cent. Time money was quoted at 4¼ and 4½ per cent for all periods from two to seven months. Commercial paper was fairly active and strong, specialists reporting a ready sale of the best names at 4½ per cent, and liberal sales of other names at 5 per cent.

The Stock Market

Trading in the stock market has been upon a somewhat larger scale during the week, and although prices displayed more or less irregularity as a result of realizing sales, the general tone of the market ruled firmer. Speculation, however, has been largely of a professional character. Operations for foreign account at no time assumed large proportions, and judging from the volume of commission house business, public interest in the market continues extremely light. There was less apprehension regarding the monetary situation, further advances in rates for both call and time loans being almost entirely ignored. In the early dealings prices were influenced to a great extent by the additional engagements of gold for import to this side, the total now amounting to nearly $11,000,000, including the $5,000,000 reported in transit from Australia to San Francisco. Further engagements of the yellow metal, however, are not expected, the inflow having been temporarily checked by the sharp advance in prime sterling bills to 4.8565. At the beginning of the present week the market was under heavy selling pressure by Western houses, which carried prices off 1 per cent or more, but in the subsequent dealings the upward movement was resumed, and the closing was near the highest of the week. Underlying conditions continue exceptionally strong; gross and net railway returns, as a rule, show gratifying increases over those for the corresponding period of last year, and according to the reports from the Western traffic managers there is every reason to expect a continuance of the present heavy movement of merchandise. Other favorable influences were the continued activity in the iron and steel trade, the advance in the price of copper metal and the increase of 50 cents a share in the dividend distribution in Anaconda Mining stock. A noteworthy, strong feature of the market was Canadian Pacific, which made a new high record price. Pronounced strength was also exhibited in Reading, Union Pacific, Great Northern, Northern Pacific, Illinois Central, Louisville & Nashville, Delaware & Hudson and Chicago & Northwestern. Toward the close there was heavy buying of United States Steel common on persistent reports of an early resumption of dividends in the stock. Sloss-Sheffield Iron & Steel and Tennessee Coal were also strong features.

The local traction issues were generally strong, especially Brooklyn Rapid Transit, which was heavily bought by Philadelphia houses and by strong local interests. The strength was accompanied by rumors that the Long Island Railroad Company had acquired a large interest in the property.

Philadelphia

Trading in the local traction issues has been upon a much smaller scale this week, but the tendency of prices has been toward a higher level, in sympathy with the strength prevailing in other quarters of the market. The list included less than a dozen issues, only one or two of which developed any degree of activity. In the early part of the week interest centered largely in Philadelphia Company common. There was some disposition to sell on the part of the speculative element, which carried the price down to 47¼, but subsequently there was an advance to 47⅞, on what was considered good buying. At the close there was a reaction to 47½. Total transactions amounted to about 10,000 shares. Philadelphia preferred was practically neglected, the trading consisting of a few small lots at 48½ and 48⅜. Philadelphia Rapid Transit displayed moderate activity, and after an advance to 28¾, the price eased off to 28, a loss of ⅛. Over 7000 shares changed hands. Philadelphia Traction responded to an increased demand by advancing from 99½ to 100¾, on the purchase of about 700 shares. Consolidated Traction of New Jersey held firm at 83⅜ and 83½. Union Traction sold at 62 and 61⅞ for about 700 shares. Other transactions included United Companies of New Jersey at 267½ ex. the dividend, 150 United Railways of San Francisco preferred at 89¾, Railway General at 3⅞, and American Railways at 53⅛ and 53.

Baltimore

Trading in traction issues at Baltimore has been broader, and prices with few exceptions have shown an upward tendency. United Railway issues again furnished the leading feature, trading in them being stimulated by reported heavy buying by the pool, and by persistent rumors of a deal of some kind. Definite news regarding the company's future, however, was not forthcoming. Interest centered largely in the income bonds, which were heavily dealt in. From 66¾ at the opening the free incomes rose to 67⅞, but later reacted fractionally. Upward of $30,000 changed hands. The certificates, representing bonds deposited, for the first time sold on a parity with the free bonds, about $75,000 changing hands at prices ranging from 66 to 67⅜. The 4 per cents ruled quiet and firm, upwards of $70,000 selling at from 92¾ to 93¼. The stock displayed considerable activity, about 2500 shares being dealt in at prices ranging from 16⅞ to 16¼, while more than 10,000 shares of the deposited stock sold at from 16½ to 17½, and back to 17. Other transactions included Norfolk Railway & Light 5s at 94, Virginia Electric Railway & Development Company at 100 and 99¾, City & Suburban 5s at 114½, Norfolk Street Railway 5s at 113, and North Baltimore 5s at 121⅜.

Other Traction Securities

Trading in the Chicago market was more active than for some weeks past, and prices generally scored substantial gains over those ruling at the close of last week. Interest centered in the stocks of the surface lines, prices being influenced largely by the sharp rise in Chicago Union common and preferred in the New York market. There was also talk of important developments pending regarding the Chicago street railway situation. Chicago Union Traction rose from 8½ to 10, an advance of 1½ points, while North Chicago moved up 4 points to 74 on the purchase of about 400 shares. West Chicago advanced from 50 to 55, and a small lot of City Railway brought 192, an advance of 2 points over the preceding week's closing bid quotation. The elevated issues also shared in the improvement, about 400 shares of Metropolitan common selling at 25 and 25¾, while the preferred rose from 70 to 71⅜. Northwestern sold at 23, and South Side Elevated ruled firm at 97. Chicago & Oak Park common brought 4¾, and the preferred

sold at 17 and 16⅝. The activity and strength in Boston & Worcester common was the principal feature of the Boston market, upwards of 2200 shares changing hands, at from 29½ to 30¾, and back to 30¼. The preferred stock was weak, the price running off 1½ points to 74 on the sale of small lots. Massachusetts Electric common broke from 16¼ to 15, and closed at the lowest, aggregate transactions being about 800 shares, but the preferred held steady at 59 and 59½. Boston Elevated sold at 153½ and 154. Boston & Suburban common sold at 21 and 20, and the preferred at 66. West End common was reactionary, sales taking place at from 101¼ to 99¾, and of the preferred at 113½. In the New York curb market, Interborough Rapid Transit was considerably less active and weak, about 2500 shares changing hands at from 216⅝ to 211½, a loss of 4½ points. New Orleans Railway common declined from 37 to 36, but later recovered to 36¾, while the preferred advanced from 78¼ to 80. Washington Railway common sold at from 43 to 41¾ for 900 shares. Other transactions included 80 American Light & Traction at 102, $20,000 Washington Railway 4½s at 90½, $35,000 Public Service 5 per cent notes at 97⅛ and 97½ and interest, $25,000 Jersey City, Hoboken & Paterson 4s at 76½ and interest, and $30,000 United Electric of New Jersey at 75¾ and interest.

Announcements of dividend payment and increased earnings were probably responsible for strenuous movement in Cincinnati, Dayton & Toledo securities at Cincinnati last week. Some 4500 shares changed hands in small lots, advancing the price from 23¾ to 26½. Sales in the 5 per cent bonds amounted to $56,000 worth, at an advance to 97¾. Cincinnati, Newport & Covington common took an upward movement on new rumors of Widener-Elkins negotiations for the property; it opened the week at 38¼ and advanced to 40½; sales, 2800 shares. Cincinnati Street Railway sold at 147, a slight decline. Detroit United sold at 95⅝, a fractional advance, and $16,000 worth of the 4½ per cent bonds sold at 94½.

A record breaking week on the Cleveland Exchange. Cleveland & Southwestern was most active, about 3500 shares changing hands at from 12 to 14½. The report that the preferred dividend will be passed caused a drop two weeks ago, and since then insiders have been buying heavily. A pool to hold the preferred at 70 caused that issue to jump from 50½ to 62 on a few sales, aggregating less than 200 shares, and no more is to be had at less than 66. Northern Ohio Traction had another movement, advancing from 22¾ to 25 on sales of about 1800 shares. Muncie, Hartford & Fort Wayne made a slight decline on report that negotiations for the sale of the property to the Widener-Elkins syndicate were off for the time being, last sale being at 48. Western Ohio receipts strengthened slightly, selling at 15⅛. Aurora, Elgin & Chicago common braced up again and sold at 29⅞. Northern Texas bonds sold at 99.

Security Quotations

The following table shows the present bid quotations for the leading traction stocks, and the active bonds, as compared with last week:

	Sept. 20	Sept. 27
American Railways	52	52½
Boston Elevated	153	153½
Brooklyn Rapid Transit	68⅝	72
Chicago City	190	195
Chicago Union Traction (common)	8½	12⅜
Chicago Union Traction (preferred)	—	—
Cleveland Electric	79	78
Consolidated Traction of New Jersey	82	82½
Consolidated Traction of New Jersey 5s	109	109
Detroit United	93¼	93½
Interborough Rapid Transit	*215	212
International Traction (common)	34	39
International Traction (preferred) 4s	73	a74½
Manhattan Railway	165⅛	125⅞
Massachusetts Electric Cos. (common)	15½	15
Massachusetts Electric Cos. (preferred)	58½	57½
Metropolitan Elevated, Chicago (common)	25	25¼
Metropolitan Elevated, Chicago (preferred)	70	71
Metropolitan Street	126⅞	125⅞
Metropolitan Securities	80⅛	80¾
New Orleans Railways (common), W. I.	36¾	36
New Orleans Railways (preferred), W. I.	79	79
New Orleans Railways, 4½s	90¼	90⅛
North American	98	98
North Jersey Street Railway	28	28
Philadelphia Company (common)	47⅝	48
Philadelphia Rapid Transit	28	27¾
Philadelphia Traction	99	—
Public Service Corporation 5 per cent notes	96½	97
Public Service Corporation certificates	69¼	69½
South Side Elevated (Chicago)	97	97
Third Avenue	126½	126
Twin City, Minneapolis (common)	117	116½
Union Traction (Philadelphia)	61⅝	61¾
West End (common)	100	99
West End (preferred)	113	113½

a Asked. W. I., when issued. * Ex dividend.

Iron and Steel

The "Iron Age" says the past week has carried further the remarkable buying movement that burst upon the iron market two weeks ago, and the September tonnage is easily the greatest for a single month in the history of the trade. Veterans in the trade refer to the present market as the greatest in which they have participated. The United States Steel Corporation has bought 40,000 tons of Bessemer iron at $15 at furnace for delivery in September and October. Further iron will be required for October, and the corporation is expected to be a buyer of Bessemer at the rate of 40,000 tons a month well into next year. The total of its purchases in September is 80,000 tons. Bessemer iron is now squarely $15.50 at valley furnace. Coke manufacturers have advanced prices and are chary of long commitments. Rail buying and railroad equipment are still the backbone of the finished material markets. Fully 125,000 tons of rails have been booked in the week. The stringency in structural material is more marked.

U. G. I. INTERESTS GET WESTERN PROPERTIES—STORY OF CONSOLIDATION

Papers have been signed transferring four important Western traction companies to a Philadelphia syndicate headed by Randal Morgan, who is identified with the United Gas Improvement Company. The properties and the securities outstanding upon them are as follows:

	Bonds	Preferred Stock	Common Stock
Indianapolis Northwestern Traction Company	$2,470,000	$450,000	$2,550,000
Indianapolis Western	1,500,000	750,000	1,250,000
Columbus, Buckeye Lake & Newark	1,243,000	500,000	1,000,000
Columbus, Newark & Zanesville	1,250,000	400,000	850,000

All of these roads were built, financed and managed by Tucker, Anthony & Company. It is understood that the sale involves the transfer of about $14,000,000 in cash and securities. While these properties are not sold to the United Gas Improvement Company as a company, the fact that the Improvement Company has large traction interests in Indiana and Ohio which connect with the above four roads makes it quite possible that they will in time turn up in the ownership of these properties.

In this connection a statement coming from Philadelphia is of interest. It is to the effect that the purpose of the United Gas Improvement Company is to organize a separate company to consolidate the important traction lines in and around Indianapolis. In calling attention to the holdings of the United Gas Improvement in the territory mentioned, the authority quoted says that in order fully to understand the extent of the company's interests in Indiana it might be well to divide them into two parts—those which it is known practically to control and those in which it is rumored to be interested. Under the first class there may be included the following: (1) Indianapolis Traction & Terminal Company, (2) Indianapolis Street Railway, (3) Broad Ripple Traction Company, (4) Indiana Union Traction Company, (5) Fort Wayne & Wabash Valley Traction Company, (6) Union Traction Company of Indiana, (7) Indianapolis Coal Traction Company, and (8) Fort Wayne, Van Wert & Lima Traction Company. These lines Messrs. Morgan and Jones practically control. The other group—the lines in which rumor says the company is interested—are Indianapolis & Northwestern Traction Company, Indianapolis & Eastern Railway, Indianapolis & Martinsville Rapid Transit Company, Terre Haute Traction & Light Company, Evansville Electric Railway Company, Richmond Street & Interurban Railway Company and the Indiana Northern Traction Company. The companies have a combined capital (stocks and bonds) of $103,300,000, of which, however, only $85,947,500 is issued. The total is divided as follows: Stock, $45,250,000 authorized; $44,667,500 issued. Bonds, $58,050,000 authorized; $41,280,000 issued.

AMERICAN RAILWAYS REPORT FOR YEAR ENDED JUNE 30

The American Railways Company has issued its full pamphlet report for the year ended June 30, 1905. The income account compares as follows:

	1905	1904
Gross	$444,254	$443,196
Deductions*	180,757	172,734
Net	$263,497	$270,462
Dividends	234,742	234,180
Surplus	$28,755	$36,282
Previous surplus	418,065	381,783
Total surplus	$446,820	$418,065
Tranferred to fire insurance fund	89,000	......
Profit and loss surplus	$357,820	$418,065

* Includes expenses, taxes, depreciation, interest on funded debt, etc.

The general balance sheet as of June 30, 1905, compares as follows:

Assets—	1905	1904
Stocks and bonds	$3,226,433	$2,925,272
Bills and accounts receivable	3,427,441	4,865,311
Office furniture, etc.	3,253	3,216
Eng. dept. inst.	1,216	1,347
Discount on loans paid	......	5,496
Interest on bonds	23,812	52,870
Cash	62,895	43,987
Fire insurance fund investment	107,420	......
Total	$6,852,470	$7,897,500
Liabilities—		
Capital stock	$3,915,500	$3,903,000
Collateral trust convertible 5 per cent's	2,435,500	2,448,000
Bills payable	......	1,104,291
Bills audited	579	......
Vouchers payable	12,380	5,551
Accident insurance fund	5,669	3,094
Interest accrued	10,148	10,200
Taxes accrued	5,332	3,680
Insurance reserve fund	......	1,618
Fire insurance fund	109,541	......
Surplus	357,820	418,066
Total	$6,852,470	$7,897,500

President Sullivan says:

"Gross earnings of subsidiary companies, $1 471,938; an increase over 1904 of $64,972, or 4 2-5 per cent; after paying all fixed charges, interest and taxes, the net income was $263,497; dividends paid to the stockholders of the American Railways Company, $234,742; leaving balance of $28,755 to be added to the credit of surplus account, making the balance to the credit of surplus account, June 30, 1905, $357,820.

"We sold bonds in the treasury of the company at a profit of $46,500 over the amount carried on our books. This amount was credited to the cost of the bonds remaining in the company's treasury, and is not included in the earnings of the company.

"The total number of passengers carried was 33,222,013, showing an increase for the year of 1,746,321.

"During the year, believing it to be sound policy where our properties are so widely separated, we started a fire insurance fund for the purpose of doing most of our own fire insurance. For this purpose we transferred $89,000 from our surplus account to this fund. This insurance fund amounted on June 30, 1905, to $109,541, and is separately and securely invested.

"On May 1 the $100,000 income bonds of the Springfield Railway Company, Springfield, Ohio, matured and were paid off at par, showing a profit to this company of $19,988, which was charged off the capital stock of this company.

"During the year we purchased 413 additional shares of the capital stock of the Springfield Railway Company. The American Railway Company now own all but fifty-six shares of the entire capital stock of that company.

"During the year we have sold $1,500,000 of the 4½ per cent bonds of the Altoona & Logan Valley Electric Railway Company, which bonds were in our treasury. With part of the proceeds we paid off all of the floating indebtedness of this company, which amounted to $1,104,291 on June 30, 1904.

"During the year $12,500 of the American Railways Company's bonds were converted into stock, making the amount of stock outstanding $3,915,500. The privilege of converting the bonds expired on Nov. 1, 1904.

"During the year we have expended the amount of $360,383 for extensions and betterments."

EARNINGS OF THE CONSOLIDATED RAILWAY

The earnings of the Consolidated Railway, which operates the electric lines owned by the New York, New Haven & Hartford Railroad, are as follows for the year ended June 30, 1905:

Gross receipts	$4,567,979
Operating expenses	2,885,622
Net earnings	$1,682,357
Miscellaneous income	13,391
Total income	$1,695,748
Charges, taxes, etc.	1,264,414
Surplus	$431,334

Of this amount, $200,000 has been paid as a dividend to the New York, New Haven & Hartford Company, and the balance has been carried to surplus account.

REPORT ON NEW YORK ACCIDENT

The New York Railroad Commissioners have issued their report of the investigation conducted by them of the accident on the elevated line of the Interborough Rapid Transit Company at Fifty-Third Street and Ninth Avenue, which happened on Monday, Sept. 11, and in which twelve persons were killed and more than forty injured. Two men are held responsible for the accident. Neither of these gave testimony before the commission. One is Paul Kelly, the missing motorman, and the other is Towerman Cornelius A. Jackson, who refused to give any testimony.

The commissioners established that Kelly displayed the signal for a Ninth Avenue train, and that Jackson had his switches set for a Sixth Avenue train. They blame Kelly because he ran by the Sixth Avenue signal when he was running a Ninth Avenue train, and also because he did not obey the company's rule to slow down on approaching curves. They blame Jackson because he set the switches for Sixth Avenue, sending the train around the curve, when he should have had them set for the approaching Ninth Avenue train with properly set signals. This is the recommendation concerning the new signal system:

1. That the two signals at and near the switch point connecting the Ninth Avenue and Sixth Avenue southbound tracks be replaced by a double-blade semaphore signal, one of these blades to govern the operation of the Ninth Avenue trains, the other the operation of the Sixth Avenue trains. The size of these blades and lights to be used in connection with them to be approved by this Board.
2. That a stationary "slow" sign be placed at a proper point in a manner to make it conspicuous and so that it can be seen and read by motormen of all southbound trains.
3. That all southbound trains on the local track come to a full stop before reaching the above-mentioned semaphore.
4. That a rule to the above effect be issued, properly posted and a copy of it properly delivered to every motorman, conductor, trainman and all employees in any manner connected with the operation of the Sixth and Ninth Avenue lines.
5. That the above rule be rigidly enforced.

The report goes into a history of the wreck as gathered from the testimony of the officials of the road at the hearing. It tells about the tracks, the signals and the equipment, and concludes its findings, concerning the motorman and the towerman, as follows:

"That Jackson, the towerman, was in the tower operating room about one minute before the accident occurred.

"That the derailed train was running more than 15 m.p.h. when the head car passed over the switch points, and that no appreciable reduction in the speed of the train was made after the head car passed the switch point until the derailment.

"As a result of our investigation we find that this accident was caused by Motorman Paul Kelly violating the company's rules in running by a cautionary signal without reducing speed, and by running by a signal showing that the switch was set for a Sixth Avenue train, he running a Ninth Avenue one carrying proper signals for that line.

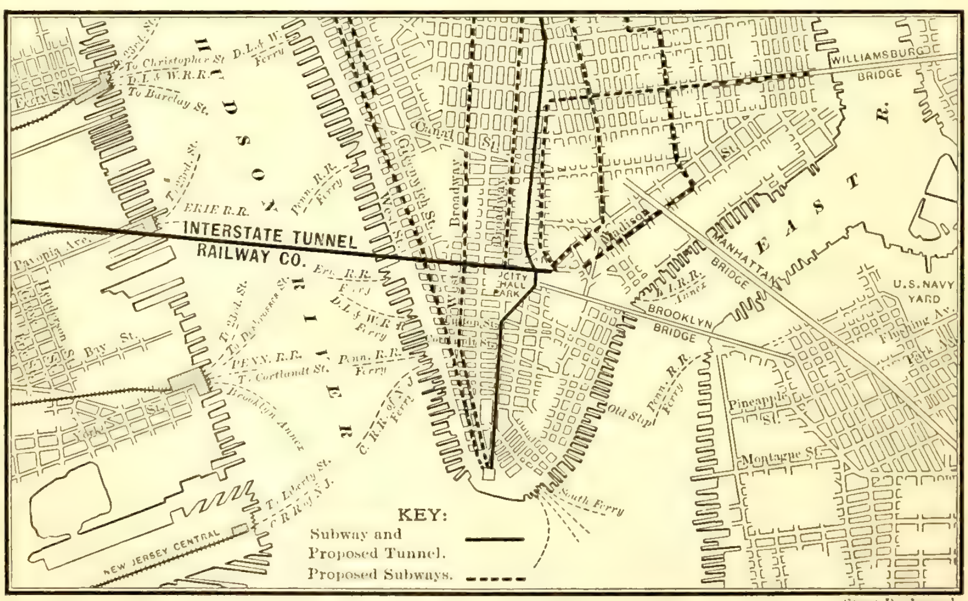
"We also find that Cornelius A. Jackson, the towerman, contributed to the cause of the accident by having the switch and signal set for a Sixth Avenue train, when a Ninth Avenue train displaying proper signals was approaching the junction."

HIGH-SPEED LINE FROM NEWARK TO JERSEY CITY, WITH TUNNEL UNDER THE NORTH RIVER TO NEW YORK

An announcement that assures the consummation of the plan for a high-speed electric railway from Newark to Jersey City, N. J., with a tunnel under the North River to New York, was made last week. It is to the effect that a combination has been formed of Public Service Corporation and Metropolitan Street Railway interests to carry out the project. In the interest of the plan two companies have been incorporated, one at Albany, the other at Trenton. The Trenton company is called the Interstate Tunnel Railway Company of New Jersey, and the Albany company is the Interstate Tunnel Railway Company of New York. The capitalization in each case is $7,500,000, and the incorporators are the same, being Thomas N. McCarter, of Rumson, N. J., president of the Public Service Corporation; Charles A. Sterling, of East Orange, N. J., secretary of that company; Albert B. Carlton, vice-president, and Mark T. Cox, of East Orange, a director of the same company; Herbert H. Vreeland, president of the Metropolitan Securities Company; John B. McDonald, vice-president of the Metropolitan; John D. Crimmins and R. A. C. Smith, directors of that company, and Henry D. Macdona, of counsel for the Metropolitan.

It is proposed to run the new tunnel from Erie and Twelfth Streets, Jersey City, to the new general terminal station planned for the Brooklyn Bridge. An application for the necessary rights has been made to the Rapid Transit Commission, and construction will begin as soon as the proper permission is given. It is estimated that the tunnel will take about three years to build and that it will cost in the neighborhood of $12,000,000, with the terminal. S. L. F. Deyo will be chief engineer of the company, and J. B. McDonald, who built the New York Subway, will have general charge of the work.

In connection with the tunnel the Public Service Corporation will build a new high-speed line from Newark to Jersey City, and it is believed that passengers from Newark will be landed at the City Hall, New York, in twenty minutes, the ride from Newark to Jersey City taking fifteen minutes, and five minutes more to go under the city. Arrangements have been made also for a joint passenger station at Jersey City, which will enable the Erie Railroad to transfer its passengers direct to the new tunnel. The Erie has not yet decided on the location for its new terminal, but it has conferred with the projectors of the new tunnel, and it has been decided that there shall be a joint station.



ROUTE OF PROPOSED TUNNEL TO CONNECT LINES OF PUBLIC SERVICE CORPORATION OF NEW JERSEY AND THE ERIE RAILROAD WITH METROPOLITAN SYSTEM IN NEW YORK

The financing of the enterprise, it is understood, will be in the hands of the Public Service and the Metropolitan companies. According to the brief official statement issued by the Metropolitan Company, "the Interstate Tunnel Railway Company will be controlled and financed jointly by the Metropolitan interests, by the Public Service Corporation and the other interests which will furnish the traffic at the New Jersey end." Considering the close physical connection between the tunnel and the Erie Railroad, the conclusion is that the Erie is the "other interests," and will take a large part in financing the enterprise.

With the present projected tunnel and one other yet to be built, there will be four under the river between New York and Jersey City. The first is the Pennsylvania tunnel, now in course of construction, and two of the others are owned by the Hudson Companies of New York. One of these, now well toward completion, is the old Morton Street tunnel, which was taken up some years ago by William G. McAdoo. The accompanying map shows the projects now in contemplation.

Two separate companies, to be eventually merged, were incorporated in Trenton on September 23 for the construction, maintenance and operation of the proposed high-speed electric railway between Newark and Jersey City, which will be continued under the Hudson River by tunnel to New York. Their respective corporate names are Newark & Hackensack River Railway Company and Jersey City & Hackensack River Railway Company. The capital stock of each is $1,000,000, divided into 10,000 shares. The amount of capital paid in is $100,000 in each instance, and the incorporators, who are the same for both companies, are as follows: Thomas N. McCarter, of the Public Service Corporation; Charles A. Sterling, East Orange; Albert B. Carlton, Elizabeth; John J. Burleigh, Merchantville; Anthony P. Kuser, Bernardsville; Thomas C. Barr, Orange, and Mark T. Cox, East Orange

THE WESTINGHOUSE SINGLE-PHASE LOCOMOTIVES ADOPTED BY THE NEW YORK, NEW HAVEN & HARTFORD RAILROAD COMPANY

The very interesting and important announcement is made in the paper by C. F. Scott, published elsewhere in this issue, that the New York, New Haven & Hartford Railroad Company is planning to use single-phase locomotives on its system. It is needless to say that this statement attracted the widest attention at the convention.

The contract taken by the Westinghouse Company comprises twenty-five locomotives for high-speed passenger service, each of which will weigh approximately 78 tons, and will be capable of maintaining a schedule speed of 26 m.p.h. in local service with a 200-train train making stops every 2.2 miles and reaching a maximum speed of about 45 m.p.h. between stations. In express service a speed of from 60 m.p.h. to 70 m.p.h. can be maintained with a train weighing 250 tons. To handle heavier trains two or more locomotives will be coupled together and controlled from the forward cab by the multiple-unit control system.

The motors will be of the Westinghouse single-phase commutating type, which can be used with direct current, so that the locomotive will be able to operate over the direct-current section now being installed by the New York Central Railroad Company, an important feature, as the New York, New Haven & Hartford Railroad utilizes the tracks of the latter company between Woodlawn and the Grand Central Depot in New York City. For a time the service will be confined to this section. It is therefore with an eye to the future rather than to present requirements that the alternating-current system has been adopted.

Each locomotive will be equipped with four gearless motors and with the unit-switch system of multiple control. The motors will be permanently connected two in series. On direct current the pairs of motors will be operated in series parallel, and on alternating current by voltage control. The motors will be spring supported and connected by flexible drive in such a way that all dead weight will be taken off the axles. On direct current each motor will be capable of developing a rated output of 400 hp.

Congratulations are due to the management of this progressive road for their courage and foresight in adopting a system capable of meeting their future requirements, and to the manufacturing company which has developed the apparatus for the system, which makes the electrical operation of large trunk railways a commercial success.

The Philadelphia Rapid Transit Company is reported to have placed a contract with the Pressed Steel Car Company for forty steel cars for its subway and elevated lines.

FRANCHISE LITIGATION IN DES MOINES

What is believed to be the beginning of extended litigation to determine the franchise rights of the Des Moines City Railway and the Interurban Railway Company, in Des Moines, has been instituted by the Des Moines Civic League in the District Court of Polk County. Petitions in quo warranto proceedings have been filed against both companies with the city of Des Moines as joint defendants in each case. In these petitions the Des Moines Civic League declares in brief that neither company has any franchise rights to operate in Des Moines. The cases, which will be tried in the equity courts, will be assigned for hearing some time in January.

It is generally understood that the cases will depend on the interpretation of the Turner franchise of 1866, although many other franchises have been acquired. The Turner franchise was a blanket grant giving the Turner company, known as the Des Moines Street Railway Company, the right to construct railway lines on any streets of the city that it desired. The vital clause of this franchise is that which gave the company an exclusive right to the streets for a period of thirty years from the time the first mile of track was laid, which was in 1867. This franchise does not place any time limit on its grant to the streets of Des Moines, except that the exclusive right is limited to thirty years. The present street railway company, which has acquired the Turner and all other franchises, contends that the Turner grant was a perpetual one, and gives the company the right to operate its lines on the streets of Des Moines for all time.

The Civic League contends that there can be no perpetual franchises under the Iowa laws, and holds that the Turner franchise expired at the end of the thirty-year exclusive right in 1896. According to the statements of the Civic League the companies have no franchise rights to any of the streets of the city, except the rights acquired under the franchise granted to the Des Moines Broad-Gage Street Railway Company in 1887. This franchise gave the company the right to six streets for a period of twenty-five years. This franchise will expire in 1912. The Civic League also contends that the freight franchise of the present street railway company, which was granted in 1895, expires in 1903, and that, therefore, the amendment thereto, granting the Interurban Railway Company the right to operate its cars over the tracks of the Des Moines City Railway, adopted in 1903, was wholly invalid, because the franchise which it attempted to amend had expired several months previous thereto. It is also contended that the ordinance of the City Council granting the company the right to lay tracks on Second Street for freight hauling purposes is invalid, because it was never ratified by a vote of the people as provided by the code of Iowa.

The following is a résumé of the franchises under which the Des Moines Street Railway Company has operated:

Turner Franchise.—Granted Dec. 10, 1866, to Des Moines Street Railway Company, for a horse line on any and all streets of Des Moines. Franchise made exclusive for thirty years from time first mile of track was laid, but is silent as to whether franchise rights continue after expiration of exclusive period. The franchise also provided that the company shall pay a tax of 3 per cent on net receipts for city purposes each year in lieu of all other taxes.

Broad-Gage Franchise.—Granted to Bayless, Teachout and Van Ginkel, of the Des Moines Broad-Gage Street Railway Company, Dec. 20, 1887, for a perior of twenty-five years. Ordinance specified streets to be used by said company as follows: Center, West Walnut, Fourth Streets, University Avenue, East Sixth Street and East Grand Avenue. After ten years from passage of ordinance the company is to pay annually to the city 5 per of its net earnings, but such payment is not to be construed as exemption from taxation same as other property.

Consolidation.—By resolution of City Council, Sept. 5, 1889, consolidation was authorized of Des Moines Street Railroad Company, Des Moines Electric Street Railway Company and Des Moines & Sevastopol Street Railroad Company. J. S. Polk effected this consolidation and first became identified with the Des Moines Street Railway system.

Electricity for Turner Lines.—Amendment passed by City Council, March 8, 1890, authorizing use of electricity instead of horses on lines operated under the Turner franchise of 1866.

Other Franchises.—Des Moines Rapid Transit Company, May 14, 1888, and March 12, 1889; Des Moines Belt Line Railway Company, May 16, 1888; Des Moines River Line Street Railway Company, Sept. 20, 1888; North Des Moines town franchise to all existing lines.

Final Consolidation.—In 1893 consolidation of all existing street railway lines with the Des Moines City Railway Company was affected, by which the present company claims to have acquired all franchise rights granted to preceding companies.

Freight Franchise.—By ordinance of City Council of Feb. 4, 1895, the Des Moines City Railway Company was granted privilege of carrying mail, express, freight and material for construction and operation of its lines. Five per cent of gross receipts from mail, express and freight business was required to be paid into city treasury for eight years from date of ordinance.

Suburban Franchise.—On June 8, 1903, Council amended the freight ordinance so as to permit suburban railway companies to operate over tracks of Des Moines City Railway Company.

CLEVELAND COMPANY PLACES INSURANCE

The Cleveland Electric Railway Company, which has been active in organizing companies for the purpose of insuring the properties of street railway companies against loss by fire, has made a three-year's contract with the stock insurance companies, reserving the right to write 10 per cent of the line, amounting to nearly $400,000, with the traction mutual companies as soon as they become operative; that is, as soon as these companies have secured $20,000,000 of sprinkled risks. Judging from present indications it will only be a matter of a short time before this is accomplished. At the start these companies would not care to take the entire line on a property like the Cleveland Electric. As has been outlined in these columns, the Electric Mutual Insurance Company will insure electric light and power stations and the Traction Mutual Insurance Company will cover car houses that are equipped with automatic sprinklers. The two will be supplemented by a stock company known as the Associated Railway Companies' Insurance Company. The stock company will not only insure power plants and sprinkled car house properties, but unprotected properties as well, at rates as low as those made by the "old line" companies. The management of all these companies is in the hands of Henry N. Staats, of Cleveland, an insurance underwriter of long experience.

In placing its insurance this year the Cleveland Electric Railway was enabled, by reason of the fact that six of its car houses are now protected by sprinklers, to secure a proposition from the Factory Mutual Companies, of New England, which heretofore have declined to write policies upon car houses and their contents. By reason of this competition it was enabled to secure a better proposition than ever before from the "old line" companies. The proposals were made under sealed cover, and the bid of the "old line" companies was so low that the business went to them.

While intimating that the new rates will effect a considerable saving in the cost of insurance, the officials of the Cleveland Electric Railway were unwilling, by reason of a pledge made to the underwriters, to make public anything relative to the per cent of saving made possible through the installation of sprinkler outfits. From a general agent of one of the companies carrying the risk, the Street Railway Journal representative was enabled to secure a clear idea of the new proposition. This gentleman stated that the stock companies imposed two conditions—that the insurance be written for three years, and that the companies be given all the business, except for the reservation mentioned.

In the past the Cleveland Electric Railway Company has made a practice of carrying its own insurance on its fire-proof power stations and storage battery houses. Last year it carried insurance on $1,962,500 of property, including car houses, shops, etc. Under the new contract the stations and battery houses valued at about $1,400,000, together with eleven car houses and contents, six of which have already been equipped with sprinkler systems, and the balance of which are now being equipped, make a total of $3,266,700 of preferred risks.

As soon as the remaining houses are equipped with sprinklers, all of this property will be carried at about one-third the rate, which is as low as any given on sprinkled manufacturing property in Cleveland. Other property, including unequipped car houses, oil houses, cars in open yards, etc., aggregating $405,800, was also insured. The investment for sprinkler outfits was about $120,000.

The 80 per cent co-insurance clause will apply on all building items; the 100 per cent clause on all car items, and the 90 per cent clause on machinery in power stations. The dynamo loss clause, the lightning and the automatic sprinkler clauses will attach to policies.

A couple alighted from a Market Street car at Fifty-Second Street, after getting transfers. No Fifty-Second Street car was in sight, so the young man said: "It's only a couple of blocks; let's walk." He was about to tear up the red transfers when the girl he was escorting interrupted him, saying: "Don't do that; give them to me." He handed them over and she walked to a letter box and dropped them in the slot. To the man's questioning look she said: "Oh! everybody out this way does that. You see, the mail man always finds among a number of the transfers dropped in the box one that is still good for a ride. So he is able to ride several squares to the next box, where he finds more transfers."—Philadelphia "Record."

STREET RAILWAY PATENTS

[This department is conducted by Rosenbaum & Stockbridge, patent attorneys, 140 Nassau Street, New York.]

UNITED STATES PATENTS ISSUED SEPT. 19, 1905

799,688. Car Brake; Thomas A. Steele, West Elizabeth, Pa. App. filed June 27, 1905. Comprises independently operated brake-shoes engaging respectively the tops and sides of the rails.

799,893. Car Wheel; John R. Davies, Waukegan, Ill. App. filed Jan. 14, 1905. A wheel center and tire having registering recesses, a dowel pin joining said parts, having its inner end equipped with a bearing through which pressure may be exerted in drawing the dowel pin inwardly to free it from engagement with the tire, whereby the tire may be detached without drilling holes therein.

799,894. Automatic Railway Switch; Frederick R. S. Ditmars, Galveston, Tex. App. filed March 18, 1905. When a trip mechanism is engaged by an approaching car the switch is thrown through a T-lever. The switch is normally held closed by a bell crank lever, one end of which is attached to the switch bar, while the other end is weighted.

799,896. Electric Contact Device; Robert W. Farrington, Buffalo, N. Y. App. filed Sept. 23, 1904. The bearing surface of the trolley wheel is made up of a series of pivoted shoes which successively make contact with the wire, presenting thereto a flat surface, thereby securing a greater contact area than can be obtained by the plain surface of the wheel.

799,907. Steel Car Wheel; Frank W. Hudson, St. Louis, Mo. App. filed March 31, 1905. A car wheel consisting of a soft steel body portion and hard steel inserts cast in the tread thereof.

799,908. Elevated Railway; David Humphrey, Cleveland, Ohio. App. filed May 18, 1904. An elevated structure of tubular construction throughout supports cars running on a single rail and having a guard rail at the top.

799,940. Automatic Switch Throwing Device; Clinton J. G. Rickerson, Colorado Springs, Col. App. filed April 17, 1905. A forwardly and downwardly movable plate is engaged by the approaching car to throw the switch through rack and pinion mechanism.

800,121. Car Fender; Joseph W. Seibert, Washington, Pa. App. filed July 20, 1905. Details of construction.

PERSONAL MENTION

MR. G. W. APPLER, who for two and a half years has occupied the position of superintendent of construction for the Northern California Power Company, of Reading, Cal., has been appointed general superintendent of the Rochester, Syracuse & Eastern Railway Company.

MR. J. G. SCHMIDLAPP, of Cincinnati, well known to the financial and railway interests of the West, who is a member of the Taft party, now in the Orient, will leave the party shortly to visit Japan, where he will spend a month or more looking into the traction development of that country.

MR. E. H. McHENRY, fourth vice-president of the New York, New Haven & Hartford Railroad, who has at present the supervision of the engineering department of the electrical division, will after Oct. 1 have direct supervision of the engineering department of the entire New Haven system.

MR. ELMER E. BARTON, assistant superintendent of Division 1 of the Worcester Consolidated Street Railway, has resigned to take a position with the Rio Janeiro Tramway, Light & Power Company, of which Mr. Frederick A. Huntress, formerly general manager of the Worcester Company, is general manager.

MR. EDWARD H. RICHARDS, formerly assistant general superintendent of the Boston & Worcester Street Railway, has been appointed superintendent of the Middleboro & Monument Beach division of the Southeastern Street Railway system. Mr. Richards has recently been superintendent of the Taunton & Pawtucket branch of the same system.

MR. B. B. WINCHESTER, of the Philadelphia Rapid Transit Company, is to succeed Mr. Frank A. Polhemus as superintendent of the New York & Long Island Traction Company. Mr. Polhemus returns to Cleveland and will rejoin the corps of the Cleveland Construction Company, now building several electric railways in the West. Mr. Winchester's headquarters will be at Hempstead, Long Island.

MR. O. A. HONNOLD has been appointed to succeed Electrical Engineer Hayward, of the Utah Light & Railway Company, of Salt Lake City, Utah. Mr. Honnold has been with the company since 1896. He is a graduate of Purdue University. After leaving college Mr. Honnold was for two years with the Detroit United Railway Company as assistant to the superintendent of construction, and was also two years with the Lachine Rapids Power Company at Montreal, Can.

HON. LUTHER ALLEN, one of Cleveland's most prominent business men, died a few days ago as a result of an operation for appendicitis. For the past five years Mr. Allen had been very active in the building of electric railways. He was interested in the Toledo & Western Railway, the Cleveland, Painesville & Ashtabula Railway, the Buffalo, Dunkirk & Western and the Toledo & Chicago Railway. At the time of his death he was president of the Toledo & Western Company, and formerly was president of the Cleveland, Painesville & Ashtabula Railway. He was interested in several banks and manufacturing institutions.

MR. FRANK HOOKER ALFRED, who is now associated with the Canadian White Company, Ltd., as general manager, with headquarters in Montreal, Can., was born Dec. 24, 1866, and educated at the University of Michigan and the Ohio State University. From 1887 to 1890 he was engaged successively as rodman, transitman and resident engineer on railroad construction. From 1890 to 1894 was with the Norfolk & Western Railroad, during which time he had charge of the field work in the construction of its terminals at Columbus, Ohio. From 1894 to 1896 he was with the engineering department of the Hocking Valley Railroad, and from 1896 to 1899 was engineer of maintenance of way of the Cleveland, Akron & Columbus Railway. From 1899 to 1900 Mr. Alfred was engineer of maintenance of way of the Wheeling & Lake Erie Railway, and from the latter date till 1902 was division engineer of the Pere Marquette Railway, of which company he has since acted as chief engineer.

MR. FRANCIS H. PEABODY, senior member of the firm of Kidder, Peabody & Company, of Boston, and director of the Boston Elevated Railway Company, died very suddenly Saturday morning, Sept. 23, at his summer home in Beverly, of heart failure. Mr. Peabody was born in Springfield, Mass., Oct. 9, 1831. He came to Boston at the age of seventeen and entered the banking house of J. E. Thayer & Brother as a clerk. In 1865 Mr. Henry P. Kidder, Mr. Peabody and Col. O. W. Peabody formed the firm of Kidder, Peabody & Company. Mr. Kidder died in 1886, and at that time Mr. Frank E. Webster and Mr. Frank E. Peabody were admitted to the firm. Col. O. W. Peabody died in 1896. Mr. Robert Winsor was admitted to the firm in 1894. Mr. Peabody married April 27, 1854, Miss Adelaide Kingsley, of Canton, Mass. They have one son, Mr. Frank E. Peabody, of Kidder, Peabody & Company.

MR. EDWARD G. CONNETTE, for several years vice-president and general manager of the Syracuse Rapid Transit Company, with which he had a long-term contract, has obtained permission from the directors of the company to accept the position of general manager of the Worcester Consolidated Street Railway, of Worcester, Mass. He will assume his duties on Oct. 1. Mr. John J. Stanley, of Cleveland, who is intimately associated with Mr. Horace E. Andrews, president of the Syracuse Rapid Transit Company, the Utica & Mohawk Valley Railroad and Cleveland, Ohio, roads, will succeed Mr. Connette as vice-president. Mr. John E. Duffy, who has been superintendent of the Rapid Transit under Mr. Connette, will continue as superintendent, but will have practical charge of the operation of the system, it being Mr. Stanley's intention to spend only two or three days a month in Syracuse. The Rapid Transit will be operated by Niagara Falls power by April 1. Cars from Rome by the electrified West Shore Railroad will come into Syracuse probably over the Burnet Avenue line of Rapid Transit.

MR. K. B. THORNTON has been appointed operating engineer with J. G. White & Company, of New York. Mr. Thornton was born at Montreal, June 23, 1873, and was educated in London, Eng. After taking a three years' course in electrical and mechanical engineering at the Central Technical College, South Kensington, London, he returned to Canada, in June, 1893, and entered the Royal Electric Company, Montreal, working in the several manufacturing departments, and also in the testing and drafting departments. In September, 1895, he was transferred to the operating department of the Royal Electric Company, which at that time was supplying light and power in and around Montreal. From that time until August, 1905, Mr. Thornton was intimately associated with the construction, operation and engineering details in connection with the generation and distribution of light and power for the Royal Electric Company, and latterly for the Montreal Light, Heat & Power Company, which finally secured a monopoly of all the electric companies in Montreal in 1903.

A Dictionary of Electric Railway Material

In the following pages will be found brief descriptions of a very large percentage of the principal types of American electric railway apparatus and supplies now on the market; also references to leading Dealers, Engineers, Contractors, Financial Institutions, etc. To make this Dictionary as representative as possible of the leading interests engaged in the manufacture and selling of electric railway material, and at the same time keep the manual within reasonable size, representation has been limited to the STREET RAILWAY JOURNAL'S advertisers, although not necessarily to those using space in this particular issue. The "definitions" have either been furnished by the advertisers, especially for this Dictionary, or have been compiled from the trade literature or published advertisements of the various companies.

HOW TO USE THE DICTIONARY.—It will be noticed that there are three main divisions in the Dictionary—"Manufacturers," "Dealers" and "Financial, Professional, etc." Under the first division it has been the aim to include in the various classifications only the manufacturers of the material described, or dealers having the exclusive selling agency for the electric railway field. In indexing these items the most distinctive word in the heading has been used—Car Wheels, for instance, being indexed under "W"; Rail Bonds under "B," and Line Material under "L." If the apparatus sought is not found under its specific heading, a more general heading should be consulted. For example, "Band Saws" will be found under "Woodworking Machinery," and "Frogs" under "Track Work." The classification under each heading is alphabetical according to the trade name of the apparatus where that differs from the name of the manufacturer.

MANUFACTURERS

ALLOYS AND BEARING METALS

(See also Bearings for Trucks and Motors.)

BRADY BABBITT METALS. These babbitt metals are made from pure raw materials, no drosses or other residues are used and the composition is guaranteed. The following are especially adapted for electric railway service: Special armature bearing babbitt metal, the highest grade babbitt metal especially adapted for high speed and heavy service conditions; No. 1 armature bearing babbitt metal, a high grade tin babbitt, suitable for the average street railway conditions; No. 2 armature bearing babbitt metal, a medium grade tin babbitt, giving good service under favorable conditions; Cyprus anti-friction metal, a babbitt metal less in grade than the foregoing, but suitable for babbitting journal bearings, or may even be used for armature work where a cheaper babbitt metal is desirable; special anti-friction metal is only suitable for babbitting journal bearings and not recommended for armature work.
—BRADY BRASS COMPANY, NEW YORK.

BRADY PHOSPHOR BRONZE. This old and well-known alloy is made up by this company in either ingot or casting form. It has great strength and is exceedingly useful for gears, pinions and in fact for all purposes where great strength is desired.
—BRADY BRASS COMPANY, NEW YORK.

BROWN PLASTIC ALLOY. A metal putty used in connection with the alkaline solid alloy for preventing rust and obtaining a permanent low resistance upon electrical contacts of rail bonds, switches, terminals, bus bars, lightning arresters, ground wires, circuit breakers, ammeter shunts, etc. Ten years' successful use in all parts of the world. Said to be higher in conductivity than the best soldered contacts.
—HAROLD P. BROWN, NEW YORK.

BROWN SOLID ALLOY. A powerful alkaline alloy used in connection with the plastic alloy for preventing rust and obtaining a permanent low resistance upon electrical contacts.
—HAROLD P. BROWN, NEW YORK.

DELOS METAL. This is a special composition metal for journal bearings.
—ELMER P. MORRIS COMPANY, NEW YORK.

"ELEPHANT BRAND" PHOSPHOR-BRONZE. A strong, non-magnetic metal not easily corroded. In the form of wire is used for springs, binding armatures and various purposes; in sheet for springs, etc.; both wire and sheet of various tempers from soft, like copper, to spring temper; rods and bars for shafting, piston rods and bolts. Castings of different varieties for bearings, gears and general machine use. Also sold in ingot form of various grades for smelting purposes.
—THE PHOSPHOR BRONZE SMELTING COMPANY, LTD., PHILADELPHIA, PA.

LOTUS LINING METAL. This is composed of tin and lead as a base, with sufficient copper and antimony to give it the proper degree of strength and hardness. The formula is said to be the best combination of metals that can be used in a lead base babbitt for high speed and heavy pressure. In armature bearings on high speed interurban work, it is claimed to have out-lasted many of the higher priced so-called genuine babbitt. It can be remelted and used over again with equally good results by the addition of a slight amount of new metal.
—LUMEN BEARING COMPANY, BUFFALO, N. Y.

LUMEN BRONZE. This white bearing metal is composed of copper, zinc and aluminum in such proportions that it combines the strength of brass with the anti-friction properties of the highest grade babbitts. It is cast and machined in a manner similar to brass, but cannot be used as a lining metal like babbitt. It is about 20 per cent. lighter than brass, will run cooler under the same conditions and will not cut or score the shaft or journal under any circumstances. It is used largely for street railway motor axle and car journal bearings, where it is giving excellent service. One of the largest manufacturers of street railway apparatus has adopted lumen bronze as a standard bearing metal for motor axle bearings.
—LUMEN BEARING COMPANY, BUFFALO, N. Y.

METALLIC PHOSPHORO. This is a phosphorized alloy of active metallic reducing agents, combined with due regard for the specific characteristic of each element which enters into the mixture; hence they do not neutralize each other, but act in unison to increase the chemical affinity in molten alloys to which the mixture is added. This product takes the place of phosphor tin in the manufacture of brass and bronze, less than one-half the amount being required. Metallic phosphoro is also used extensively as a tempering agent in babbitt metal. It adds to the wearing period of the commercial babbitts, thereby reducing cost and improving service. (See advertisement.)
—THE NEW ERA MANUFACTURING COMPANY, KALAMAZOO, MICH.

MORE-JONES ARMATURE BABBITT METAL. A metal especially designed for electric railway armature bearing service. This metal is characterized by a high rate of heat radiation, a very low rate of wear, great elasticity and tensile strength. It has none of the brittleness of lead-base metals, nor will it creep or spread under excessive strain. Careful tests made by some of the principal electric railways in the United States, have demonstrated its superiority under severe service and high speeds, and have proven it a very economical metal for armature service.
—MORE-JONES BRASS & METAL COMPANY, ST. LOUIS, MO.

NEW ERA BABBITT METALS. The superior quality of the new process metals is due to the improved metallurgical process by which this company secures the chemical union of the constituent elements. These alloys possess the highest possible molecular tension; hence their close, fine, uniform grain, which insures superior strength, elasticity and high anti-friction quality, enabling them to withstand heavy, crushing strains and to run at high speed without becoming overheated or injuring the journals. (See advertisement.)
—THE NEW ERA MANUFACTURING COMPANY, KALAMAZOO MICH.

NICKELUMEN. Nickelumen is not a babbitt metal, but a nickel tempered aluminized white bronze which fuses at a temperature sufficiently low to admit its being melted and recast from an iron vessel. It possesses the remarkable quality of parting very slowly with the heat which it absorbs upon fusing, which makes it possible to pour it into journal bearings the same as babbitt is used; hence, by its use a fine quality of bronze bushings can be secured without the expense of machine work. Its wearing quality is equal to the best red or yellow bronze. (See advertisement.)
—THE NEW ERA MANUFACTURING COMPANY, KALAMAZOO, MICH.

"OHIO BRASS" GENUINE BABBITT METAL. For babbitting journal bearings of street railway motors, power motors and generators, engines, etc. Made strictly in accordance with Isaac Babbitt's original formula and said to be the highest grade of anti-friction metal which can be produced. (See Catalogue No. 6, page 422.)
—OHIO BRASS COMPANY, MANSFIELD, OHIO.

PITTSBURG WHITE METAL. The company making this composition has enjoyed a wide experience in the manufacture of special alloys for babbitting, soldering, electrotyping, etc. Recently it completed a series of careful experiments resulting in a new anti-friction metal for railway service, which the company has termed "Armature." Although this metal is considerably cheaper in cost, the company has found it superior even to some of its own high priced metals, and recommends its use wherever a first-class anti-friction metal is wanted.
—PITTSBURG WHITE METAL COMPANY, PITTSBURG, PHILADELPHIA AND NEW YORK.

RIDLON BABBITT. This babbitt, made according to this company's own formula, is used exclusively in babbitting bearings, except when other babbitt is specified. It is made especially for railway and motor bearings and is the result of exhaustive experiments.
—FRANK RIDLON COMPANY, BOSTON, MASS.

STILES BABBITT. Made under special formula and claimed by the manufacturer to be the most durable, cool running babbitt made. It is asserted to be a babbitt which is a revelation to trolley and steam railroads, as it will run cool under the most trying conditions.
—A. C. STILES ANTI-FRICTION METAL COMPANY, NEW HAVEN, CONN.

ALTERNATORS

(See "Generators, Alternating Current")

AMUSEMENT ATTRACTIONS

(See Park Attractions.)

ANCHORS (GUY)

STOMBAUGH GUY ANCHOR. A device consisting of a simple cast iron helix. Made in five sizes for strains from 1,000 lbs. to 100,000 lbs. So constructed that it may be bored into the ground by turning like an augur. The smaller sizes, 5 in. and 6 in., are made both with and without rods. These sizes, whether with or without rods, each require a separate, specially designed, wrench for their installation. The larger sizes, 8 in., 10 in. and 12 in., are provided with 1⅛ in., 1¼ in. and 1½ in. steel rods, and can be installed without the assistance of a wrench.
—W. N. MATTHEWS & BRO., ST LOUIS, MO.

(INDEX TO ADVERTISERS, PAGES 15 AND 18)

ARMATURE AND FIELD COILS

(INCLUDING WINDING AND HANDLING METHODS.)

ARMATURE AND FIELD COILS. The importance of quality is never more strongly felt than in field and armature coils, and the manufacture of good coils, while it can be done by any railway's electrical department, demands the most expert supervision to secure the best results. Good coil experts are rare and the tendency in home made coils is to use material which has been bought by the purchasing agent as a bargain instead of insisting on selected material throughout. These conditions combine to make it profitable to use coils made by specialists. Facilities for this work, impossible for individual roads to secure, and far in advance of the average shop which makes a bid for this class of work are maintained by this company.

—The Magnet Wire Company, New York.

CHATTANOOGA ARMATURES. Armatures for the standard types of street railway motors are built by this firm of the best quality of soft steel punchings, and are guaranteed to be exact duplicates of factory built armatures.

—Chattanooga Armature Works, Chattanooga, Tenn.

CHATTANOOGA FIELD COILS. These field coils are made as duplicates in every particular of factory built goods. Only the best insulating materials are employed in their construction. Asbestos covered wire for field coils is used when desired.

—Chattanooga Armature Works, Chattanooga, Tenn.

CLEVELAND ARMATURE AND FIELD COILS. All coils are impregnated with the best liquid insulation. The final coverings are of mica, prepared linen, and fish paper, put upon the coils and placed into a steam heated press having a die which makes every coil alike. This process so compresses and hardens the insulation that a greater amount can be used, thus reducing the chance of a ground and increasing the life of the coil. The field coils are mica insulated and are made in the same substantial way.

—Cleveland Armature Works, Cleveland, Ohio.

COLUMBIA ARMATURE AND FIELD COILS. Made of the best magnet wire and insulating material. All coils tested before shipping.

—Columbia Machine Works and Malleable Iron Company, Brooklyn, N. Y.

COMSTOCK ARMATURE AND FIELD COIL FORMS. To enable street railway companies to wind their own armature and field coils, this company makes bronze coil forms which are guaranteed to form perfect coils.

—J. F. Comstock & Company, West Pittston, Pa.

DITTRICK & JORDAN ELECTRIC COMPANY, CLEVELAND, OHIO. See item on this company under Repair Work.

FORD ARMATURES AND FIELD COILS. The modern coil machinery installed in this company's shops enables it to produce high-grade coils, every one of which is an exact duplicate; each pressed in individual cells, electrically heated and pressed. No corrosion or verdigris.

—Ford Electric & Manufacturing Company, St. Louis, Mo.

GENERAL ELECTRIC ARMATURE AND FIELD COILS. These are made with the greatest care from selected and oftentimes specially prepared materials. Railway motor field coils are wound with asbestos and single cotton covered wire and cotton ribbon. Many types of coils are wound on metal spools. The copper strip is insulated with asbestos and the principal coils are thoroughly impregnated by a new vacuum compound process, used exclusively by this company. The insulation on the field coils must withstand 4,000 volts A.C. The end connections of the field coils are on the outside. The armature coils are form wound and the slot portions moulded in steam presses. They are insulated with materials which have stood the test of severe practical service and are tested at 2,500 volts.

—General Electric Company, Schenectady, N. Y.

GRISWOLD ARMATURE COIL TAPING MACHINE. This is a simple-labor saving device for taping coils. It is stated that with this machine a boy can tape in one hour 40 coils for a Westinghouse 12A armature.

—Geo. M. Griswold, New Haven, Conn.

HERCULES TINNED STEEL WIRE FOR ARMATURE BINDING. This wire has tensile strength of 190,000 lbs. to the sq. in., and an elasticity limit of 150,000 lbs. It is used for binding armatures. Street railway companies use it for repair work.

—Driver-Harris Wire Company, Harrison, N. J.

MORRIS ARMATURE AND FIELD COILS. This firm has its own shops for making any standard types of armature and field coils.

—Elmer P. Morris Company, New York.

RIDLON ARMATURE COILS. In the manufacture of these coils only the most approved insulation is employed. All are wound on standard forms and each coil is tested before it leaves the factory.

—Frank Ridlon Company, Boston, Mass.

RIDLON ARMATURE COIL TAPING MACHINE. This machine was designed and is manufactured by this company. It is of the same type as those in use at the company's factory. By the employment of these machines, uniform work is obtained and a great saving of time and money secured over the old style methods. The parts are of bronze and being well made are durable and reliable.

—Frank Ridlon Company, Boston, Mass.

RIDLON ARMATURE COIL WINDING MACHINE. This device is very similar to the company's field coil winding machine. It has no back-gears and the face plate is designed to take armature coil forms.

—Frank Ridlon Company, Boston, Mass.

RIDLON ARMATURE TRUCKS. These trucks manufactured in three sizes as follows: No. 1, for G. E. 800 Westinghouse 12-12A and 49 armatures, dimensions 2 ft. 10 in. over all by 2 ft. between centers; No. 2, for G. E. 1,000 and 67 Westinghouse 38B, 49 and 68 armatures, dimensions 3 ft. 6 in. over all by 2 ft. 8 in. between centers; No. 3, for G. E. 1,200 and 57 armatures, dimensions 4 ft over all by 3 ft between. centers. The above trucks have four wheels, the two on the sides being 6 in. in dia. and those on the ends being 5 in. in dia.

—Frank Ridlon Company, Boston, Mass.

RIDLON ARMATURE WINDING STANDS. These stands are used to support the armature while being worked upon; they are of cast iron, have swivel head and rolls in head to permit of revolving the armature. They are so constructed that it is not necessary to bolt them to the floor, as the weight and diameter of base is sufficient to keep them in position, although it is an easy matter to shift them so as to adapt them to the different lengths of shafts of the various types of armatures.

—Frank Ridlon Company, Boston, Mass.

RIDLON FIELD COIL WINDING MACHINE. This machine has been devised especially for field winding. It has a face plate designed to take forms for any type of railway motor and may also be used for winding transformer coils. The machine is back-geared and is run with loose belt, but provided with pulley operated by foot for tightening belt so that speed may be under control and any desired tension may be had.

—Frank Ridlon Company, Boston, Mass.

RIDLON FIELD COILS. These, like the company's armature coils, are wound on standard forms and manufactured of new wire only. No re-taped or re-covered wire is used. The company is prepared to manufacture field coils of Deltabeston magnet wire. These fields are made to withstand unusual temperatures and are not readily effected by weather. Consequently the life of the coil is increased. In these coils a special insulating material is used, and they are manufactured according to the manufacturer's specifications.

—Frank Ridlon Company, Boston, Mass.

ROSSITER-MacGOVERN ARMATURES AND FIELD COILS. This company manufactures all types of armature and field coils for electric railway service.

—Rossiter, MacGovern & Company, Boston, New York, St. Louis.

VAN DORN-ELLIOTT ARMATURE AND FIELD COILS. These are all form wound and are exact duplicates of the original factory coils. The insulation used is the best obtainable. In building the armature coils they are pressed to the exact size of the slot of the armature, which makes it easy to rewind armatures. The field coils are wound with double cotton covered insulated wire, or one asbestos and one cotton covered, and insulated with mica. (See advertisement.)

—The Van Dorn-Elliott Electric Company, Cleveland, Ohio.

WOOD ARMATURE BANDING MACHINE. An efficient device for banding armatures. The tension of the wire is always taut and uniform.

—Chas. N. Wood Electric Company, Boston, Mass.

ARMATURE LIFTS

(See Cranes and Hoists.)

BABBITTING DEVICES

RIDLON BABBITTING DEVICE. This is designed for babbitting solid bearings. It is provided with a collapsible arbor which is broken down by removing the center core. The operation is quick and simple. No machining is necessary on the bearing when babbitted by this method. The ends are squared and the oil holes and oil ways are finished by the same operation.

—Frank Ridlon Company, Boston, Mass.

WELD BABBITTING DEVICE. This is for babbitting split bearings. As in the case of the Ridlon device, the operation is simple and rapid. This machine is furnished with split arbors, one for the top and one for the bottom bearing. These cast the oil holes and oil ways and also square up the ends so that no machine work is necessary. The arbors are made to the exact size of the shaft, consequently the surface of bearings babbitted by this method is left smooth and the outer scale of the babbitt intact, giving the advantage of greater wearing qualities, whereas by the old method, where it is necessary to ream or bore out, this scale is removed.

—Frank Ridlon Company, Boston, Mass.

BABBITT METALS

(See Alloys and Babbitt Metals.)

BADGES AND BUTTONS

AMERICAN BADGES AND BUTTONS. This company is prepared to furnish practically anything desired in the way of first-class badges and buttons. The badges are made of any metal, with black or other colored japaned background; raised figures; panels, borders and figures brightly polished.

—American Railway Supply Company, New York.

HEEREN BADGES. The special enamel composition of which both background and figures are made is prepared in large sheets and the parts are cut from these sheets by dies of proper shape. The letters and figures, of different color from the background are inserted as in inlaid work. The whole is then placed in a non-corrosive metal frame with an aluminum back, subjected to high temperature and pressure which welds it into one mass, and is afterwards highly polished, producing an appearance equal to jewelers' enamel work and a durability unexcelled. Made in several colors and a great many styles and shapes.

—The International Register Company, Chicago, Ill.

RECORDING FARE REGISTER COMPANY'S BADGES AND BUTTONS. Badges of German silver from stock designs or special designs made to order. Caps and uniform buttons made of gold, silver, brass or aluminum, furnished from stock designs or made to order.

—The Recording Fare Register Company, New Haven, Conn.

WATERBURY BUTTONS. Buttons for railway conductors, motormen and other uniformed employes are manufactured by this company, both in gilt and in nickel.

—Waterbury Button Company, Waterbury, Conn.

BALLAST CARS AND BALLASTING MACHINERY

ALLIS-CHALMERS PORTABLE BALLAST AND MACADAM PLANTS. Plants consist of a boiler and engine, or electric motor, Gates gyratory rock and ore breaker, and elevator and screen, all mounted in a platform car. Can be moved to any part of a railroad where it is convenient to feed them with quarry rock or boulders, and will produce broken stone for ballast or macadam rapidly and with economy.

—Allis-Chalmers Company, Milwaukee, Wis.

ALLIS-CHALMERS ROCK BREAKING PLANTS. Complete rock breaking plants for producing ballast and macadam, specially designed to meet local conditions. Contain, according to needs, proper combinations of Gates gyratory rock and ore breakers, Gates elevators, Gates revolving iron frame screens, bins and bin gates with boilers and engines for operating. Built to be motor driven or operated from any source of power.

—Allis-Chalmers Company, Milwaukee, Wis.

BROWNING MAINTENANCE OF WAY DERRICK CARS AND STANDARD LOCOMOTIVE CRANES. Especially designed and adapted for handling ballast, ties, rails, bridge material, etc.
—The Browning Engineering Company, Cleveland, Ohio.

BROWNING SQUARE TYPE AUTOMATIC GRAB BUCKETS. These buckets form the simplest and most substantial outfits for handling coal, ashes, sand, gravel and ballast material.
—The Browning Engineering Company, Cleveland, Ohio.

BROWNING STANDARD LOCOMOTIVE CRANES AND GRAB BUCKETS. Comprise the most developed and economical outfit for handling coal, coke, ballast, crushed stone, sand, gravel and for loading and unloading machinery, light wrecking, changing trucks, etc.
—The Browning Engineering Company, Cleveland, Ohio.

GATES GYRATORY ROCK AND ORE BREAKER. This is used for breaking rock for railroad ballast, macadam and all other purposes. The working parts consist mainly of a powerful shaft suspended at its upper end and carrying a breaker head of suitable material which moves successively toward all parts of an encircling set of concaves because the lower end of the shaft is carried about through a small circle through the medium of an eccentric wheel operated by suitable bevel gear. For crushing very hard rock and ore, a manganese steel head mantle and concaves are used.
—Allis-Chalmers Company, Milwaukee, Wis.

BASES, TROLLEY

KELSEY TROLLEY BASES. Of perfectly uniform tension, regardless of the angle at which the pole stands. Guaranteed only 5 ins. high. With intermediate ring, making a perfect anti-friction swivel.
—The Recording Fare Register Company, New Haven, Conn.

MILLOY TROLLEY BASE. This base has uniform tension. It is mounted on a double set of taper roller bearings; has no center pin, fulcrum or friction. No oiling is required. The cable connections are under cover.
—Milloy Electric Company, Cleveland, Ohio.

UNION STANDARD TROLLEYS. These are made in almost half a hundred designs, in compression and extension spring types, some adapted to street railway service only, others arranged especially for other work. Among the recent additions are two ball bearing types, Forms 10 and 11, with a maximum height of 4½ in. Form 10 is equipped with double springs capable of giving ample wire pressure when extreme length pole is necessary. Form 11 or single spring type is especially suited to ordinary service where a low and sensitive base is required.
—R. D. Nuttall Company, Pittsburg, Pa.

BATTERIES

BIJUR "HIGH-DUTY" BATTERY. The plates of the Bijur "High Duty" storage battery consist of multicellular grills of pure lead, welded to strong alloy frames. The active portions of both positive and negative plates are electro-chemically formed, and so disposed with respect to the grid that perfect provision for expansion is obtained, eliminating the possibility of buckled plates. The pure lead grills are open structures, having no center web, giving a thorough and through circulation of electrolyte and maintaining perfect acid diffusion, resulting in low charging voltage and constant E. M. F. on discharge.
—General Storage Battery Company, New York.

"CHLORIDE ACCUMULATOR." A lead storage battery cell for electric railways; whether for central stations or sub-stations, to relieve the power house and feeder system at heavy peaks, to remove the momentary fluctuations of load and regulate the voltage, or in rotary substations to allow the rotaries and transmission lines to carry a steady load; always constituting a reserve of energy instantly available when needed. These cells represent the latest development in the art, having been perfected by the highest available talent in this special field.
—The Electric Storage Battery Company, Philadelphia, Pa.

GOULD STORAGE BATTERIES. The plates are spun from chemically pure rolled lead which is thus homogeneous and of maximum density. They are then electro-chemically formed. The greatest possible surface per unit area of plates is exposed to the electrolyte and the variation of voltage on charge and discharge is a minimum. Plates are not built up and contain no antimony or other injurious foreign elements. In consequence of the general design and vertical spinning the action is distributed evenly over the plate insuring maximum conductivity. The plates offer maximum base of unformed lead distributed under the active material so that their capacity is maintained throughout their life and with minimum deterioration, adapted to all classes of battery work and particularly where high charge and discharge rates are required. The company also furnishes counter electro-motive force booster systems and all battery auxiliaries. (See advertisement.)
—The Gould Storage Battery Company, New York.

"LITTLE GIANT" STORAGE BATTERIES. Manufactured along the latest approved lines, and of the best materials possible to obtain. They hold their charge for long periods and respond quickly when occasion demands for drawing excessively upon them. They have he greatest output for size and weight. Cases containing the accumulator batteries are of hard wood, thoroughly acid proof. Every precaution is taken to insure long life, and every battery is guaranteed to meet the specifications and perform the duty for which sold. These batteries are manufactured for every purpose for which storage batteries are used. (See advertisement.)
—Chicago Pneumatic Tool Company, Chicago, Ill.

RED SHIELD DRY BATTERIES. The quality of the elements contained in this cell, together with the peculiar process of its manufacture, makes this somewhat higher in price than ordinary batteries. The chemicals are expensive and are selected under rigid specifications as to purity and strength. Each cell is individually examined at each stage of its manufacture to insure absolute uniformity It has a long life and great recuperative power.
—Wesco Supply Company, St. Louis, Mo.

SILVEY STORAGE BATTERIES. Made in several different styles, two or three of which are particularly adapted to street railway work. The suspended plate type cells are furnished in glass jars and range in capacity from 10- to 600 amp. hours, and are used as line or "floater" bat0 teries for voltage regulation. The plates are unusually heavy and durable and are so designed as to retain securely the active material. Silvey storage batteries, central station type, are furnished in lead lined tanks and range in capacity from 500 to 20,000 amp. hours. The positive plates contain a large number of corrugated lead ribbon plugs in which the active material is placed. These plates increase in capacity with increase of age.
—The Dayton Manufacturing Company, Dayton, O.

"UNIT ACCUMULATORS." In the positive plates the units, or active portions (of Plante formation), are hung in rigid antimoniated lead frame, with ample space at bottom and sides for expansion. The negative plates are of Faure, or pasted type, having antimoniated lead frame with staggered bevel shape ribs, provided with pins extending into active material, the ribs and pins insuring perfect contact. "Unit Accumulators" have high potential at high discharge rates, low internal resistance and high watt efficiency, and are used in station and railway work to carry peak loads, to regulate fluctuations and as a reserve. (See advertisement.)
—National Battery Company, Buffalo, N. Y.

BEARINGS FOR TRUCKS AND MOTORS

(See also Alloys and Babbitt Metals.)

BALTIMORE CENTER AND SIDE BEARINGS. An extremely simple and remarkably durable device coming extensively into use to replace the ordinary center plates and side rub plates between the car body and its trucks. Both center and side bearings assembled and applied in two integral parts—a body and truck member. The hardened and ground balls of forged steel are so held in their retaining castings as to make their loss impossible. The balls, bearing on forged steel race plates hardened and ground to .001 of an inch, make the best known mechanica device for overcoming friction between a car body and itl truck when rounding curves, effecting great saving in powers and in flange and wheel wear. (For illustration see advertisement.)
—Baltimore Railway Specialty Company, Baltimore, Md.

BRADY MOTOR BEARINGS FOR ELECTRIC RAILWAYS. Motor bearings manufactured by this company are either cast iron babbitted or solid bronze. A fine quality of gray iron is used and they are lined with armature bearing babbitt metal, especially devised to meet street railway requirements. When bronze motor bearings are ordered, the composition is a high grade tin bronze.
—Brady Brass Company, New York.

CYPRUS BRONZE JOURNAL BEARINGS FOR ELECTRIC RAILWAYS. These bearings are made from cyprus bronze. It is an alloy of copper, tin and lead, especially adapted to service on electric railways. It is of great strength, has the ability to carry great loads on a rapidly revolving journal, and runs with the least development of friction or heat, consequently offering an ideal metal for the purpose of a journal bearing. The bearings may be either lead lined or solid; when lined the lining consists of a high grade anti-friction metal
—Brady Brass Company, New York.

GENERAL ELECTRIC RAILWAY MOTOR BEARINGS. The frame heads are a one-piece casting of malleable iron, forming a strong and rigid support for the linings. The linings for armature and axle bearings are solid or split brass, babbitted, solid or split malleable iron, babbitted. The brass bearing, babbitted, forms an ideal bearing surface, the babbitt being so thin that if melted by overheating, the armature will not rub on the poles. Large oil wells, with oil wool waste packed against a large surface of the shaft through an opening on low pressure side of bearing, insures perfect lubrication. Bearings of this type have run 13,700 miles without renewal.
—General Electric Company, Schenectady, N. Y.

"OHIO BRASS" MOTOR BEARINGS. Genuine bell metal and babbitted motor bearings are made by this company for all standard types of railway motors. All accurately machined to size. Bell metal is a high grade anti-friction composition metal of great durability. The babbitt metal is made in accordance with Isaac Babbitt's original formula and is the best anti-friction metal that can be produced. (See pages 411 to 422 of Catalogue No. 6; and also advertisement.)
—The Ohio Brass Company, Mansfield, Ohio.

RIDLON MALLEABLE IRON BEARINGS. This company makes standard motor bearings for either Westinghouse or General Electric equipments. The shells are made of malleable iron, which insures longer life and less liability to breakage than shells made from gray iron. Bearings are furnished either babbitted or unbabbitted. In babbitting bearings, the maker employs either the Ridlon or the Weld babbitting device, which leaves the outer scale of the babbitt intact and insures greater wearing qualities.
—Frank Ridlon Company, Boston, Mass.

ST. LOUIS SPIRAL JOURNAL BEARING. This bearing combines efficiency, economy and low first cost. The brass spiral is wedged into the malleable back; the flanges on the end being over ¼ in. in thickness permit of as much end wear on the brass as is consistent with good railroading. The babbitt is "anchored" by the malleable flanges and by the arms of the brass under which it flows in pouring. These brasses are tinned and the babbitt poured on to the hot tinned surface. The Company has observed a number of spiral bearings which have run on journals so hot as to melt out every particle of babbitt metal, and has found not even a crack in the brass.
—St. Louis Car Company, St. Louis, Mo.

STILES' BRONZE BEARINGS. A high grade journal-bearing bronze made from secret mixtures of Mr. Albert C. Stiles. It presents a feature of special interest that is patented, viz.: Being so cast as to provide in the bronze a bearing surface which fits to the exact size of the journal, so that the journal at all times finds a perfectly fitted bed to run in. The babbitt, instead of being tinned in as usual, is inter-locked by a very ingenious method. There is no possibility of the journal ever wedging in this bearing. This company gives its entire attention to the manufacturing of bearings for steam and trolley roads, also a high grade babbitt metal.
—A. C. Stiles Anti-Friction Metal Company, New Haven, Conn.

TAYLOR JOURNAL BEARINGS. These journa bearings are made of the best aluminum bronze and are lined with an anti-heating Eureka metal, which prevents heating and is self-fitting.
—Taylor Electric Truck Company, Troy, N. Y.

BELLS AND GONGS

BRILL "DEDENDA" PLATFORM GONG. Aside from the gong the parts consist of a pedal, pedal-socket, clapper and gong-holder. The clapper is weighted and cannot come within a half-inch of the gong unless the pedal is pushed quickly down. When the blow is struck the clapper instantly rebounds, resulting in a sharp, clear

tone and making chattering impossible. A half turn of the pedal locks it down when not in use. Any carpenter can install it. The gong is made in 8 in., 12 in., and 14 in. sizes.

—J. G. Brill Company, Philadelphia, Pa.
—American Car Company, St. Louis, Mo.
—G. C. Kuhlman Car Company, Cleveland, Ohio.
—John Stephenson Company, Elizabeth, N. J.

BRILL "RETRIEVER" SIGNAL BELL. This bell has no springs. A leverage so powerful as to enable it to retrieve the cord through three long cars is obtained by a long clapper with a heavily weighted head and at the other end a toe which bears against a trigger. The trigger starts with a small leverage which jumps suddenly to a high leverage, sending the clapper up against the tappet with an astonishing amount of energy. The pull is less than a quarter of an inch and the tone is always sharp and clear.

—J. G. Brill Company, Philadelphia, Pa.
—American Car Company, St. Louis, Mo.
—G. C. Kuhlman Car Company, Cleveland, Ohio.
—John Stephenson Company, Elizabeth, N. J.

DAYTON GONGS. Foot gongs, roof gongs or signal bells in forty-six different patterns. Rolled steel gongs made in six sizes, 8 in., 9 in., 10 in., 12 in., 14 in., and 16 in. diameter. Furnished with foot or roof attachments if desired. Finished black, tinned or nickel plated. Any kind of a gong, either for alarm or signal, can be furnished.

—The Dayton Manufacturing Company, Dayton, O.

"OHIO BRASS" BELLS AND GONGS. The foot gongs and roof gongs made by this company are of extra heavy, high grade pressed or rolled steel of approved designs (See pages 438 and 439, Catalogue No. 6.)

—The Ohio Brass Company, Mansfield, Ohio.

WALLACE STEEL GONGS. Foot gongs, overhead gongs, trip gongs and conductors' signal bells. Attachments and shells furnished separately if required. Gong shells are made of high carbon cold rolled steel of a grade that produces the best results as to tone and lasting qualities. Shells may be obtained either in plain black rough finish or polished and nickeled. All attachments are made of malleable iron.

—Wallace Supply Company, Chicago and New York.

BELTING

BOYLE SOLID WOVEN COTTON, RUBBER FILLED BELTING. This belting is a solid woven fabric, filled and covered with rubber. There are no separate plys to "open up" and "creep." It has less stretch and better pulley adhesion, and ply for ply, is 25 per cent. stronger than the old style rubber or stitched canvas belting. This belting is well adapted for all conveying, elevating or power transmission work.

—John Boyle & Company, New York.

BELT LACING

BRISTOL STEEL BELT LACING. Made for all widths, thicknesses and styles of belt that are used for driving machinery and for conveying belts. The convenience with which it can be applied is one of its great merits, as no special tools are required. The zigzag design gives the greatest strength with the least amount of material. The wedge shape points of the lacing as they are driven through the belt force the fibres aside without cutting them so that the full strength of the belt is maintained at the joint, which is not the case where the old fashioned style of leather lacings is used and holes are cut through the belt to permit the insertion of the raw-hide strips. Another valuable feature of this lacing is that when applied no lump is made on the belt causing it to jump as it passes over pulleys.

—The Bristol Company, Waterbury, Conn.

BENCHES

(See Settees and Benches.)

BENDERS, RAIL

THE FAIRBANKS-MORSE RAIL BENDER. This bender is provided with wedges which feed down automatically as the lever is operated and hold absolutely the full amount of the bend secured by the throw of the eccentric, that is, there is not a particle of back spring. It is claimed to be much more powerful and durable than any type of screw bender; can be operated by fewer men and does its work in less time. Made for use on both T and girder rails.

—Fairbanks, Morse & Company, Chicago, Ill.

KALAMAZOO ROLLER RAIL BENDER AND STRAIGHTENER. After being applied to rail it is made to run over rail rapidly by turning the lever at the top of the standard. Adjustable to the degree of curvature. Rails precisely bent without kinks or breakage of grain. Besides bending rails it is useful in truing up old and imperfect curves. Made in six styles covering 20 to 100 lb. rail.

—Kalamazoo Railway Supply Company, Kalamazoo, Mich.

NILES-BEMENT-POND RAIL BENDERS. These rail benders are of the hydraulic type and are capable of bending rails up to 100 lbs. per yd. in weight.

—Niles-Bement-Pond Company, New York.

Q AND C-SAMSON RAIL BENDER. Exceedingly valuable in track work. It will bend 100 lb. rails into position without drawing spikes, when straightening and taking kinks out of track. One man can operate it and it is an effective substitute for expensive roller benders. The frame is made of open hearth cast steel and is very strong. Screw is of steel working in bronze nut and provided with automatic friction washers. Thrust piece is of hardened steel. Weighs 100 pounds.

—Railway Appliances Company, Chicago and New York.

BENDING TOOLS

WALLACE BENDING TOOLS. Hand power tools for quickly forming eyes on ends of rods or for bending bars or rods to an angle. The eye bending tools are built in three sizes. No. 1 for bending stock up to and including one-half in., and forming the same into rings or eyes up to 2¾ in. outside diameter; No. 2 takes stock ⅞ in. thick and under and forms eyes 3 in. outside dia. and under; No. 3 takes stock 1⅛ ins. thick and under and forms eyes or rings 7 ins. outside dia. and less. The No. 1 angle tender has a capacity for bending flat stock 2 ins. wide by ⅜ in thick, or round or square stock up to ¾ in., while the No. 2 angle bender will bend flat stock up to 4 ins. wide by ½ in. thick or square or round up to 1 in.

—Wallace Supply Company, Chicago, Ill.

BLOCK SYSTEMS

(See "Signal Systems")

BLOWERS

(See "Mechanical Draft Apparatus")

BLUE PRINTING MACHINES

BUCKEYE ELECTRIC BLUE PRINTING MACHINE. Each machine is equipped with two rollers, one on each side, which carry the contact curtain and are operated independently so that only one side may be printing, while the other is being unloaded or reloaded. The contact curtain is held firmly to the glass by weights attached to small wire cables engaging both ends of the rollers carrying the curtain. By this arrangement perfect contact is secured over the entire surface of the glass, entirely removing the difficulty of only partial and uneven contact when springs are employed in or attached to the rollers. The latter will remain stationary at any point on the circle and the curtain back of the roller is in perfect contact with the glass regardless of how far it has been unrolled. The value of this arrangement cannot be overestimated in making small and medium size prints.

—Buckeye Engine Company, Salem, Ohio.

FRANKLIN BLUE PRINT WASHING AND DRYING MACHINE. This machine is arranged to wash and dry either separate prints, or continuous rolls of any length. After the prints are washed and dried they are wound up on a roller ready for immediate delivery This machine saves space, time and labor, and avoids dripping prints and wet floors.

—Williams, Brown & Earle, Philadelphia, Pa.

FRANKLIN ELECTRIC BLUE PRINT MACHINE. This continuous feed blue print machine is arranged so that prints of any length can be made. Prints of any width up to 42 in. are handled. The printing is done by electric light. The action of the machine is entirely automatic, it being necessary only to insert the roll of paper and start the print.

—Williams Brown & Earle, Philadelphia, Pa.

BOATS AND LAUNCHES

(See Park Attractions.)

BOILER CLEANERS, MECHANICAL

(See also Reseating Machines.)

DEAN BOILER TUBE CLEANER. Worked either by steam or compressed air. In the type used for return tubular boilers the hammer head, vibrating with a pressure of 40 lbs. to 70 lbs., strikes the tubes 3,500 to 4,500 times a minute, thus setting up a vibratory motion and dislodging the scale. In the water tube boiler the hammer is changed slightly, and as the cleaner is forced through the tube it breaks up the scale into small pieces, which are blown out of the tube in front of the cleaner.

—William B. Pierce Company, Buffalo, N. Y.

LAGONDA TUBE CUTTER. This machine cuts off tubes in either water tube or return tubular boilers. It is a simple and effective device, doing the work quickly with little trouble. It makes a clean cut every time, without leaving any burr either on the inside or outside of the tube. It can be furnished with an extension shaft for water tube boilers so that the tubes can be cut out at any desired point, inside the boiler. This is a great time and money saving machine.

—The Lagonda Manufacturing Company, Springfield, Ohio.

LIBERTY TURBINE TUBE CLEANER. The principal advantages of this cleaner are: The turbine is constructed without ball bearings, thus insuring greater power and longer life; the cleaning tools are attached direct to the shaft, which insures solidity and durability of construction; the vanes in the revolving part are cut by a special process—not cast. Cut vanes are stronger and smoother than cast vanes and offer less resistance to the flow of the water; it is furnished with cleaning tools for both heavy and light scale, the former being capable of cleaning tubes which are entirely stopped up. A number of types of cleaning heads are furnished for different kinds of scale, the freely swinging arm head being used only for light scale. (See advertisement.)

—Liberty Manufacturing Company, Pittsburg, Pa.

THOMPSON'S SOOT EJECTOR. By the use of a small amount of steam, which is first superheated by wire drawing through the aperture in the discharge tip, a vacuum is formed drawing the soot from the tubes and ejecting it with great velocity up the chimney and into the atmosphere, cleaning the tubes, flue and chimney. No steam is admitted into the tubes, no soot is blown around the boiler room or into other tubes, but drawn out in the direction of the draft, leaving clean tubes. All the parts are made of brass and will not corrode or rust. When bituminous coal is used the tubes should be cleaned every day. With this soot ejector 80 tubes can be cleaned in from five to six minutes.

—Richard Thompson & Company, New York.

TWENTIETH CENTURY TUBE CLEANER. This cleaner presents an entirely new feature for cleaning boiler tubes. With a small amount of steam discharged through the apertures of a central tip a powerful current of heated air is driven through the tubes without any perceptible moisture, cleaning them quickly and thoroughly. Eighty tubes can be cleaned in five minutes. All the parts are made of brass so that they will not corrode or rust. The company makes special couplings and bands, and furnishes the best quality of steam hose when required.

—Richard Thompson & Company, New York.

WEINLAND TUBE CLEANERS. These cleaners are made for all styles of water tube boilers and for all sizes of tubes. The manufacturers have recently purchased the tube cleaner business from the Gem Manufacturing Company, and thus get absolutely unrestricted liberty in the manufacture of cleaners

—The Lagonda Manufacturing Company, Springfield Ohio.

BOILERS

AMERICAN WATER TUBE BOILER. Made by Broomell, Schmidt & Steacy Company, York, Pa.

BERRY SAFETY BOILERS. Consist of two vertical cylindrical shells, united at the top by a crowned ring and at the bottom by a conical crown-sheet. Tubes radiate from the inner to the outer shell, uniting and bracing them. A deflecting arch of fire-brick is placed in the internal flue at a point above about two-thirds of the submerged tubes, and a casing or smoke-flue surrounds the boiler on the outside. The gases rise into the internal combustion chamber, are deflected by the arch and pass through the tubes to the outside flue, thence upward and inward through the middle section of tubes to the internal flue, thence upward and outward through the superheating tubes, thence upward and inward over the top of the boiler to the stack. The circulating tubes extend back and forth under the boiler over the fire, connecting to outside shell of boiler.

—Robert Wetherill & Company, Inc., Chester, Pa

BABCOCK & WILCOX WATER TUBE BOILER. This boiler is too well known to need description. The Babcock & Wilcox Company publishes a book entitled "Steam," recognized as one of the best technical works on the subject of steam published anywhere and containing full descriptions of its products. This book will be mailed free upon request.
—The Babcock & Wilcox Company, New York.

CAHALL HORIZONTAL WATER TUBE BOILERS. These boilers are of the sectional header type. The greatest care in the selection of material and in the methods of working it, is exercised in every detail of the construction and is combined with a design that affords perfect circulation with the utilization of the largest proportion of the heat units and permits of access to every part for cleaning, examination and repairs. These boilers have for many years been exploited by The Aultman & Taylor Machinery Company, and are now controlled by
—The Stirling-Cahall Boiler Company, New York.

THE HEINE BOILER. This boiler is of the horizontal water tube type, suitable for all purposes for which high steam pressure is required. Built entirely of flange steel plates, completed in shop and tested before shipment. Design gives a large combustion chamber, horizontal pass of the gases and free circulation of water, all conducing to economical operation and maximum power in minimum space. All cleaning is done from front and rear, thus permitting as many boilers to be set in battery as desired. Setting may be arranged to accommodate any stoker.
—Heine Safety Boiler Company, St. Louis, Mo.

MURRAY BOILERS. These boilers are of the tubular, internal-furnace and water tube types. The former are usually made to Hartford specifications and are distinguished for their strict adherence to stipulated requirements. The steel is of full thickness; the rivet holes are actually drilled after the plates are rolled up and the fixtures are extremely heavy and durable. Internally-fired boilers are built either with the patented corrugated furnaces or the Adamson ring furnaces with Galloway circulating tubes. The water-tube boilers are of an approved and time-tested type.
—Murray Iron Works Company, Burlington, Iowa.

PARKER WATER TUBE BOILER. Has straight horizontal tubes and malleable junction boxes. Large drums with separate chambers for water and dry steam which does not rise through the water in the ordinary way, but flows direct from the bottom ends of the elements to the steam chamber. The flow is downward in the steam generating tubes, and is induced by the lighter column in the upcast. A scale pocket is provided at the front ends of the drums for the scale and sediment which is discharged from the tubes by the extraordinary flow. The boiler is built double ended and with superheaters.
—Parker Boiler Company, Philadelphia, Pa.

PHOENIX BOILERS. Steam generators for power stations are constructed by this company.
—Phoenix Iron Works Company, Meadville, Pa.

STIRLING WATER TUBE SAFETY BOILER. Is notable for the simplicity of its construction. Special provision is made to counteract the effect of all contraction and expansion and the method of suspension employed distributes the weight of the drum among all the long tubes so that increased stability is obtained. The rapid circulation eliminates severe stresses due to unequal expansion, permits the quick raising of steam and prevents the formation of steam pockets, which quickly burn out the tubes. It is designed for positive safety and to this end all parts are of wrought metal and are either spherical or cylindrical in form. The facility with which repairs can be made, its adaptability to different kinds of fuel and its extreme compactness are points of interest to engineers.
—The Stirling Company, New York.

BOILER CLEANING COMPOUNDS

DEARBORN BOILER WATER ANALYSIS AND TREATMENT. This company has on record reports of over twenty-three thousand water supplies, analyses of which were made in its laboratory. It has been continually furnishing preparations the past six to ten years for some eight thousand to ten thousand of these different waters. The company, therefore, has had wide experience in the treatment of water for boilers and is prepared to carry on thorough investigations along this line.
—Dearborn Drug & Chemical Works, Chicago, Ill

LORD'S WATER PURIFYING CHEMICALS. The business of manufacturing chemicals for use in steam boilers was originated in America by George W. Lord in 1865, and was continued by him until 1901, when the George W. Lord Company was incorporated. No stock is carried at any of the company's branches, as every order is filled direct from Philadelphia, being prepared especially and containing the exact ingredients required to treat each case. To make the preparation of these special Rixtures possible this company insists upon analyzlng either a sample of scale or boiler feed water before an orer for chemicals is accepted. These analyses, however, are made free of charge.
—Geo. W. Lord Company, Philadelphia, Pa.

BOILER COVERINGS

(See "Coverings, Pipe and Boiler")

BONDS, RAIL

"ALL WIRE" RAIL BONDS. Compressed terminal "All Wire" rail bonds are made from a continuous piece of flexible soft drawn pure copper cable, exceptional conductivity resulting. Terminals compressed and carefully machined to exact size. Bonds applied under pressure and adapted for use under fish plates or on base of rail, being made in numerous forms for various requirements of bonding. Soldered "All Wire" Rail Bonds.—Identical in process with the company's "All Wire" compressed terminal, except that terminals are designed for soldering to rails, either under fish plates, to base or ball of rail. Specially adapted for bonding light weight rails; exceptional conductivity retained. (Advertisement illustrates both types.)
—The Ohio Brass Company, Mansfield, Ohio.

THE AMERICAN STEEL & WIRE COMPANY'S BONDS. These bonds comprise not only the well-known Crown bonds, with pin and solid terminals, but United States bonds, with solid terminals and flat strips; soldered bonds in several styles, with tools for applying and a new terminal stud bond for application to the ball of the rail. This new bond will particularly interest railway men who are desirous of using a short, visible bond to be applied by compression.
—American Steel & Wire Company, Chicago and New York.

BROWN SOLID COPPER RAIL BONDS. These bonds are composed of heavy copper plates held by spring pressure against the rail web across each joint. Contact is secured by non-rusting plastic alloy, and dirt is excluded by cork composition packing. At the end of three or four years service the bonds may be made as good as new at small cost by cleaning and re-amalgamating. (See advertisement.)
—Harold P. Brown, 120 Liberty Street, New York.

BROWN PLASTIC PLUG RAIL BONDS. These bonds are composed of a non rusting metal putty and are designed for bonding steam roads for electric service, or for rebonding electric roads without disturbing the rail joints. The putty is placed on a ¾-inch to ⅞-inch hole drilled through the base of the angle plate into, but not through, the rail base. They can not be injured by the motion of the rails and will transmit 1,000 amps. without heating. (See advertisement in this issue.)
—Harold P. Brown, New York

BROWN PLASTIC RAIL BONDS. These bonds are composed of a non-rusting metal putty. When placed under both angle plates per joint they give practically the full conductivity of the rail. On well maintained track they will not rust nor break. A. M. Ballou, Electrical Engineer of the Denver Tramway Company, and R. E. Danforth, General Manager of the Rochester Railway, report that Plastic Bonds applied in the fall of 1896 still have the same conductivity as at first. Mr Ballou reports that the resistance of 1 ft. of joint with bonds is equal to that of 2 ft. of unbroken rail; only one angle plate per joint bonded. (See advertisement.)
—Harold P. Brown, New York.

BROWN SWITCH CONTACT BONDS. These bonds consist of rolled copper sockets soldered to web at end of each rail, with horizontal openings facing together. Into these openings slides a copper contact piece of heavy section, covered with non-rusting plastic alloy. The rails can move on each other in vertical or horizontal planes without breaking the circuit or injuring the bond which is made on the plan of a knife blade switch. (See advertisement.)
—Harold P. Brown, New York

CLARK IMPROVED RAIL BOND. This is an improved rail bond of the soldered type. It is made up of either small wires or laminations with the extreme ends welded together, then spread out to increase the area of contact between the rail and bond, and perforated to facilitate soldering. The specially shaped ends, together with the perforations, prevent any accumulation of gas in soldering, all gases being forced to escape through the perforations. This affords opportunity for the solder, or other material used, to flow freely and effect a firm and lasting union between the rail and the bond, thus prolonging the life of the bond, greatly increasing its conductivity and preventing the bond from becoming loosened by expansion and contraction or by jar of cars or other ordinary means.
—The Clark Electric & Manufacturing Company, New York.

COLUMBIA RAIL BONDS. This company makes the Columbia rail bond and also the Roebling soldered bond. The Columbia bond consists of two copper thimbles and a connecting copper rod. On each end of the rod is a truncated cone head with a fillet at the base. The inside of the thimble is tapered to fit the head while the outside is slightly tapered in the opposite direction. In applying the bond the cone shaped heads are placed in holes in the rails on one side and the thimbles are slipped over them from the other. The parts are pressed together tightly with a hand press. The Roebling soldered bond is a one piece bond, every part of which is tinned. It has soldered pockets, assuring a thorough contact with the railway.
—John A. Roebling's Sons Company, Trenton, N, J..

GENERAL ELECTRIC BONDS. These bonds are made with drop forged pure copper terminals welded to a copper conductor, which may consist of ribbon, stranded cable or solid wire, by a process which insures absolute perfection of union between terminal and conductor. Ribbon bonds are furnished for use under fishplates, solid wire and stranded cable bonds for cross bonding and special work. Separate terminals, drilled and tinned for use with scrap wire, are furnished for cross bonding. A complete line of bonding tools is furnished. This company also furnishes a complete line of soldered bonds for application to the head or foot of the rail, or under the fish plate.
—General Electric Company, Schenectady, N. Y.

LORAIN ELECTRICALLY BRAZED BOND. This bond is used for attaching to welded track the terminals of large copper cables passing around special work. A copper block having a groove across one face is placed over the cable and both electrically brazed to the web of the rail, the cable welding to the block. The area of union for a 500,000 cm. cable is about 9 sq. in. Overhead return cables and ground cables to generators are also attached to rails by this method. These bonds are applied by the apparatus used for electrically welding rail joints, by the track welding department of the company. (See advertisement.)
—The Lorain Steel Company, Philadelphia, Pa.

PROTECTED RAIL BONDS. The principal features that have made this bond so successful are: The drawn flat wire or ribbon of which it is made is formed into a loop from a continuous strand and crimped suitably to escape the bolts—which construction gives the maximum amount of flexibility in exactly the direction in which it is demanded; and the fact that the terminals are fused to the strand in molten state insures in the terminal head one homogeneous mass of copper, and eliminates the possibility of the introduction of any electrical resistance between the body portion of the bond and the terminals. May be made to suit any special condition. (See advertisement.)
—The Mayer & Englund Company, Philadelphia, Pa

SHAWMUT SOLDERED BONDS. Consist of copper laminations with ends separately tinned for a short distance to insure perfect union when proper heat and flux have been applied. The laminations after tinning are clamped together and dipped, then surrounded by a tinned copper wrapper of proper length for contact area, which wrapper is soldered intimately around the strips. The bonds are applied by cleaning the rail with a rotating emery wheel or a sand blast. The rail when cleaned is tinned, the bond is clamped in position and heat is applied with a torch until the rail is sufficiently hot for a soldered union (Several types are shown in advertisement.)
—Chase-Shawmut Company, Newburyport, Mass.

THERMIT WELDED THIRD RAIL. This bond consists of a lug of steel welded on the ends of the flanges of the rail on one side, the rail being held in position on the other side of the web by a simple splice bar. The operation described under "Thermit Joint" is further simplified in this case, as the thermit charge is ignited directly over the mold, in a piece of gas piping, without the use of a crucible.
—Goldschmidt Thermit Company, New York

THOMAS SOLDERED RAIL BONDS. The result of exhaustive tests and years of actual practical experience. Every detail of design, construction and application has been carefully worked out. A suitable and satisfactory type is provided for every size and style of rail and joint plate and condition of service. They are furnished in all capacities with contact terminals always at least eight times greater than the cross section. This insures a permanent and enduring contact with ample mechanical strength and current capacity. Each strip is tinned separately, after which they are securely clamped, soldered and riveted. (See illustration in advertisement.)

—Lord Electric Company, Boston, Mass.

BOND TESTERS

ROLLER DIRECT READING BOND TESTER. This instrument shows directly on its calibrated scale the resistance of rail bonds when same are in place on the track. The readings show what number of feet of uncut rail have the same resistance as the bonded joint. The apparatus is extremely light and arranged so that but a single operating observer is needed. It can be set to show instantaneously whether a given bond is above or below a predetermined resistance. The device for making contact with the rail has hack-saw blade contact edges which can be renewed immediately when dulled. (See advertisements.)

—Whitney Electrical Instrument Company, Machado & Roller, New York, N. Y., General Sales Agents.

BONDING TOOLS

(See Tools, Track and Miscellaneous.)

BOOSTERS

GENERAL ELECTRIC BOOSTERS. The series booster built by this company embodies, in general, the same mechanical features as direct current generators of the same make. Some of the more important electrical features are as follows: Good regulation is assured by liberal distribution of the magnetic material, keeping the voltage characteristic a practically straight line. Field coils are tapped out so that connections may be made which enable the booster voltage to be regulated conveniently between given limits without rheostatic control. Boosters can be furnished for full load voltages from 50 to 500 volts.

—General Electric Company, Schenectady, N. Y.

BORERS, WHEEL

(See "Machine Tools")

BOXES, JOURNAL

(See "Journal Boxes")

BRACKETS AND CROSS ARMS

CREAGHEAD FLEXIBLE BRACKETS. The Creaghead flexible bracket system is used to flexibly support overhead trolley wires on both high and low speed electric railways. These brackets are peculiarly adapted to interurban construction on account of the low cost of construction and maintenance. Many styles are made to meet the varying conditions. Each style is made in any desired length, giving about one hundred kinds of brackets. Made for wooden or iron poles, with or without insulation in the span wire; plain or ornamental; with top brace or under brace or both. The fittings are of malleable iron and the other parts are steel. High carbon steel tubing is recommended and furnished, but ordinary pipe will be furnished if desired.

—The Creaghead Engineering Company, Cincinnati, Ohio.

"OHIO BRASS" POLE BRACKETS. Pole brackets are supplied by this company for supporting overhead trolley wires on either direct current or single phase systems. Wood's adjustable, Wood's flexible, Richmond flexible, Detroit flexible and single phase pole brackets. Made from steel tubing or iron pipe, single or double arm, for wood and iron poles, plain or ornamental. (See catalogue No. 6, pages 5 to 60, and Bulletin No. 1, pages 666 to 676.)

—The Ohio Brass Company, Mansfield, Ohio.

MAYER & ENGLUND POLE BRACKETS. The castings are of well annealed malleable iron and so proportioned as to impart the greatest strength just where it is required without necessitating the use of a mass of surplus metal. This type has been adopted by quite a number of the higher class constructions of recent years.

—Mayer & Englund Company, Philadelphia, Pa.

S.-H. BRACKET ARMS. These bracket arms are manufactured in the following types: Standard, standard flexible, special flexible and combination flexible. They are constructed with 1⅝ in. welded wrought iron pipe threaded at both ends. The castings are of best malleable iron, and are especially heavy, and will stand any strain to which they are likely to be subjected in service, with a large margin to take care of all emergencies. The guy rods are of heavy ⅝ in. steel with buttonhead. Galvanized seven strand either ¼ in. or 5-16 in. is furnished with all flexible arms. All types are neat, well made and reliable. (See advertisement.)

—Stuart-Howland Company, Boston, Mass.

BRAKES AND BRAKE SYSTEMS

BRILL RATCHET BRAKE-HANDLE. This brake has the form and mechanism to enable the motorman to get the most effective service from the brakes because he is able to use his strength to the utmost advantage. The form gives the leverage and the ratchet mechanism keeps the leverage at its greatest power. It differs from all others in strength and simplicity as well as in rapidity and effectiveness. The simplicity of the mechanism cannot be exceeded, as a spring and upper ratchet comprise all the movable parts, aside from the handle itself. The handle is made in all standard sizes.

J. G. Brill Company, Philadelphia, Pa.
—American Car Company, St. Louis, Mo.
—G. C. Kuhlman Car Company, Cleveland, Ohio.
—John Stephenson Company, Elizabeth, N. J.

CHRISTENSEN AIR BRAKE SYSTEM. A very compact motor driven air compressor, having the motor mounted directly above the compressor, is used to furnish compressed air to a suitable reservoir. An automatic governor is used to stop and start the compressor motor when the pressure in the reservoir rises above or falls below certain limits. From the reservoir air is admitted by aid of a special valve at the end of the car, known as the engineer's valve, to the brake cylinder; the compressed air forces the piston out and thus through suitable leverage applies the brake shoes to the wheels. Over 15,000 equipments in operation throughout all parts of the world. (See advertisement.)

—National Electric Company, Milwaukee, Wis.

COLUMBIA CAR BRAKES. The brakes are between the wheels. No brake beams or long chains are required. They are easily adjusted, and the shoes are so arranged as to wear equally on all of the wheels. The brakes are adjusted independently on either side. They are quick-acting, requiring only a three-quarter turn of the brake handle for their application.

—Columbia Machine Works and Malleable Iron Company, Brooklyn, N. Y.

FRESH'S EMERGENCY CAR BRAKE. This brake consists of chucks operated under the wheels on the rails, using the weight and momentum for stopping the car. The chucks employ wool felt, compressed into a detachable friction plate on the rail. As the wool felt is absorbent and elastic, it offers the greatest resistance on the wet or icy rail without jar or derailing the car. The chucks are carried by the drawbars and instantly dropped by one-half turn of the brake staff. This equipment is independent of power, simple and durably constructed and offers greatest protection against accidents.

—Emergency Car Brake Company, Cumberland, Md.

DAYTON BRAKE HANDLES. The No. 7 Kling Leen ratchet handle insures positive engagement of the ratchet and pawl. It is made in three sizes, 10 in., 12 in. and 14 in. swing. The gravity brake handle is of more recent production. To make sure that it was up to its claims, the company put this brake to a two years' test before placing it on the market. It has no ratchets to wear out or spring to catch and miss action; no pawls to break. There are simply three strong and durable steel gravity rollers.

—The Dayton Manufacturing Company, Dayton, O.

QUICK ACTION SAFETY CAR BRAKE. Has pinion, gear, two chains and horizontal drum. One of the important features is that the two chains secured, one on each side of the drum by staples riveted into drum heads, divide the strain on the links and diminish chances for breakage of chain; the slack chains are taken up quickly by the drum. One turn of the brake handle puts a car under full control. The pinion shaft has a square hole in it to receive the brake staff, thus making it impossible for it to slip. The brake is designed for use on light or heavy equipment on electric or steam roads.

—Traction Equipment Company, Brooklyn, N. Y.

PEACOCK BRAKE. A hand brake, adapted for any kind of car up to the heaviest and fastest suburban type. The brake is durably constructed, has few parts and is easily operated and applied because the drum works on roller bearings. The speed obtained when taking up the slack chain and the great power gained when applying the brake are very valuable features. The spiral drum, with its eccentrically geared cam construction, not only accomplishes these objects but extends sufficiently to provide for the taking up of any surplus chain caused by the car house men neglecting to keep the brakes properly adjusted. (See advertisement.)

—National Brake Company, Buffalo, N. Y.

PHILADELPHIA AIR BRAKE. This company presents a complete air brake equipment which through two years of practical use has proven to be economical, well built and reliable. The compressor is compact with all wearing parts easy of access and running in oil. The design of the engineer's valve is entirely different from anything else in use and eliminates many of the causes of trouble. The automatic cut-off is simple, easy to adjust and positive in action. The duplex jam cylinder gives the operator two independent air brakes, reducing the chance of accident to a minimum.

—Philadelphia Air Brake Company, Philadelphia, Pa.

ST. LOUIS VERTICAL WHEEL BRAKE. The company recommends its vertical wheel brake because it is easy to operate. Motorman can use both hands in operating. It is strong, though simple in construction. It saves platform space. Removes possibility of injuring operator and passengers—a frequent occurrence where brake handle is used. The action on the brake is at once quick and effective. Heavy equipment nowadays has the modern air brake, and a hand brake is added for emergencies only. For this reason the vertical brake wheel is to be especially recommended as the hand brake should not take up much space on the platform.

—St. Louis Car Company, St. Louis, Mo.

STERLING SAFETY BRAKE. Consists of a pinion shaft, ratchet, pinon, gear, double sprocket (cast with the gear) and two chains. The pinion shaft receives the brake staff and actuates the pinion. The force exerted on a 14 in. handle is multiplied by this brake 17 times. Operation is easy and smooth. The chains attach to two hooks on the brake rod. One chain does the work. The idle chain runs slack, always new, ready for instant service should the working chain break, as such chains do. This brake, therefore, anticipates a common danger. Properly installed, one turn of the handle stops any car. (See advertisement.)

—Sterling-Meaker Company, Newark, N. J.

TAYLOR BRAKES. All Taylor trucks are equipped with a compound lever brake, through which the power is applied centrally, and an even and direct pressure of the brake shoes put upon all the wheels. These brakes are so hung that the shoe adjusts itself accurately to the periphery of the wheel, thereby securing uniform wear of the brake shoes. The shoe is entirely independent of the brake head and is held to it by a key which can be readily removed, allowing the worn out shoe to be replaced without unscrewing a single bolt. The brakes are also supplied with an adjustable release spring which can be so nicely adjusted that each shoe can be set at an equal distance from the wheel.

—Taylor Electric Truck Company, Troy, N. Y.

U. S. COMBINED WHEEL AND RAIL-BRAKE. The brake shoes are normally supported by spiral springs to permit the free movement of the shoes both toward and away from the wheels and rails. The first movement of the brake spindle brings the brake-applying cams into contact with inclines on the shoe backs and presses the brake shoes hard against the wheels. In emergencies, if necessary, an extra pressure on the brake spindle will force the rail brake at the bottom of shoes into contact with the rails.

—U. S. Metal & Manufacturing Company, New York, Chicago, Pittsburg.

WESTINGHOUSE AUTOMATIC AIR-BRAKE SYSTEM. As adapted to electric railways, this system consists of a motor-driven air compressor supplying compressed air to a main reservoir and the brake system; an automatic governor controlling minimum and maximum pressures in main reservoir; a motorman's brake valve by which brakes are applied and released; a brake cylinder piston rod which is connected through suitable levers to brake shoes; an auxiliary reservoir in which air is stored for use in the brake cylinder; a triple valve forming connection between brake pipe, auxiliary reservoir and brake cylinder, and suitable piping, air strainer, cut-out cocks, reducing valve, hose couplings, etc., to connect the various pieces of apparatus above mentioned, and to connect different cars. In this system the brake pipe, which runs throughout the train and connects the motorman's brake valve with the various triple valves, is normally under pressure, the

brakes being applied whenever this pressure is reduced, whether such reduction is caused by the motorman or by accident.
—THE WESTINGHOUSE AIR BRAKE COMPANY, PITTSBURG, PA.

WESTINGHOUSE STRAIGHT AIR-BRAKE SYSTEM. This system consists of a motor-driven air compressor furnishing compressed air to a reservoir; an automatic governor controlling the minimum and maximum pressures in the reservoir; a motorman's operating valve by which brakes are applied and released; a brake cylinder, piston rod which connects through suitable system of levers to the brake shoes; piping connecting the various apparatus above mentioned, and cut-out cocks, air strainers and fittings. The brake pipe is under pressure only during a brake application; the motorman allows air to flow from the reservoir to the brake cylinder to apply the brakes, and from the brake cylinder to the atmosphere to release them. Entirely safe only when applied to single cars; for trains of two or more cars the Westinghouse automatic air brake should be applied.
—THE WESTINGHOUSE AIR BRAKE COMPANY, PITTSBURG, PA.

BRAKE SLACK ADJUSTERS

AMERICAN AUTOMATIC BRAKE-SLACK ADJUSTER. This device consists of a worm, the rotation of which causes the fixed end of the air brake cylinder lever in the foundation brake gear to move so as to take up the slack due to worn brake shoes. On the end of the worm is a toothed wheel, opposite to which and at right angles to the worm, is an air cylinder, the single acting piston of which connects by a ratchet-finger with the toothed wheel in such a manner that whenever air pressure is admitted back of the piston, the latter is pushed forward and the ratchet-finger engages with the toothed wheel; when the air leaves the cylinder, a spring back of the piston forces it to its former position, while the ratchet-finger is engaged with the toothed wheel, thereby causing the worm to rotate. The cylinder is connected by a small pipe to the brake cylinder, so that when the piston in the latter moves out to a certain point, air pressure is admitted to the slack-adjuster cylinder. In this manner the brake cylinder is made to be an automatic valve for the slack adjuster, only admitting air to the latter when it is necessary to take up slack.
—THE AMERICAN BRAKE COMPANY, ST. LOUIS, MO.

BRAKE SHOES

AMERICAN BRAKE SHOES. This line embraces an extensive variety of brake shoes for all classes of railway car braking. For electric railway service five brands of shoes are made a specialty: The Streeter shoe, of soft cast iron with curved face-inserts of hard iron; the Corning shoe of hard cast iron body surrounding an insert of very soft iron in the wearing face; the Diamond "S" shoe of hard iron cast about a bundle of expanded sheet steel; the "U" brake shoe of car wheel iron with extended inclined ends chilled from the back, and the Morrison "Filled" shoe of a strong cast iron body with recessed face containing a block of elastic filling.
—THE AMERICAN BRAKE SHOE AND FOUNDRY COMPANY, MAHWAH, N. J.

BRILL BRAKE-SHOE. This shoe is made of soft iron and has oblong sections of wrought iron set in the contact surface. It is made on the principle of smallest possible wear to the wheel as well as the shoe. The chilled surface of wheels is too thin to permit the use of insets composed of sand or extremely hard metal. This manufacturer's experience has proved wrought iron to be the best material for this purpose, and the amount necessary to obtain the best results has been thoroughly demonstrated.
—J. G. BRILL COMPANY, PHILADELPHIA, PA.
—AMERICAN CAR COMPANY, ST. LOUIS, MO.
—G. C. KUHLMAN CAR COMPANY, CLEVELAND, OHIO.
—JOHN STEPHENSON COMPANY, ELIZABETH, N. J.

BUDA FLANGED BRAKE SHOES. These shoes are designed to permit a greater braking power by extending not only along the tread, but over the flange. Especially adapted to street car service where the narrower tread of the wheel and the consequent decreased frictional surface is increased by the bearing which goes over the flange.
—BUDA FOUNDRY & MANUFACTURING COMPANY, CHICAGO, ILL.

MURRAY BRAKE SHOES. These brake shoes are not cast from the tailings of the cupola, as is frequently done, but are poured from a special mixture of steel and iron, insuring toughness, durability and good friction.
—THE MURRAY IRON WORKS COMPANY, BURLINGTON, IA.

ST. LOUIS BRAKE SHOES. The "K" brake shoe has a hard iron insert, around which is cast a gray iron casting which is not permitted to chill, differing, in this respect, from all other insert shoes. This hard iron insert is a dovetail casting, and is made from high grade malleable iron before it is annealed. The company's process of casting gray iron body around insert, without chilling, not only gives great strength to body of shoe, but also produces a better gripping and wearing effect, with less liability of glazing. None but high grade iron used.
—ST. LOUIS CAR COMPANY, ST. LOUIS, MO.

SPEAR BRAKE SHOE. This is an insert brake shoe, the insert being chilled iron and the balance of the shoe soft iron. Has long life, highest braking power, and saves tires and wheels. It rides the tread at the points where there is the least track wear. There is no cutting edge as the shoe wears down. (See illustrated advertisement.)
—THE DORNER MANUFACTURING COMPANY, CHICAGO, ILL.

"STANDARD" BRAKE SHOES. This company's brake shoes include the following: Gray iron shoes, of special mixture, plain, inserted or filled; steel back shoes, of special mixture, plain, inserted or filled; filled shoes with "corrugated pocket" and steel back shoes with "re-enforced lug."
—STANDARD BRAKE SHOE COMPANY, AURORA, ILL.

TAYLOR BRAKE SHOES. These brake shoes are made of the best hard gray iron, and are guaranteed to fit the brake heads accurately.
—TAYLOR ELECTRIC TRUCK COMPANY, TROY, N. Y.

THE WHEEL TRUING BRAKE SHOE. A wheel grinding shoe, used in place of the ordinary shoe whenever the car wheels need grinding. It trues the wheels while the car is in service; each pair will true a number of pairs of wheels. It consists of an iron shell containing pockets filled with an abrasive substance, so that whenever the brake is applied the wheels are being ground. It is made in any style, so as to fit any type of brake head.
—THE WHEEL TRUING BRAKE SHOE COMPANY, DETROIT, MICH.

BRAZING PROCESSES

FERROFIX FOR BRAZING CAST IRON. The principal feature is the uniting of the surfaces of broken castings by the use of "Ferrofix" and spelter employed in conjunction therewith. The fractures when brazed are as strong as any other part of the casting of equal dimensions, and in all cases the joint is guaranteed, in that should the casting break again it will not do so in the line of the old fracture. This process is particularly applicable to the repairing of motor frames, trucks and gear cases, but has many other applications. (See advertisement.)
—THE AMERICAN FERROFIX BRAZING COMPANY, PHILADELPHIA, PA.

BRIDGES AND BUILDINGS

AMERICAN BRIDGES AND BUILDINGS. This company is a large manufacturer of structural steel and is prepared to design and build steel railway and highway bridges of any desired length and carrying capacity; also to furnish steel construction for buildings.
—AMERICAN BRIDGE COMPANY OF NEW YORK, NEW YORK.

BRIDGES AND BUILDINGS. Bridges, viaducts, steel buildings and structural steel work of every description.
—THE PENNSYLVANIA STEEL COMPANY, PHILADELPHIA, PA.

CONCRETE BRIDGES AND BUILDINGS. The Concrete Steel and Tile Construction Company, a corporation organized under the laws of the State of Michigan, undertakes contracts for the erection of reinforced concrete buildings, bridges, arches, etc., using for its reinforcement the Kahn trussed bar. Its experience in building construction covers a vast range, as it has under way at the present time some 200 contracts of various types. Having a competent corps of engineers always in its employ the company gladly offers its services in submitting designs to prospective customers.
—CONCRETE STEEL AND TILE CONSTRUCTION COMPANY, DETROIT, MICH.

KAHN CONCRETE STEEL CONSTRUCTION. In reinforced concrete girders and beams provision must be made not only for the tension existing in the bottoms thereof, but also for the transverse stresses occuring within the constructions. It is therefore absolutely essential that the reinforcement be arranged not only along the bottom edge but also transversely to the concrete. For efficiency these transverse reinforcing members must be rigidly connected to the main horizontal tension bar. The Kahn trussed bar accomplishes this result by striking up from the member a portion of the section where a reduced area is permissible on account of the reduction in the tensile strain. The Kahn trussed bar possesses the following decided advantages: Reinforcement along theoretical as well as practical lines, absolute assurance of the proper installation of the steel, greater ease and facility for handling, greater speed of erection, less need of skilled labor, less deflection under a given load, greater economy in the use of steel, and saving in time and money without sacrificing the value of the construction.
—TRUSSED CONCRETE STEEL COMPANY, DETROIT, MICH.

THE OWEGO BRIDGE COMPANY, OWEGO, N. Y.; OFFICE, PHILADELPHIA, PA. This company has been established for about fifteen years; its shops are on the lines of three railroads, and have a capacity of from 1,200 to 2,000 tons. Its facilities are of the best for building bridges economically and promptly. About two years ago this company was reorganized by the Transit Finance Company of New York (builders of the Lackawanna & Wyoming Valley Railroad, Buffalo, Rochester and Lockport Railway, etc.); through such connections the new Owego Bridge Company has been naturally led into the electric railway field, and to specializing traction road bridges. Its engineering department will submit plans and estimates upon request.

REINFORCED CONCRETE CAR HOUSES. The value of reinforced concrete in fire-proof construction has been thoroughly well established. It is peculiarly well adapted to electric railway car houses, as it is possible with this material to construct a building absolutely without any combustible material. Owing to the simplicity of its design and the duplication of parts, such a building can be constructed at a cost not materially exceeding that of first class mill construction using brick and steel. It is not necessary to carry insurance on such a building. An example may be seen in the new car houses of the Central Pennsylvania Traction Company at Harrisburg, Pa.
—MASON D. PRATT, HARRISBURG, PA.

RIVERSIDE BRIDGES AND BUILDINGS. This company is prepared to construct railway bridges, viaducts and other heavy structural work. Its equipment is modern in every respect for carrying out its contracts quickly and efficiently.
—RIVERSIDE BRIDGE COMPANY, WHEELING, W. VA.

SCOFIELD REINFORCED CONCRETE SYSTEM. Concrete work to be reliable must have the concrete carefully made and placed; offset bars, so that reliance is not placed upon adhesion; some mechanical means of retaining bars in their proper position while concrete is placed. If these characteristics are achieved, the strength which is calculated will develop in practice. The "Scofield" system of reinforced concrete construction accomplishes these ends, and enables the inspector to see that all steel work is in proper place before concreting begins. It has been used with marked success in powerhouse construction, car barns, coal bunkers, reservoirs, track stringers, railroad bridges, etc. (See advertisement.)
—THE SCOFIELD COMPANY, PHILADELPHIA, PA.

BRUSHES, CARBON

"NATIONAL CARBON" FLEXIBLE CONNECTION FOR CARBON BRUSHES. In this flexible connection for carbon brushes the woven wire is inserted into the brush the full length of the hole, the sleeve is then slipped in and the screw following expands the sleeve to make a contact superior to that obtained by driving in a plug. The greatest feature this connection has, however, is that it is much closer to the commutator surface than any other connection, thereby reducing the resistance between the commutator and the terminal to a minimum and increasing the carrying capacity of the brush because there is less carbon resistance between the commutator surface and the end of the flexible connection.
—NATIONAL CARBON COMPANY, CLEVELAND, OHIO.

GENERAL ELECTRIC BRUSHES AND HOLDERS. The company's brush holders for street railway motors are of bronze with carbon brushes. The brushes slide in finished ways, giving a large surface of contact. Independent brush springs insure freedom of motion, with no tendency to stick. All carbon brushes are provided with "pig tails" or shunts so that the springs are short circuited. A simple and efficient mechanism is used for the adjustment of wear and ease of renewal.
—GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

"HIKO" CARBON BRUSHES. These brushes are especially adapted for street railway and other service

where it is inconvenient to apply a commutator compound. With these brushes there is no scratching, as both the commutator and brushes remain smooth.
—Atlantic Manufacturing Company, Allenhurst N. J.

LE VALLEY VITAE CARBON BRUSHES. These brushes are permanently self-lubricating. They last long, have low resistance, give excellent contact, wear smooth, run cool and do not throw off any carbon dust to cause short circuits. As the brushes will not cut or scratch the commutator, no sandpapering or turning down is required. Many styles are manufactured, each being best adapted for certain conditions and guaranteed by the maker.
—Le Valley Vitae Carbon Brush Company, New York.

NATIONAL CARBON BRUSHES. This company is well-known as a manufacturer of carbon and other electrical specialties for railway work. Among these are carbon brushes, battery carbons, lighting carbons, dry batteries, wet batteries, electrodes, etc. The "Columbia" dry cell, one of the company's specialties, is described elsewhere in this dictionary.
—National Carbon Company, Cleveland, Ohio.

SPEER CARBON BRUSHES. While these brushes contain no grease or oil, they are self-lubricating. They give the commutator a hard glossy finish and keep it clean, thereby increasing the conductivity. They reduce the wear on the commutator and prevent sparking and short circuiting. This brush is of uniform texture and offers a soft frictional surface, and it is guaranteed not to heat up under the most severe circumstances.
—Speer Carbon Company, St Mary's. Pa.

BUMPERS, CAR

BRILL ANGLE-IRON BUMPER. Composed of a single solid forging, the angle-iron bumper possesses all the qualities essential to large effectiveness. The wrought metal is immensely tough, and, in combination with angle-iron construction and semi-elliptic form, gives a strength capable of resisting shocks which would crush a steel-faced wooden bumper and injure platform and framing. The frequent collisions in coupling cars, and the constant liability to damage through the negligence of motormen, make a good bumper an important factor in the saving of repairs. The angle-iron bumper is made in shapes and sizes suitable to every style of car. (Advertisements in last pages.)
—J. G. Brill Company, Philadelphia, Pa.
—American Car Company, St Louis, Mo.
—G. C. Kuhlman Car Company, Cleveland, Ohio.
—John Stephenson Company, Elizabeth, N. J.

BUTTONS

(See "Badges and Buttons")

CABLES

(See "Wires and Cables")

CARBON BRUSHES

(See "Brushes, Carbon")

CARS
(Passenger, Freight and Express)

"AMERICAN CAR AND FOUNDRY" CARS. This company, incorporated in 1899, having formed a consolidation of the largest and oldest car building interests in the United States, is the largest builder of cars in the world. Its specialty is any type of cars of wood or steel construction. The plants for the manufacture of these various products are located as follows: Passenger and street railway car shops—St. Charles, Mo.; Jeffersonville, Ind.; Wilmington, Del.; Berwick, Pa. Freight car shops—Detroit, Mich.; Berwick, Pa.; St. Louis, Mo.; Madison, Ill.; Chicago, Ill.; Huntington, W. Va.; St. Charles, Mo.; Terre Haute, Ind.; Jeffersonville, Ind.; Buffalo, N. Y.; Milton, Pa.; Indianapolis, Ind.; Memphis, Tenn. In addition to these the company operates axle forges, sawmills, malleable foundries, brass foundries, etc.
—American Car and Foundry Company, St. Louis and New York.

AMERICAN CAR COMPANY'S CARS. For cars manufactured by this company see item beginning "Brill."

BRILL BAGGAGE AND EXPRESS CARS. The cars are powerfully framed and trussed for carrying heavy loads, are provided with one or two sliding doors at each side and usually have doors at diagonally opposite corners, to admit long pieces of material and for the motorman's use. A removable gate extending across the car behind the motorman, against which material may be piled, may be used instead of a compartment. It is usually advisable to have baggage and express cars of the largest capacity that conditions permit, as the difference in cost of handling is comparatively small and the earnings are increased proportionally to the tonnage carried. (Advertisements on last pages.)
—J. G. Brill Company, Philadelphia, Pa.
—American Car Company, St Louis, Mo.
—G. C. Kuhlman Car Company, St. Louis, Mo.
—John Stephenson Company, Elizabeth, N. J.

BRILL "CALIFORNIA" CAR. A single truck car with closed compartment at the center, and long dropped platforms, each having two seats back-to-back with bulkhead between. A pair of angle irons, with the upper flange under the side sills, is offset and prolonged to support the long dropped platforms without strain to the body. Ingress and egress are facilitated by the dropped platforms which have running boards only 13 ins. from the track, and 12 ins. from board to platform. Sashes in the bulk head, and side curtains which can be drawn to the floor, provide for stormy weather. Double-truck "Californias" are also built. (Advertisements in last pages.)
—J. G. Brill Company, Philadelphia, Pa.
—American Car Company, St. Louis, Mo
—G. C. Kuhlman Car Company, Cleveland, Ohio.
—John Stephenson Company, Elizabeth, N. J.

BRILL CENTER-VESTIBULE CAR. As there are no platform steps to be avoided, the trucks may be placed so as to reduce the objectionable overhang and thus enable the car to be satisfactorily operated on narrow and crowded streets where the curves are of short radius The entrance and exit of passengers can be easily watched and controlled by the conductor. A heavy stirrup-iron, which connects the sills, allows the steps to be kept within the line of body and preserves the stiffness and strength of sills. The seating capacity is increased by a sliding seat in the vestibule. (Advertisements in last pages.)
—J. G. Brill Company, Philadelphia, Pa.
—American Car Company, St. Louis, Mo.
—G. C. Kuhlman Company, Cleveland, Ohio.
—John Stephenson Company, Elizabeth, N. J

BRILL COMBINATION CONVERTIBLE AND SEMI-CONVERTIBLE CARS. Where railways are laid out to enable cars to run in one direction and have the entrances all on one side, it has been found advantageous to have the entrance side convertible, with sashes and panels that can be raised into roof pockets, and the other side of the car semi-convertible, with built-in panels and only the sashes to be raised into pockets. The Brill patented convertible and semi-convertible systems are well suited to such a combination as the sash arrangement of both is identical. Several types of cars have been built with this combination for both motor and trailer service.
—J. G. Brill Company, Philadelphia, Pa.
—American Car Company, St. Louis, Mo.
—G. C. Kuhlman Car Company, Cleveland, Ohio.
—John Stephenson Company, Elizabeth, N. J.

BRILL CONVERTIBLE CAR. Large double-sash windows slide into roof pockets in the same manner as in the Brill semi-convertible car. The panels also slide into the same roof pockets by means of metal guides on the posts which are straddled by the projecting edges of the two sheets of thin steel which compose the panels. These metal sheets are held ⅜-in. apart by horizontal wooden slats and have spaces between which successfully air-jacket the car against cold. The car is as substantially built and as weather-proof as a standard closed car, and costs no more for maintenance. No rattling of sliding sashes and panels. (Advertisements in last pages.)
—J. G. Brill Company, Philadelphia, Pa.
—American Car Company, St. Louis, Mo.
—G. C. Kuhlman Car Company, Cleveland, Ohio.
—John Stephenson Company, Elizabeth, N. J.

BRILL DRAWING-ROOM CARS. Among those designed and built for officials, and for regular service, are cars with staterooms, bathrooms, kitchens and dining-rooms, observation ends with windows which reach nearly to the floor, large platforms enclosed with dashes and gates of dull brass grill work. The compartments are finished in rich woods handsomely carved and inlaid, and the upholstering and appointments are all of the most luxurious character. Drawing-room cars are being profitably used on many interurban lines. A number of these cars have included the Brill semi-convertible window system, which adds to their comfort in summer.
—J. G. Brill Company, Philadelphia, Pa.
—American Car Company, St. Louis. Mo.
—G. C. Kuhlman Car Company, Cleveland, Ohio.
—John Stephenson Company, Elizabeth, N. J.

BRILL INTERURBAN CARS. These companies do not follow the common methods of building interurban cars, which are drawn largely from steam car practice. Their forms of construction are not excessively heavy. The proper form and amount of bracing and trussing reduces the weight and bulk. That these methods are correct and that infinite care is given to their application in every case, is amply proved by the straight sills, tight joints and thoroughly satisfactory condition of the cars after they have been in service long enough to demonstrate their strength and durability. The Brill semi-convertible window system is frequently included in interurban car designs and is adaptable to the arched-top twin-window arrangement. (Advertisements in last pages.)
—J. G. Brill Company, Philadelphia, Pa.
—American Car Company, St. Louis, Mo.
—G. C. Kuhlman Car Company, Cleveland, Ohio.
—John Stephenson Company, Elizabeth, N. J.

BRILL "METROPOLITAN" CAR. This combination open and closed car is used in a number of large cities in conjunction with standard equipment. One-half of the car is simply a standard open car and the other half a standard closed. It was designed for the Metropolitan Street Railway, of New York, when the Board of Health of that city demanded that every fourth car in summer be closed, and has proved so popular that it is used as a regular part of the winter equipment, smoking being allowed in the open part. The car is designed to be carried on "Eureka" maximum-traction trucks. (Advertisements in last pages.)
—J. G. Brill Company, Philadelphia, Pa.
—American Car Company, St. Louis, Mo.
—G. C. Kuhlman Car Company, Cleveland, Ohio.
—John Stephenson Company, Elizabeth, N. J.

BRILL "NARRAGANSETT" CAR. The summer excursion car for handling crowds safely, and the only practical double-truck open car. A double-step is provided by having the upper step on the middle web of Z-iron sills. The width over all is no greater than a single-step double-truck open car, as the sill step is within the line of the posts. The double steps of the Narragansett make it possible for women and children to get in and out safely and quickly. It is the safest open car. The Z-iron sills make it the strongest open car ever built. The seats are full standard length. (Advertisements in last pages.)
—J. G. Brill Company, Philadelphia, Pa.
—American Car Company, St Louis, Mo.
—G. C. Kuhlman Car Company, Cleveland, Ohio.
—John Stephenson Company, Elizabeth, N. J.

BRILL SEMI-CONVERTIBLE CAR. Each pair of sashes is joined together with brass tongue-and-groove sliding connections and conducted into a pocket in the side roof by means of small metal roller-brackets, moving on bow-shaped steel guides, which extend from top-plate to lower ventilator rail, and are within the pocket. This is the improved patented system known as the "grooveless-post." Having the window pockets in the roof adds 6 ins. to 7½ ins. to the interior width; the pockets cannot be used for rubbish receptacles; the window sills may be as low as desired; the operation of the sashes is easier than with wall pockets. (Advertisements in last pages.)
—J. G. Brill Company, Philadelphia, Pa.
—American Car Company, St. Louis, Mo.
—G. C. Kuhlman Car Company, Cleveland, Ohio.
—John Stephenson Company, Elizabeth, N. J.

BRILL STANDARD CLOSED CARS. Single- and double-truck closed cars longitudinal seats and drop sash windows are still built in large numbers. For city service, the wide space between the seats is often an important advantage over the limited aisle space of the transverse seat arrangement, as greater carrying capacity is obtained and the movement of passengers in and out is facilitated. When cars are built with entrance at one side only of either open or vestibuled platforms, it is usual to include the company's "semi accelerator" doors at the body ends, which permit passengers standing on the platforms without obstructing the passage from step to door. (Advertisements in last pages.)
—J. G. Brill Company, Philadelphia, Pa.
—American Car Company, St. Louis. Mo.
—G. C. Kuhlman Car Company, Cleveland, Ohio.
—John Stephenson Company, Elizabeth, N. J.

JEWETT CARS. This company is particularly well-known in the electric railway field on account of the many handsome and substantial cars which it has furnished to the high-speed interurban electric railways of the middle West. In addition to interurban cars this company has built some fine types of surface cars, a characteristic example being the style used for handling the local traffic on the new East River bridge between New York and Brooklyn.
—Jewett Car Company, Newark, Ohio.

(CONTINUED ON PAGE IX.)

CARS—Continued.

BRILL STANDARD OPEN CARS. As usually constructed, the seats have reversible backs with the exception of the four against the bulkheads, so that the passengers, on all but two seats, face forward. The cars are sometimes built without bulkheads, vestibule ends with stout corner posts taking their place, thereby permitting all seats to have reversible backs. If bulkheads are used and weather conditions require protection for passengers outside of them, light but substantial vestibules may be employed to advantage. All open cars are provided with the company's "round-corner seat-end panels," which facilitate ingress and egress and permit the curtains to be drawn to the floor.
—J. G. BRILL COMPANY, PHILADELPHIA, PA.
—AMERICAN CAR COMPANY, ST. LOUIS, MO.
—G. C. KUHLMAN CAR COMPANY, CLEVELAND, OHIO.
—JOHN STEPHENSON COMPANY, ELIZABETH, N. J.

BRILL TOP-SEAT CARS. These companies build every type of single- and double-truck top-seat car, with and without canopies and enclosures, with longitudinal seats on the deck, facing outwardly, or transverse seats. A form of stairway, which they have devised, reduces the length of the platforms, provides a covering for the motorman, and keeps him out of the way of passengers. Other features, developed by long experience, include a variety of window systems which adapt the cars to local conditions.
—J. G. BRILL COMPANY, PHILADELPHIA, PA.
—AMERICAN CAR COMPANY, ST. LOUIS, MO.
—G. C. KUHLMAN CAR COMPANY, CLEVELAND, OHIO.
—JOHN STEPHENSON COMPANY, ELIZABETH, N. J.

DORNER CARS. Are rebuilt equal to new by taking out all defective and worn parts, substituting new and thoroughly overhauling every portion of the cars; adding new trimmings, vestibuling, repainting and mounting on new trucks. (See advertisement.)
—THE DORNER MANUFACTURING COMPANY, CHICAGO, ILL.

JONES CARS. Ever since the establishment of this firm in 1839, its rolling stock has continued to enjoy that popularity that comes from keeping abreast with the changes of time. This company makes a specialty of equipment for electric railway service, cars for steam railroads not being built by them. It has brought out numerous up-to-date designs of high grade cars for electric street railways.
—J. M. JONES' SONS, WEST TROY, N. Y.

KUHLMAN CARS. For cars manufactured by the G. C. Kuhlman Car Company see items beginning "Brill."

LACONIA PASSENGER CARS. Made on the company's own plans and specifications or to specifications of the railway company. The Laconia semi-convertible car is built in any length to suit purchaser; has straight sides; steam car type of roof; all side windows have double sash, and arranged to drop into pockets flush with window stool, making when windows are lowered a very comfortable summer car. The open cars are furnished with closed or vestibuled ends, either 9, 10, 12, 13, 14 or 15 benches; with malleable iron seat panels; folding running boards; drop side guards; curtains running between posts to floor; solid bronze trimmings; extra strong bottom framing, reinforced by steel plates.
—THE LACONIA CAR COMPANY WORKS, BOSTON, MASS.

LACONIA EXPRESS AND COAL CARS. These cars are built on standard specifications, in capacities from ten to forty tons, to suit requirements of purchaser. Cars are built on steam car lines with modifications to suit electric service, for either standard or narrow gage tracks.
—THE LACONIA CAR COMPANY WORKS, BOSTON, MASS.

NILES CARS. Consist of all styles and sizes of electric railway cars, heavy interurban, medium size suburban and city service cars of closed, open and convertible types, but the company's specialty is large cars for fast interurban service and electric parlor cars for limited extra fare service. It furnishes drawings and specifications of standard types of cars to prospective purchasers or builds all classes of cars on purchaser's specifications. The works are new and of latest plan, are centrally located and have economical shipping facilities. (See Niles standard type of car illustrated in advertisement.)
—NILES CAR & MANUFACTURING COMPANY, NILES, O.

PRESSED STEEL CARS. See items under the heading of "Cars, Pressed Steel."

ST. LOUIS CARS. At this plant cars of every description are turned out, from the ten bench open to the handsome interurban car and steam railway coach. For city and light interurban service the company draws attention to its steel channel bottom semi-convertible car, which is the car for all year round. This form of bottom construction permits car body to be hung low, resulting in but one step from platform to ground. There being no intermediate sills, there is plenty of room for trucks to radiate. This type car is strong and durable, weighing no more than those of ordinary construction.
—ST. LOUIS CAR COMPANY, ST. LOUIS, MO.

STEPHENSON SEMI-CONVERTIBLE CAR. This window system combines the wall pocket and roof pocket methods of disposing of the sashes. Both pockets are narrow and the side lining is set in between the posts to add additional interior width to the car. In opening a window, the lower sash is dropped into the wall pocket, which is covered with a hinged cap, and the upper sash is raised into the roof, where it is held securely. This window system is suitable for use with arched-top twin-window type of cars, as well as for the ordinary form. The car is successfully used on elevated lines and in all forms of city and interurban service. (See illustration in advertisement.)
—JOHN STEPHENSON COMPANY, ELIZABETH, N. J.

STEPHENSON CARS. In addition to the above item see also those beginning "Brill."

CARS, PRESSED STEEL

AMERICAN CAR AND FOUNDRY PRESSED STEEL CARS. This company is the largest builder of steel passenger cars in the world. The principal plants for the manufacture of steel cars are at Berwick, Pa., and Detroit, Mich.
—AMERICAN CAR AND FOUNDRY COMPANY, ST. LOUIS AND NEW YORK.

PRESSED STEEL STREET CAR. A type of street or interurban traction car which, while conserving the general contour and appearance of the usual wooden construction, is built entirely of steel. The material used in construction is pressed steel and rolled shapes in the underframing and superstructure, with steel plates for sides, floor and ends. The design accomplishes a vehicle of extreme rigidity, coupling lightness with practical indestructibility by collision, fire or other accident.
—PRESSED STEEL CAR COMPANY, PITTSBURG, PA.

CARS, PORTABLE SUBSTATION

BRILL PORTABLE SUB-STATION CARS. Instead of building sub-stations which could only be used part of the year, a car containing a rotary converter and transformers may be placed on a siding wherever needed and connection made to the transmission lines with a pole. The delivery of a heavy voltage of direct current over a long line is expensive and as the percentage of waste is slight with alternating current, the car may be placed as far from the powerhouse as desired. The roof of these cars is constructed to be removable in a single piece to permit installation of machinery by crane.
—J. G. BRILL COMPANY, PHILADELPHIA, PA.
—AMERICAN CAR COMPANY, ST. LOUIS, MO.
—G. C. KUHLMAN CAR COMPANY, CLEVELAND, OHIO.
—JOHN STEPHENSON COMPANY, ELIZABETH, N. J.

CARS, CONSTRUCTION AND REPAIR

BUDA HAND CARS AND PUSH CARS. These cars are made in various styles for all track purposes. The wheels are pressed from a single plate of steel; they are spun into shape while hot, so that they are perfectly true and do not require to be "turned-up." The natural skin of the metal is thus preserved on the tread and the life is considerably prolonged. Being of one piece they are not affected by climatic changes. The form of construction was pronounced the strongest by a test made at the University of Illinois, where a number of prominent wheels were tested at the same time.
—BUDA FOUNDRY & MANUFACTURING COMPANY, CHICAGO, ILL.

KALAMAZOO GASOLINE MOTOR CARS. Four-passenger inspection car, fitted with 7 hp. automobile type engine, two speeds ahead and one reverse, capable of attaining a speed of 35 miles per hour, operates like an automobile, comfortably upholstered in leather. A car is also made for section gang purposes, having the same motor, but with a flat deck with seats for large section gangs; will also carry full equipment of tools and if necessary haul push cars. This section gang car can also be fitted with a tower for trolley line work, which tower can be raised or lowered as desired.
—KALAMAZOO RAILWAY SUPPLY COMPANY, KALAMAZOO, MICH.

KALAMAZOO HAND CAR. Equipped with all the desirable features, such as taper-wheel and pinion-fit axles; machine-cut gears; 20 in. dia. pressed steel wheels; flexible steady-box; double-acting brake; wrought walking-beam; specially stout gallows-frame, with vertical and diagonal bracing; car frame made of dry white ash, gained and thoroughly bolted together, braced diagonally and trussed with longitudinal and transverse wrought iron rods against any chance of sagging or getting out of true. Ten styles of hand cars are made by this company.
—KALAMAZOO RAILWAY SUPPLY COMPANY, KALAMAZOO MICH.

KALAMAZOO PUSH CAR. The platform of this car is 7 ft. long, 5 ft. 8 in. wide; frame and deck of seasoned hard wood; axles, $1\frac{1}{2}$ in. dia.; bearings, brass; wheels, 20 in. dia., all metal; ends strapped with $2x\frac{1}{2}$ in. iron; weight, 480 lbs.
—KALAMAZOO RAILWAY SUPPLY COMPANY, KALAMAZOO, MICH.

KALAMAZOO RAIL CAR. The frame is of thoroughly seasoned oak, gained and reinforced by tie-rods; cross beams faced with flat steel bars; axles, $2\frac{3}{4}$ in. dia.; wheels, 16 in. dia., 6 in. tread. Stout hooks for pulling car are provided, one at each corner; 6 in. dia. rollers, two at each end to facilitate handling iron; weight, 1,620 lbs.
—KALAMAZOO RAILWAY SUPPLY COMPANY, KALAMAZOO, MICH.

KALAMAZOO TOWER HAND CAR. Car platform 4 ft. 4 ins. by 7 ft. 6 ins. Wheels, 20 ins. dia., all metal or wood center. Axles, $1\frac{1}{2}$ in. dia., steel. Fitted with roller bearings when desired, for which a slight extra charge is made. Weight about 800 lbs. Tower is built to any height specified, and, if required, may be made adjustable to different heights at small additional cost. Tower can be easily removed and car then used as an ordinary section car. This car is always ready to be run over the rails directly to breaks which are often inaccessible to horses and wagon.
—KALAMAZOO RAILWAY SUPPLY COMPANY, KALAMAZOO, MICH.

OLDSMOBILE INSPECTION CARS. Made in several types especially adapted to street railway uses. The Number 1 inspection car is used as a line car and when fitted with a ladder is a practical car for quick repair work and getting out on the line in case of emergencies. It is simple in operation, easy to handle and made to suit grades and special rails. This car is manufactured by the Olds Motor Works and sold only by the
—RAILWAY APPLIANCES COMPANY, CHICAGO AND NEW YORK.

SHEFFIELD TROLLEY REPAIR CAR. This car is designed for repair work on electric railways. Furnished with tower, either of angle steel or wood construction, as preferred, in two sections; the upper section is telescoped inside of the lower when traveling over the line. Car is equipped with 6 hp. vertical single cylinder automobile type gasoline engine, and has two speeds forward and one reverse. Has a maximum speed of about 15 miles per hour, and reverse speed of 5 miles per hour. The car is under control of the operator at all times. Ample space is provided on car for gang of men and full complement of tools. Several different designs made for inspection, construction and repair work.
—FAIRBANKS, MORSE & COMPANY, CHICAGO, ILL.

CAR EQUIPMENT

(For Fenders, Heaters, Registers, Wheels, etc., see those headings)

CAR TRIMMINGS

(See also Curtain Fixtures, Register Fixtures, etc.)

DAYTON CAR TRIMMINGS. A very extensive line of car trimmings is made by this company in thousands of patterns. The company's catalogue illustrating them has over 1,000 pages, showing more than 8,000 articles of brass hardware used in the construction of passenger cars, for interior, platform and vestibule construction. Many patterns are of recent design, finished in bronze, brass, silver, nickel, oxidized, sand blast or satin as desired.
—THE DAYTON MANUFACTURING COMPANY, DAYTON, O

RECORDING FARE REGISTER COMPANY'S CAR TRIMMINGS. Highly finished bronze trimmings for all kinds of cars. Individual or continuous package racks for steam or interurban cars. Door, window and seat trimmings; hand grab straps, etc.
—THE RECORDING FARE REGISTER COMPANY, NEW HAVEN, CONN.

WALLACE CAR TRIMMINGS. Brass, bronze, nickeled and oxidized trimmings made free from blow holes in castings or other imperfections. Steel sash springs, deck sash pivots, deck sash operating mechanism and in fact all metal furnishings for car bodies.
—WALLACE SUPPLY COMPANY, CHICAGO AND NEW YORK

CASTINGS

AMERICAN BRIDGE COMPANY'S CASTINGS. Steel and iron castings form one of the important products of this company.
—AMERICAN BRIDGE COMPANY OF NEW YORK, NEW YORK

AMERICAN BRAKE SHOE AND FOUNDRY COMPANY'S MISCELLANEOUS CASTINGS. Castings of soft and hard iron, from all sizes and shapes of patterns are undertaken, and manhole castings are a specialty of this company.
—AMERICAN BRAKE SHOE & FOUNDRY COMPANY, MAHWAH, N. J.

BEAVER DAM CASTINGS. (See item under Track Work.
—BEAVER DAM MALLEABLE IRON COMPANY, BEAVER DAM, WIS.

BRADY INGOT COPPER. For street railways operating their own brass foundries this company is enabled to offer ingot copper of the best quality for immediate supply.
—BRADY BRASS COMPANY, NEW YORK.

COLUMBIA CASTINGS. The gray iron castings are made of best pig iron and are soft and smooth. The brass castings are made of the best composition.
—COLUMBIA MACHINE WORKS AND MALLEABLE IRON COMPANY, BROOKLYN, N. Y.

FALK CASTINGS. Founders of miscellaneous iron and steel castings.
—THE FALK COMPANY, MILWAUKEE, WIS

LACONIA CASTINGS. The malleable castings used in this company's cars and trucks are of its own manufacture. The company also manufactures malleable castings for all kinds of electrical work, making a specialty of this work in its foundry. Material used is the best grade of charcoal iron, and after passing through the annealing furnaces the iron becomes very tough and is easily machined.
—THE LACONIA CAR COMPANY WORKS, BOSTON, MASS.

MICHIGAN CASTINGS. Brass, bronze and grey iron castings.
—MICHIGAN MACHINERY MANUFACTURING COMPANY, YPSILANTI, MICH.

MORRIS CASTINGS. All classes of small castings furnished in connection with electric railway line material and other work.
—ELMER P. MORRIS, NEW YORK.

MURRAY CASTINGS. Made in large foundries in Iowa and Illinois and are the result of the experience of a third of a century. The mixtures are made by analysis and there are separate cupolas for different grades; therefore every casting is especially suited and adapted for its particular purpose.
—THE MURRAY IRON WORKS COMPANY, BURLINGTON, IA.

"OHIO BRASS" CASTINGS. Brass, bronze and aluminum castings and special brass work of all knds are the specialties of this company.
—THE OHIO BRASS COMPANY, MANSFIELD, OHIO.

PENNSYLVANIA STEEL CASTINGS. Steel castings and special steels for all purposes.
—PENNSYLVANIA STEEL COMPANY, PHILADELPHIA, PA.

RIDLON CASTINGS. This company has an up-to-date brass foundry and is prepared to make all classes of castings in bronze, brass or composition, either in the rough or finished; a brass finishing department is connected with the factory, making it possible to turn out any class of work in this line. A specialty is made of register fittings and car trimmings.
—FRANK RIDLON COMPANY, BOSTON, MASS.

CAST-WELDED JOINTS

(See Joints, Rail.)

CATCHERS AND RETRIEVERS, TROLLEY

AMERICAN CATCHER. An ordinary trolley-pole catcher that prevents pole from getting beyond control and doing damage, and with special provision for taking care of slack rope. Its principal features are its simplicity, durability, and its low cost. Its simple mechanism and small number of parts make dis arrangement almost impossible, and as each part is a solid piece of malleable iron it is practically indestructible, thereby greatly reducing the the cost of maintenance.
—THE TROLLEY SUPPLY COMPANY, CANTON, OHIO

EARLL TROLLEY CATCHER. Weight 10 lbs. diameter 7½ in.; projects 5 ins from dash of car. Drum will wind 25 ft. No. 10 rope. Contains no screws or pins. Made entirely of steel and malleable iron. Drum runs on shaft supported at both ends. Bearings 3½ ins long. Check pawl is cushioned when the trolley jumps and the centrifugal paw, is relieved of all pressure due to checking the pole. Contains only three working parts, the drum and two pawls. Is very light, strong and durable.
—CHARLES I. EARLL, NEW YORK

EARLL TROLLEY RETRIEVER. Weight 14 to 17 lbs., diameter 7½ ins.; projects 5½ ins.; large rope capacity. Taken apart and assembled without tools in two minutes. Adjustable for any power within limits of retrieving spring without changing spring. Reset by merely pulling out the rope. May reset by reciprocating rope up and down in short strokes with assistance of pole without permitting pole to strike, should car be in motion. Conductor compelled to reset completely. Contains release by which the rope may be instantly withdrawn before resetting or in case of any accident to the mechanism.
—CHARLES I. EARLL, NEW YORK.

KNUTSON TROLLEY RETRIEVER. A device that prevents damage to poles, overhead, car tops, etc., by pulling down the trolley-pole instantly when it leaves the wire and holding it several feet below. Built for service under severe trolley conditions on high speed lines, and has a record of three years of successful usage. Now in use on a majority of high speed lines throughout the country and in many foreign countries. The distinguishing feature of its mechanism is that it is entirely automatic, the retrieving spring being wound by pulling out rope without touching machine till mechanism locks itself at the proper point. The pole is held below wire till retrieving mechanism is automatically locked.
—THE TROLLEY SUPPLY COMPANY, CANTON, OHIO.

MILLOY AUTOMATIC TROLLEY RETRIEVER. This retriever is operated by compressed air and can be used on any type of car with any air brake. It is installed on the roof beside the running board, is self-operating and requires no attention from the car crew. The retriever is durably constructed and is not affected by the weather.
—MILLOY ELECTRIC COMPANY, CLEVELAND, OHIO.

RIDLON TROLLEY CATCHER. This device has a permanent stop on reel and in case, with an action devised to prevent the partial locking of the reel. When used on oscillating single truck cars it will not catch and pull the wheel from the wire. When the wheel does leave the wire it catches quickly and has the advantage of having an action devised to retard the unlocking should the pole rebound. The reel spring is housed inside the case, thereby protecting it against the entrance of rain water, which would cause the spring to rust and consequently shorten its life. The construction of the case allows ample room for the trolley rope so that with the pole down, the reel will take up the slack. The lower part of the case has a large opening, giving access to the reel without removing it from the case. The rope may be unwound without taking the catcher apart. This also provides a drip so that in wet, sleety or freezing weather the reel cannot become blocked.
—FRANK RIDLON COMPANY, BOSTON, MASS.

WILSON TROLLEY CATCHERS AND RETRIEVERS. These devices have been in successful service for more than five years, and are in use on many representative electric railway systems.
—WILSON TROLLEY CATCHER COMPANY, BOSTON, MASS.

CATTLE GUARDS

(See Stock Guards.)

CEMENT

ASBESTOS CEMENTS. These cements are found adaptable for many conditions. No. 302 asbestos cement felting is a high grade insulation for covering boilers and other flat steam heated surfaces. It possesses high insulating qualities. Asbestos "Retort" cement, the base of which is asbestos, is in general use in gas and chemical works for repairing broken retorts and pipes; hardens rapidly, and is not affected by heat, nitric or sulphuric acids, petroleum, oils, etc. Asbestos "Fireite" is a strong and durable cement for setting up broken furnaces, ranges and finishing cracks. It vitrifies rapidly and adheres to the casts.
—H. W. JOHNS-MANVILLE COMPANY, NEW YORK

"J-M" ASBESTOS ROOF CEMENT. This is a very convenient material for cementing or painting up and making water-tight difficult joints, entrance tubes, nail holes on roofs, or repairing leaks around windows, etc. It comes in a plastic form ready for application with a knife or trowel. (See advertisement.)
—H. W. JOHNS-MANVILLE COMPANY, NEW YORK

CHAINS

AMERICAN CHAINS. Among the products of this company are steel chains.
—AMERICAN BRIDGE COMPANY OF NEW YORK, NEW YORK

JEFFREY CHAINS. Among the chains made by this company are coil chains for lumber and saw mills. "Climax" steel chain for especially heavy elevating and conveying work; phosphor bronze and standard steel bushed chain for gritty material; ores, broken stone, coal, sand, coke, etc.); steel drag and transfer chains; "Hercules" malleable and steel combination detachable, etc.
—THE JEFFREY MANUFACTURING COMPANY, COLUMBUS

TAYLOR CHAINS. These brake chains are made of B. B. iron of large size and twisted links, and the auxiliary links and eye bolts are hand made out of the above brand of wrought iron, thereby giving most absolute assurance of safety.
—TAYLOR ELECTRIC TRUCK COMPANY, TROY, N. Y.

CHANGE CARRIERS

RAPID READY CHANGE CARRIER. This device consists of four tubes attached to an adjustable belt, which is worn about the waist, either inside or outside the coat, according to weather conditions. The tubes have slots at the top for pennies, nickels, dimes and quarters respectively, which are released one at a time by the wearer of the carrier. By the manipulation of the finger and thumb the bottom coin is unlocked and readily removed The tubes can be filled either at the top or bottom, but only released at the bottom.
—CHAS. F. ETTER, HARRISBURG, PA.

CHIMNEYS

CHIMNEYS. Made by Broomell, Schmidt & Steacy Company, York, Pa.

WEBER STEEL-CONCRETE CHIMNEYS. The company makes a specialty of the erection of reinforced concrete chimneys. Weber chimneys have been successfully adopted by many leading concerns and in different countries. The materials used in the construction of these chimneys are steel, Portland cement and selected sand. They have a great many advantages over the old style of brick, radial brick and steel chimneys, and are rapidly superseding them. They are light, monolithic, absolutely air tight, occupy less space, are said to be more durable, and better in appearance than either brick or steel chimneys The company takes contracts in every part of the globe.
—THE WEBER STEEL-CONCRETE CHIMNEY COMPANY CHICAGO, ILL.

CIRCUIT BREAKERS

CONDIT OIL CIRCUIT BREAKERS. Made in desired styles and capacities for electric railway, lighting and power installations.
—CONDIT ELECTRICAL MANUFACTURING COMPANY, BOSTON, MASS.

GENERAL ELECTRIC CIRCUIT BREAKERS. Are built for 125 to 650 volts service and in capacities from 1 to 10,000 amps. These breakers are low in price and reliable. All parts are readily and cheaply renewable A final carbon break is used for the protection of the main contacts, and the carbon contacts are sweated into clamping jaws without the use of screws. The breakers may be equipped with reverse current, shunt trip, low voltage, underload or overload release, shunt trip and auxiliary bell alarm switches. The standard finish is dull black with polished copper current carrying parts.
—GENERAL ELECTRIC COMPANY SCHENECTADY N. Y.

I-T-E CIRCUIT BREAKERS. The Cutter I-T-E and circuit breakers are almost synonymous. The development of the circuit breaker is due in no small measure to the attention paid this important piece of apparatus by this company. The business established by Henry

B. Cutter in 1888 was incorporated in 1891, so that The Cutter Company is entitled to rank among the old-time institutions. Mr. Cutter retired from the management in 1900, since which time it has been under the control of A. Edw. Newton, with William M. Scott as general manager and chief engineer. Mr. Scott's ability in his line is a matter of common knowledge. Many of the important developments in the circuit breaking devices are due to his ingenuity and skill.
—The Cutter Electrical & Manufacturing Company, Philadelphia, Pa.

WESTINGHOUSE CIRCUIT BREAKERS. This line includes breakers from the smallest built up to those having a continuous capacity of 10,000 amps. and over and for circuits up to 33,000 volts for street railway service, switchboards or individual motor protection. They are made in all types; overload release, no-voltage release, underload release, overvoltage release, etc. Are made for either hand or electrical operation, and oil or air break.
—Westinghouse Electric & Manufacturing Company, Pittsburg, Pa.

CLAMPS AND CONNECTORS FOR WIRES AND CABLES

CLARK INTERLOCKING INSULATOR CLAMP, TYPE A. This clamp is designed to securely hold cable or transmission conductor in the groove of the insulator- The insulator is constructed with an undercut recess on either side of the groove in the center of insulator top, so that when the clamp is in position it is interlocked under the projecting portion in such a manner that wire cannot be removed or the clamp separated from the insulator without unlocking the clamp. The construction is such that the end strain on the clamp is distributed so that excessive pressure can at no time be concentrated on a small area of porcelain, and at the same time sufficient clearance is allowed so that the cable and clamp together may move freely when the cable or conductor is in place in the insulator, avoiding the hinge action which takes place when the wire is rigidly held in the insulator. Made in sizes ranging from No. 2 bare to 500,000 C.M. weather proof.
—The Clark Electric & Manufacturing Company, New York.

CLARK INTERLOCKING INSULATOR CLAMP, TYPE B. This clamp is designed to be used on a recessed insulator same as Type A, where the strain on the conductor is not excessive. The two halves of the clamp are placed in the undercut recesses of the insulator; the wire is then dropped in place between the two halves and clamp is drawn together on the wire. Seating the nut tightens the clamp on the wire and locks clamp and wire within the insulator, but with sufficient play to enable the swing of the wire to be transmitted from one span to the next, avoiding bending strains on the conductor. This type is especially recommended for sizes No. 1-0 and smaller.
—The Clark Electric & Manufacturing Company, New York.

CLARK IMPROVED SPLICING SLEEVE. This splicing sleeve is intended for splicing hard drawn copper wires and cables where solder cannot be used on account of the annealing of the wire in making a splice. The sleeve is made of special copper tube with soft interior so formed that the ends of the wire or cable to be spliced are passed through the tube and the tube and wires together twisted to form a tight mechanical and electrical joint. Special tools are provided for making the splices. These sleeves are being extensively used for splicing high tension transmission lines on long span work.
—The Clark Electric & Manufacturing Company, New York.

CLARK STANDARD INSULATOR CLAMP. This clamp is designed for use with standard insulators. The two clamps are tightened firmly to the conductor on either side of the insulator by means of bolt and nut. The projecting lips engaging the groove of the insulator, transfer the end strain to the porcelain in an effective manner. The loops surrounding the neck of the insulator hold the clamps firmly in position and prevent the conductor from being lifted from the groove. This is the type of clamp in use on the transmission lines of the Mexican Light & Power Company.
—The Clark Electric & Manufacturing Company, New York.

CLARK UNDERLOCKING INSULATOR CLAMP, TYPE B. This clamp is designed to clamp firmly on cable or conductor on each side of the insulator. The projections or lips engage a deep circular groove in the neck of the insulator which prevents the wire from being lifted from the groove and transfers the end strain on the conductor to the insulator without concentrating an excessive pressure at one point. Two of these clamps are required for each insulator. This clamp is being used on the transmission lines of the Rio de Janeiro Tramway, Light & Power Company, with complete success.
—The Clark Electric & Manufacturing Company, New York.

KEARNEY CABLE CLAMP. This clamp is made in one size, but is adaptable to any diameter cable from 0000 to 1,000,000 cm. By its use a great saving is effected at every corner, turn or dead end, as no splicing is required and neater and quicker work is secured.
—W. N. Matthews & Brother, St. Louis, Mo.

"DOSSERT" SOLDERLESS CONNECTORS. A mechanical joint which requires no solder. Two types. "A" for solid wires, consisting of two compression nuts, one nipple and two double beveled, split cones; and "B" for stranded cables, consisting of two compression nuts, one nipple, two outside rings and two inside rings. The inside rings are forced under the first layer of strands, forming a "hump," the strands being moulded back to their original position and the nipple screwed into the nut. Made in two-ways, three-ways, four-ways, "Y's" and all styles of lugs. Also a cable tap which can be applied in one-tenth the time it takes to make a soldered tap.
—Dossert & Company, New York.

RIDLON TWO-WAY CONNECTORS. This company manufactures standard size two-way connectors or can furnish special sizes to specifications.
—Frank Ridlon Company, Boston, Mass.

CLEANERS AND SCRAPERS, TRACK

BRILL TRACK SCRAPER. The three special features of this track scraper are: Elastic arms, diagonal cross bracing and removable shoes. The elastic arms allow the blades to spring over crossings and obstructions. The diagonal cross-bracing gives rigidity and strength exactly where it is needed, and prevents bending and breaking. Removable shoes receive the wear and are easily and inexpensively replaced. The apparatus can be installed under platforms of any height without blocking or cutting of timbers. The blades may be drawn up to any desired height by the handle, and dropped instantly on the track by kicking a trigger.
—J. G. Brill Company, Philadelphia, Pa.
—American Car Company, St. Louis, Mo.
—G. C. Kuhlman Car Company, Cleveland, Ohio
—John Stephenson Company, Elizabeth, N J.

CLARK TRACK CLEANERS. These cleaners are designed to meet the requirements of street and suburban electric railways, for the removal of snow, ice, or mud from the rails. They are constructed of the best material, are strong and durable, and will last the life of a car, requiring but few repairs, with the exception of replacing the blades, which are made of shovel steel and will last several seasons. (See illustration in advertisement.)
—The Van Dorn & Dutton Company, Cleveland, Ohio.

KALAMAZOO NO. 5 SCRAPER. This scraper is raised and lowered by the same device as the company's single scraper, and is easily handled by the motorman alone. It is designed to clean all the snow from between the rails, and 9 ins. outside the same, throwing it each way from the center; also cleans top of rail and groove. It is claimed that with this scraper practical work can be done, and more track cleaned than with the sweeper, as it can be run much faster; in fact, better results are obtained when the car is moving quite rapidly, if the pressure on rail is increased correspondingly, because the snow is deposited farther from the track. The cost is not more than one-twentieth of a sweeper, making it a very economical track cleaner. It is now in use on many railways.
—Kalamazoo Railway Supply Company, Kalamazoo, Mich.

MONARCH TRACK CLEANER. This cleaner is designed for removing snow, ice, sleet, mud or gravel from the track. The scrapers are held in position by two powerful flat steel springs, which provide for the various track and pavement conditions, and permit each blade to raise independently. The blades can be set at any desired angle, and are protected from wear by removable shoes, which can be readily replaced at small cost. (See page 446 of Catalogue No. 6 and also advertisement.)
—The Ohio Brass Company, Mansfield, Ohio.

"OHIO BRASS" TRACK CLEANERS. Adjustable track brush holder, designed for attachment to guard board under the car. This device is unequaled for keeping the track clear of light snow, dirt, sand or gravel. Can be adjusted to hold brush at any desired height over the rail. When not in use, brush is held clear of the track by spiral spring. Simple in design and strongly made. (See pages 440 and 441, Catalogue No. 6; also advertisement.)
—The Ohio Brass Company, Mansfield, Ohio.

RELIANCE TRACK CLEANER. In satisfactory use on electric railways for over fifteen years. A positive scraper, keeping snow, ice and mud from rail at all times. Made for light or heavy pressure, strongly built and made to fit any car. It is easy to attach. (See illustrated advertisement.)
—The Dorner Manufacturing Company, Chicago, Ill.

ROOT RAILWAY SPRING SCRAPERS. These scrapers are made in several styles to meet any and all conditions on city or interurban lines, and give the same results on any type of rail. They are easily installed on any type of car, either single or double track. They require little power, deposit the snow far from the track, and leave the rail and groove so clean that contact from wheel to rail is perfect. When in working position, they need no attention, and do not have to be raised for switches, crossings or high blocks in pavement. They clean the rail and groove even when the track is two in. below pavement, and give the same results whatever the conditions of snow—wet, dry or packed.
—Kalamazoo Railway Supply Company, Kalamazoo Mich.

CLEANERS, BOILER

(See "Boiler Cleaners")

CLEANING POWDERS AND WASHES

SACARBOLATE CAR WASHING COMPOUND. A non-poisonous washing and disinfecting fluid soap, possessing all the qualities of a good washing soap but acting also as a disinfectant. Does not stain or ruin paint or varnish work but improves the luster of such surfaces. If the slight carbolic odor is found objectionable, other compositions can be furnished of lesser disinfecting powes but more pleasant as deodorizers.
—Frank S. De Ronde Company, New York.

SAVROGAN CLEANING POWDER. Carries the essentials required for a general washing powder, constructed of pure materials that are a necessity for clean cleaning, avoiding the soapy or greasy odors Used for twenty-five years on steam and street railways.
India Alkali Works, Boston, Mass.,

SHIELD OIL SOAP. A soap for varnish and paint cleaning, of the consistency of tallow, and made from pure linseed oil.
—India Alkali Works, Boston, Mass.

CLUSTERS AND SOCKETS

BENJAMIN WIRELESS CLUSTERS AND RECEPTACLES. This company manufactures a line of lighting specialties for railway and general lighting purposes, chief among which is the wireless cluster. These clusters are simply made, are highly insulated, have ample air gap between contacts, and present a neat appearance. Wireless clusters are also furnished for out door lighting, with porcelain enameled steel shades, and goosenecks for attaching to poles or walls of buildings. Other products are the "Benco" W. P. socket, sign receptacles for metallic signs, angle sockets, lamp guards, etc., etc.
—Benjamin Electric Manufacturing Company, Chicago, New York, San Francisco.

DAYTON ELECTRIC LIGHT CLUSTERS. Designed particularly for railway and street car lighting. They are made extra heavy and substantial so as to withstand the unusual jarring and jolting to which they are subjected. Many of the designs are of very great beauty and the leaf work surrounding the lamps is most elaborate. At the same time the interior construction of the clusters has been carefully worked out so as to insure perfect insulation. The designs include clusters and pendants suitable for all classes of work, from a plain baggage car pendant to a multi-lamp cluster for a private car. Special fixtures are furnished for cars equipped with Silvey portable train lighting batteries.
—The Dayton Manufacturing Company, Dayton, O.

GENERAL ELECTRIC CLUSTERS AND SOCKETS. The company manufactures a special line of sockets

nd clusters for street railway work. The sockets and receptacles are fitted with spring centers which insure against lamp breakage due to jars. The receptacles may be supplied with white or chocolate color porcelain bases the latter color being preferable as it harmonizes better with woodwork. A special 500 volt socket can be supplied with aluminum or brass shell. The lamp base screws into one solid piece of porcelain. The base is weatherproof, and is particularly adapted to car work. Two to five light clusters can be furnished.
—GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

COACHES, MOTOR

OLDSMOBILE MOTOR COACH. This is a new type of car for interurban use, designed for light passenger service. It carries sixteen persons and is reliable in operation. This car is manufactured by the Olds Motor Works and sold only by the
RAILWAY APPLIANCES COMPANY, CHICAGO AND NEW YORK.

COAL HANDLING MACHINERY

(See "Conveyors")

COILS, ARMATURE AND FIELD

(See "Armature and Field Coils")

COMMUTATORS AND PARTS

CAMERON COMMUTATORS AND COMMUTATOR SEGMENTS. This company manufactures commutator segments, also commutators complete with shell, either standard or special. All segments are made from the hard drawn copper bar, which is believed to excel all other styles of commutator segments in at least three things, i. e., uniformity, density and unequaled conductivity. It is as hard, if not harder, than either the cast or drop forged bar. Where a high lug segment is required, the lug is inserted into the end of the bar, by milling a narrow slot into the center of the end of the segment, afterwards inserting the riser with countersunk rivets. To perfect this connection mechanically and electrically, the entire end of the segment, lug and all, thoroughly sweated in solder.
—H. P. CAMERON ELECTRICAL MANUFACTURING COMPANY, ANSONIA, CONN.

CLEVELAND COMMUTATORS. These commutators are made from pure lake copper segment (drop-forged). Insulated between segments with amber mica and from core with white mica. These commutators are not put together with hydraulic pressure which does not insure a firm bearing for each segment, but are bored out to the proper angle, thereby insuring a true bearing for each segment and giving always a tight commutator.
—CLEVELAND ARMATURE WORKS, CLEVELAND, OHIO.

COLUMBIA COMMUTATORS AND COMMUTATOR BARS. The commutators made by this company are made of lake copper. The bars are drop-forged and separated by amber mica.
—COLUMBIA MACHINE WORKS AND MALLEABLE IRON COMPANY, BROOKLYN, N. Y.

HOMER COMMUTATORS. For motors and dynamos; made of the best bars and mica insulation obtainable. The mechanical perfection of these commutators constitutes their greatest claim for superiority. Manufactured by the largest exclusively commutator house in the world, its output permits the company to specialize workmen upon each particular part of the commutator thus obtaining the best results. The size of the output also allows it to maintain a stock of assembled commutators ready for instant shipment.
—THE HOMER COMMUTATOR COMPANY, CLEVELAND, O.

GENERAL ELECTRIC COMMUTATORS. The segments are made of hard drawn copper, insulated throughout with the best grade of split mica. The mica cones are built up and pressed compactly in steam moulds. The segment mica is somewhat softer, that it may wear evenly with the copper. Cone surfaces are machined with great care, with long creepage distances to prevent grounding. Commutators up to about 20 ins. in diameter are tinned by dipping in the molten metal. This practice subjects the commutator to a severe temperature test which cheaper grades of material and construction could not withstand. The segments are clamped very tightly and cap is pressed down securely in a hydraulic press before the commutator nut is tightened. This construction insures long life and uniformity of wear.
—GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

MORRIS COMMUTATORS AND BARS. This company is prepared to furnish all kinds of commutators either of the drop-forged or other types.
—ELMER P. MORRIS COMPANY, NEW YORK.

RIDLON ASSEMBLED COMMUTATOR SEGMENTS. The commutators are made of pure copper, only selected mica being used to insulate the bars. The company does not limit itself to railway commutators but can furnish bars or assembled segments for generators or motors of any type or size, standard or obsolete.
—FRANK RIDLON COMPANY, BOSTON, MASS.

ROSSITER-MacGOVERN COMMUTATORS AND BARS. This company builds commutators and parts thereof of every description.
ROSSITER, MACGOVERN & COMPANY, BOSTON, NEW YORK, ST. LOUIS.

VAN DORN-ELLIOTT COMMUTATORS AND COMMUTATOR BARS. These are all made of hard drawn copper. The insulation used is the best amber mica, which will wear evenly with the copper bars. The commutators are pressed together hydraulically, assuring an absolutely tight commutator, which prevents the commutator from burning up due to loose bars. Assembled bars are bored entirely to gages and will fit the shell perfectly to which they belong. (See advertisement.)
THE VAN DORN-ELLIOTT ELECTRIC COMPANY, CLEVELAND, OHIO.

WESTINGHOUSE COMMUTATORS. These commutators are made of hard drawn copper and built-up amber mica. The copper is of uniform density and high bars never occur. The mica is of such a quality that it wears at exactly the same rate as the copper segments. The commutators are seasoned by being subjected to a very high temperature for several hours before the finishing cut is made, and are afterward tested to eliminate all danger from grounds or short circuits after the commutator is in service.
—WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, PITTSBURG, PA.

COMMUTATOR COMPOUNDS AND TRUING DEVICES

"HIKO" COMMUTATOR COMPOUND. The application of this compound on the commutator from the time of starting the machine will keep the commutator smooth, producing in time the desired hard face and gloss which increase the life of the commutator and brushes. The compound contains no injurious ingredients, and as it is an excellent non-conductor, there is no danger of short-circuits between the commutator segments.
—ATLANTIC MANUFACTURING COMPANY, ALLENHURST, N. J.

JORDAN COMMUTATOR TRUING DEVICE. This tool trues the commutator without requiring its removal from the machine. It consists of a grinding wheel in adjustable ball bearings and equipped with suitable clamps, whereby it can be fastened to the rocker arm or the motor frame. The wheel used contains no emery or other mineral matter injurious to the commutator insulation and grinds down both the copper and mica to the same height. It greatly increases the life of the commutator as there is no waste from taking unnecessarily large cuts when using the old truing methods.
—JORDAN BROTHERS, NEW YORK.

RIDLON COMMUTATOR STONES. These stones are used for grinding and smoothing commutators. By their occasional application ridges, which are frequently the cause of sparking, can be prevented and their use in many cases will save the expense of having the commutator turned down in the machine shop.
—FRANK RIDLON COMPANY, BOSTON, MASS.

COMPOUNDS, BOILER CLEANING

(See "Boiler-Cleaning Compounds")

COMPOUNDS, INSULATING

(See "Insulating Compounds")

COMPRESSORS, AIR

CLAYTON CLIMAX COMPRESSORS. Air valves are made of steel, light and durable. Valve seats are of gun metal composition, each valve and seat being a complete unit. Steam cylinder is not located near main shaft bearings, thus obviating heating from radiation and permitting the use of a standard engine crosshead with adjustable slippers and a single connecting rod with adjustable bearings at each end. All reciprocating parts adjustable for wear. Climax compressors are made single and duplex steam driven, single and duplex electric driven by means of gear or noiseless chain, also belt driven. The particular point always in mind in designing this compressor was good economy, absolute reliability and the least possible expense for maintenance.
CLAYTON AIR COMPRESSOR WORKS, NEW YORK.

CHRISTENSEN MOTOR-DRIVEN AIR COMPRESSORS. More than 15,000 of these motor driven air compressors of capacities from 7½ to 800 cu. ft. free air per minute are in daily use, mostly in connection with air brake equipments for electric cars, the license for which use has been granted by N. A. Christensen to the Christensen Engineering Company, all other rights for the use of such patents being reserved to the patentee. To meet the constantly increasing demand for these air compressors for general service in various industries where compressed air is indispensable, N. A. Christensen is marketing a line of motor and steam driven air compressors in capacities from 400 to 2,000 cu. ft. free air per minute, as well as special air compressors for high pressures, also belt driven air compressors and compressors combined with gas or gasoline engines.
N. A. CHRISTENSEN, MILWAUKEE, WIS.

CHRISTENSEN COMPRESSORS. This company has developed a line of motor driven air compressors for either stationary or portable service. The machines operate continuously or intermittently depending upon their requirements, and have been carefully designed to form a compact, self-contained unit. All working parts are enclosed, affording protection from mechanical injury and so constructed that thorough lubrication of working parts is assured.
—NATIONAL ELECTRIC COMPANY, MILWAUKEE, WIS.

FRANKLIN AIR COMPRESSORS. These compressors when first introduced attracted attention among users of compressed air, because of their sound design massive, yet graceful proportions, and the exceptionally high engineering plane upon which their lines were based. They are manufactured in over 100 styles and sizes to meet every requirement of the trade. (See advertisement.)
—CHICAGO PNEUMATIC TOOL COMPANY, CHICAGO, ILL.

GENERAL ELECTRIC AIR COMPRESSORS. For braking systems on railway cars, also about car shops and barns, for cleaning motors, controllers, upholstering etc. The motor is similar in design to the G. E. railway motor, and embodies all the excellent features of that type. All parts of the compressor are very accessible, the cranks are solid forged steel, and the bearings and all wearing parts are readily replaceable. The compressor is equipped with an efficient oiling system and the gearing is of the herringbone type, insuring noiseless operation.
—GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

MURRAY AIR COMPRESSORS. These compressors are attached tandem to Murray-Corliss engines and are made single and two stage. They are effective, durable and economical.
—THE MURRAY IRON WORKS COMPANY, BURLINGTON, IA.

REYNOLDS AIR COMPRESSORS. Remarkable for their excellence of commercial design, combining strength and lasting qualities with high steam economy and efficiency. Electrically driven; belt driven; hydraulically driven. Single, duplex and two-stage. Corliss inlet automatic outlet. Special governor, automatically controlling speed within safe limits and leaving compressor free within the limit to operate at any speed needed to meet demands for air. Steam ends with all Corliss valve gear. Reliance and heavy duty types, single, duplex and compound, in combinations with air ends, direct-connected or belted.
—ALLIS-CHALMERS COMPANY, MILWAUKEE, WIS.

SMITH-VAILE AIR COMPRESSORS. These machines are built in all sizes and for all pressures and small electrically driven machines have recently been constructed for pressures as high as 1,500 lbs. per sq. in. They are without gears and operate with a minimum amount of noise and vibration. Their small weight and space requirements render them especially well adapted for uses requiring a portable compressor.
—PLATT IRON WORKS COMPANY, DAYTON, OHIO.

WESTINGHOUSE MOTOR-DRIVEN AIR COMPRESSOR. This device consists of a horizontal, duplex, single-acting air pump connected by gear drive to an electric motor, both mounted on a common cast-iron bed plate. The motors are wound for 110, 220 and 600 volts D.C.; for 110 and 500 volts A.C.; single phase, 3,000 alternations

(INDEX TO ADVERTISERS, PAGES 15 AND 18)

per minute; and for multi-phase current of ordinary voltage and frequency as required. They are dust and weather proof for outdoor use, or ventilated for indoor application. The pumps have either plain or water jacketed air cylinders to suit conditions.

—THE WESTINGHOUSE AIR BRAKE COMPANY, PITTSBURG, PA.

CONCRETE STEEL

(See Bridges and Buildings.)

CONDENSERS

ALBERGER BAROMETRIC CONDENSER. An improved type of jet condenser operating on the dry system, in which the desirable features of the counter and parallel current principles are combined. The air and water are each handled by a special pump designed for its particular service, these being usually separate units for greater flexibility. To insure complete intermingling of the steam and water, the spraying device is automatically regulated. The air before leaving the condenser is cooled in passing through an interior jet cooler. The condenser is self-supporting and is extremely simple in design, there being no exterior pipes or contrivances.

—ALBERGER CONDENSER COMPANY, NEW YORK.

ALBERGER COUNTER-CURRENT SURFACE CONDENSER. A departure from past practice in which a condenser, primary feed water heater and air cooler are combined in one unit. The steam enters at the bottom and the dry air pump connection is taken off the top. The condensed steam falls through the entering steam into a hot well and is recovered at the temperature of the vacuum, giving water from 15 degs. F. to 25 degs. hotter than with the old types. The circulation water enters at the top and passes down and out at the bottom, carrying with it any dirt or sediment that may be entrained. Twenty-eight in. and higher vacuums are maintained.

—ALBERGER CONDENSER COMPANY, NEW YORK.

BULKLEY CONDENSERS. The "Injector" condenser requires no air pump but forms a high vacuum by the action of the exhaust steam and condensing water. An air pump condenser of improved design is also made by this firm.

—HENRY W. BULKLEY, NEW YORK AND ORANGE, N. J.

CONOVER CONDENSERS. See item under Pumps.

—WATSON MACHINE COMPANY, PATERSON, N. J.

CONDENSERS.

—HENRY R. WORTHINGTON, NEW YORK.

—THE GEO. F. BLAKE MANUFACTURING COMPANY, NEW YORK.

—KNOWLES STEAM PUMP WORKS, NEW YORK.

—DEANE STEAM PUMP COMPANY OF HOLYOKE, MASS.

REYNOLDS AIR PUMP AND JET CONDENSER. Condenser and air pump separate. Fly wheel type of air pump. Gives uniformity of speed. No racing. Condensing water introduced to condenser by nozzle carefully designed to secure most efficient and complete commingling of steam and water. Water openings not liable to clog. Ease of access to all parts for examination. Capacities 100 h.p. to 1,000 h. p.

—ALLIS-CHALMERS COMPANY, MILWAUKEE, WIS.

SMITH-VAILE CONDENSING APPARATUS. The surface condensers built by the Platt Iron Works are furnished with direct-acting combined air and circulating pumps or with independent hot-well pumps and relative dry-vacuum pumps, according to the size of the plant and the vacuum desired. The jet condensers are of the ordinary suction type or of the elevated type, depending upon circumstances and locations. Where high vacuum is wanted the elevated jet condensers are supplied with dry-vacuum pumps.

—PLATT IRON WORKS COMPANY, DAYTON, OHIO.

TOMLINSON BAROMETRIC TUBE CONDENSING SYSTEM. Includes condenser and system of handling the air in the condensing apparatus. Requires no adjustment or attention of any kind, other than to regulate the amount of injection water to condense the steam. Water is broken up in its passage through the condenser and thoroughly mixed with the steam without any spray nozzles or contracted passages to become stopped up with dirty water. Instead of discharging the dry air pump into the atmosphere, the air is discharged through the main tail pipe, combining the water and air, and the descending column of water carries the air down to the hot well with the water. The dry air pump, instead of working against the atmospheric pressure, discharges into a vacuum a little less than the vacuum in the condenser, thereby producing an effect similar to a two-stage air pump, the main tail pipe acting as the second cylinder of the two-stage pump, thereby greatly increasing the efficiency of the air pump and decreasing the power required to drive it about 70 per cent., due to the low pressure that the pump discharges into two tail pipes. The main or center pipe into which the air pump discharges is of a proper size to give the necessary velocity to carry the air away, while the overflow pipe acts as a safety device.

—ALLIS-CHALMERS COHPANY, MILWAUKEE, WIS.

W. H. BLAKE CONDENSERS. In the jet condenser the injection water is so sprayed into the exhaust steam as to secure the most intimate mixture and produce instantaneous condensation. The possibility of flooding is entirely obviated. In the smaller sizes the pumps are horizontal, and in the larger they are twin vertical or vertical compound. Capacities range from 600 to 135,000 lbs. of steam condensed per hour. The surface condensers range in capacity from 4,100 to 40,000 lbs. steam condensed per hour. The tubes are of Muntz metal, so held in the tube sheets as to allow for free expansion. Rapid condensation is secured by the introduction of baffle plates which force the steam into close contact with the exterior of all pipes through which the water flows.

—W. H. BLAKE STEAM PUMP COMPANY, BOSTON, MASS.

WHEELER CONDENSERS. The types made by this company are known as surface and jet condensers. The surface type has tubes on which the steam impinges, while the cooling water circulates through the tubes. The jet type has a vessel in which the exhaust steam mingles directly with a jet of water. This company's condensers are among the pioneers in the field; they are built in types and sizes to suit conditions, and to give the highest and best results.

—WHEELER CONDENSER & ENGINEERING COMPANY, NEW YORK.

C. H. WHEELER SURFACE CONDENSER. Circulating water chambers, steam dome and tube arrangement of special design and efficiency.

—C. H. WHEELER CONDENSER AND PUMP COMPANY, PHILADELPHIA, NEW YORK, CHICAGO, SAN FRANCISCO.

WHEELER-MULLAN HIGH VACUUM SYSTEM. C. H. Wheeler surface condensers with Mullan suction valveless crank and fly-wheel air pumps; horizontal and vertical designs; single, duplex and triplex; steam or electric.

—C. H. WHEELER CONDENSER AND PUMP COMPANY, PHILADELPHIA, NEW YORK, CHICAGO, SAN FRANCISCO.

WHEELER-PRATT WATER-COOLING APPARATUS. Cooling towers for water or liquids from any temperature to below the temperature of the atmosphere. Forced draught and natural draught systems.

—C. H. WHEELER CONDENSER AND PUMP COMPANY, PHILADELPHIA, NEW YORK, CHICAGO, SAN FRANCISCO.

CONDUITS, UNDERGROUND

AMERICAN UNDERGROUND CONDUIT. The conduit manufactured by this company is of the vitrified, salt glazed clay type, for carrying lighting, power and railway feeders. The ducts are made either single or multiple as desired.

—AMERICAN VITRIFIED CONDUIT COMPANY, NEW YORK.

BITUMINIZED FIBER CONDUITS. These conduits are used for all classes of underground electrical construction and are made in sizes ranging from 1 in. inside diameter to 6 ins. inside diameter, or larger on special order. Bends of any radius or degree of curvature are furnished. The ducts are in 7 ft. lengths and are united with the male and female joint which is sealed with the compound as the conduit is slipped together in the trench, giving a water tight duct.

—AMERICAN CONDUIT COMPANY, CHICAGO, NEW YORK, LOS ANGELES.

CAMP CONDUITS. This clay conduit was the first of its kind for carrying underground lighting and power wires, and still enjoys wide use. It is made in single and multiple duct as desired.

—H. B. CAMP COMPANY, NEW YORK AND CHICAGO.

GEST CONDUIT WORK. Contracts carried out for underground conduit construction of any extent for railway, lighting and power installations.

—GUY M. GEST, NEW YORK AND CINCINNATI.

CONTROL SYSTEMS

SPRAGUE GENERAL ELECTRIC TYPE M CONTROL. Is designed primarily for the control of a train of motor and trail cars, the whole being operated as one unit. It is adapted to all classes of severe railway service, and comprises an electrically operated motor controller for each motor car and master controllers operating these. The system is very flexible. The current is cut off if operator's hand is removed from master controller handle, insuring safety. The operation entirely by electric current at full line potential. Ease of operation makes its use advantageous on large locomotives, and heavy motor equipments All parts subject to wear are readily replaceable.

—GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

WESTINGHOUSE MULTIPLE UNIT CONTROL. This system employs a combination of electro-magnetic and pneumatic devices to produce a method of controlling from a single platform single cars or trains, all or part of which are equipped with motors. Each motor can operate as an independent self-propelling unit which may be connected to other similar units or to trailer cars in any operating combination whatsoever. It is applicable alike to alternating and direct current motors, and to double and quadruple equipment. It may be arranged for either automatic or non-automatic acceleration and with or without a train bus line.

—WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, PITTSBURG, PA.

CONTROLLERS

GENERAL ELECTRIC CONTROLLERS. Are made in various series—parallel and rheostatic types. They combine requirements of accessibility, interchangeability, strength and ease of renewal. The covers are attached with hinge clamps, all parts are machine made and tested, and the wearing parts are quickly replaceable. Cut-outs, magnetic blow-outs and interlocks add to the safety and reliability of operation. Controllers are also manufactured for automobiles, crane and mine works; see also Control Systems.

—GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

WESTINGHOUSE CONTROLLERS. These controllers include every form of controlling device from a rheostat for the operation of the smallest motor to the heaviest railway controllers. The operating parts are interchangeable, and the wearing parts such as fingers and contact segments are removable and easily renewed. Railway controllers for use with two or more motors are provided with special cutout switches, so arranged that either motor of a pair, or either pair of a four-motor equipment, may be cut out of circuit.

—WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, PITTSBURG, PA.

CONTROLLER REGULATORS

AUTOMOTONEER. A regulator for railway and other electric controllers. Limits feeding to fastest rate that will give maximum acceleration for which motors are designed. Made in two styles. Applied to top of controller, completely self-contained and enclosed to prevent tampering. In one style, a pawl, working in a zig-zag slot, requires a pause on each controller point. In another the release of pawl is limited by adjustable dash-pot. Prevents abuse of equipment, waste of current, peak starting loads, jerking passengers and other "fast feeding" evils. Insures operation of controllers in the manner for which they are designed.

—GARTON- DANIELS COMPANY, KEOKUK, IA.

DURKIN CONTROLLER HANDLE. Attached to the top of the dial of any standard controller simply by drilling three holes for bolts, this device regulates the rate of feed, thus preventing damage and economizing power. The working parts are simple, positive in action, efficient and durable. A dog suspended under the handle is, by a series of projecting teeth, thrown against the stops in turn, compelling a temporary pause at each, until the dog drops by gravity. It presents no obstruction to rapid "throw off." Incidentally, it keeps all the contacts on the controller perfect and always the same—all the controller fingers wear alike, doubling their life.

—DURKIN CONTROLLER HANDLE COMPANY, PHILADELPHIA, PA.

CONVERTERS, ROTARY

BULLOCK ROTARY CONVERTERS. These 25 cycle rotary converters for railway work range in output from 100 Kw. to 1,000 Kw. at 600 volts. Sixty cycle converters for 500-600 volts are not made, as they are not considered desirable, but for 250 volts or lower, 60 cycle machines are regularly furnished. Collector rings are of cast copper. Field yokes are of cast iron with solid steel poles bolted in place. The armature, commutator and field coils are designed to secure thorough ventilation, thus

giving a correspondingly low temperature rise and large overload capacity.

—ALLIS-CHALMERS COMPANY, MILWAUKEE, WIS. (ELECTRICAL DEPARTMENT, BULLOCK ELECTRIC MANUFACTURING COMPANY, CINCINNATI, OHIO.)

GENERAL ELECTRIC ROTARY CONVERTERS. This company manufactures rotary converters ranging in capacity from 50 kw. to 2,000 kw. inclusive. In general they embody the same notable features of structural detail as direct current generators of the same make. Forced ventilation assures low temperature rise. Connections at collector rings are so arranged as to equalize field strength and provide perfect commutation. Even wear on commutator is attained by special end play devices. Standard field winding gives flat compound characteristic. Compound wound converters are fitted with speed limiting devices which prevent excessive speed should the alternating current source be accidentally cut off. Converters are started without the aid of auxiliary motors.

—GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

WESTINGHOUSE ROTARY CONVERTERS. The rotary converter serves as the transforming agency after the alternating-current has been transmitted to conveniently located substations. Westinghouse rotary converters are very similar in construction to the direct-current generators, with the addition of collector rings and brushes. The Interborough Rapid Transit Company of New York operates eighty 1,500 kw. rotaries of this type, which are the largest ever built.

—WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY PITTSBURG, PA.

CONVEYORS, COAL AND ASHES

(Including Auxiliary Apparatus.)

BROWN FUEL CONVEYING APPARATUS. This company has designed an extensive line of coal and ash conveyors for power houses, besides various devices for hoisting coal from boats, storing, weighing, etc.

THE BROWN HOISTING MACHINERY COMPANY, CLEVELAND, NEW YORK, PITTSBURG.

BROWNING LOCOMOTIVE CRANES AND AUTOMATIC GRAB BUCKETS. Adapt themselves for all conditions arising in the conveyance of fuel and ashes in connection with power houses.

—THE BROWNING ENGINEERING COMPANY, CLEVELAND, OHIO.

DODGE CONVEYOR. Consists of non-overlapping gravity buckets pivoted between chains, and buckets of less capacity rigidly suspended from the side bars of the chains and extending beneath the gaps which separate the gravity buckets. The initial leakage at the loading point as well as the spill at the first upward turn in the conveyor path is caught by these supplementary buckets, and as they come into position above the gravity buckets on the ascending run discharge the leakage each holds into the gravity bucket next following. The conveyor is reversible and may make as many turns in the same plan as necessary.

THE LINK-BELT ENGINEERING COMPANY, PHILADELPHIA, PA.

JEFFREY CONVEYORS. The coal and ash conveyors made by this company are of the chain and pivoted swinging bucket type. In addition it builds traveling chutes for feeding stokers, coal crushers with receiving hoppers and dump cars for ashes, together with a large variety of other machinery.

—THE JEFFREY MANUFACTURING COMPANY, COLUMBUS, OHIO.

McCASLIN CONVEYOR DRIVING MECHANISM for operating the conveyor is of either direct connected or belt driven type. The direct connected type is operated by enclosed dust proof electric motors, and the steam driven type is operated by means of direct connected double steam engines. The belt driven type can be either operated by an electric motor or steam engine as preferred.

—JOHN A. MEAD & COMPANY, NEW YORK.

McCASLIN OVERLAPPING GRAVITY BUCKET CONVEYOR. This conveyor for the handling of coal and ashes consists of a series of malleable iron conveyor buckets, so arranged that when mounted in the chain and upon a horizontal track, the lips of the buckets overlap and form a continuous trough, thereby preventing the spilling of coal, and doing away entirely with the cumbersome filler, the only loading apparatus necessary being an ordinary chute. Large cast iron chilled wheels arranged for internal lubrication are located at the articulating point of the conveyor chain. The chain is of heavy design with large bearing surfaces, and is made in various sizes to suit the tonnage required. The conveyor system is in many large up-to-date power stations. As an illustration regarding the handling of ashes, this conveyor successfully handles cement clinker direct from the kilns at a temperature of about 2,000 deg. without injury to the working parts.

—JOHN A. MEAD & COMPANY, NEW YORK.

McCASLIN SINGLE ROLL COAL CRUSHERS. The McCaslin single roll coal crusher mechanism for crushing run-of-mine coal to size for stoker use is of the self-contained type for direct connection to electric motors or steam engines, also made for belt drive. This crusher consists of a heavy cast iron single roll with removable cast steel teeth, and so arranged that any foreign substance such as a car link, coupling pin, etc., will pass through without injury to the roll. This is accomplished by having the cast iron roll work against a cast iron counterweight, corrugated, baffle plate, the corrugations arranged so as to fit around the teeth on the crusher roll.

—JOHN A. MEAD & COMPANY, NEW YORK.

MEAD-MORRISON COAL HANDLING MACHINERY. This apparatus comprises the following: Cable roads, cars, motors; automatic railways; automatic shovels; case elevators; Harrison conveyors; skip hoists; narrow gage railways and cars for industrial plants; electric cars, flat top and side discharge cars for narrow gage track; storage battery locomotives; geared and direct-acting hoisting engines and electric hoists. The company also acts as contractors for complete discharging and reclaiming plants, railway power house, coal and ash handling installations.

—MEAD-MORRISON MANUFACTURING COMPANY, BOSTON, NEW YORK AND CHICAGO.

ROBINS CONVEYORS. The Robins system has but two component parts—a rubber belt and fixed sets of pulleys. The material never comes in contact with the pulleys, to retard or clog their action. The toughness and elasticity of the reinforced rubber covering of the belt give it great durability. The point where the load is received is the only point of abrasion or friction between the material and the belt. The advantage in this respect over any form of flight conveyor, in which the friction is constant all along the haul, is very apparent. Every reduction in friction not only means a corresponding reduction in the power required for operation, but also saves breaking of the material conveyed, and insures a longer life for every part of the conveyor. The shut-downs which repairs to more complex conveyors necessitates are absolutely avoided by the simplicity of this system. The Robins system conveys noiselessly, which fact alone indicates high efficiency.

—ROBINS CONVEYING BELT COMPANY, NEW YORK.

"STEEL CABLE" CONVEYING MACHINERY. The coal and ash handling apparatus made by this company covers the following: Gravity bucket and pan and bucket conveyors; drag and cable conveyors; plain interlapping pan and troughed rubber belt conveyors; continuous bucket and double-strand steel cable elevators; vertical barrel type coal breakers; double-cam conveyor driver, etc.

—STEEL CABLE ENGINEERING COMPANY, BOSTON, MASS.

COOLING TOWERS

(See "Towers, Cooling")

CORD, BELL AND TROLLEY

INTERNATIONAL WATERPROOF TROLLEY CORD. Distinguished by a red, white and blue strand in the center. This cord is made of the finest upland middlings cotton of long, strong fiber, bought directly from the growers and ginned at the mill. The yarn used is three ply, i. e., three yarns twisted, not simply grouped together, which increases the tensile strength and ability to stand abrasive wear. The threads are then waterproofed before braiding, so that the water-proofing compound thoroughly permeates the body of the cord. The braiding is not done as tightly as possible and the cord is therefore more flexible and consequently more durable

—THE INTERNATIONAL REGISTER COMPANY, CHICAGO, ILL.

RECORDING FARE REGISTER COMPANY'S BELL AND TROLLEY CORD. Woven bell and register cord, plain or with wire center; in all sizes; also leather cord in all sizes. Trolley cord "Yale" brand; hard woven, smoothly finished, thoroughly water-proofed trolley cord, made in all sizes.

—THE RECORDING FARE REGISTER COMPANY, NEW HAVEN, CONN.

S-H "SPIRAL" TROLLEY CORD. A superior grade of cotton cord, suitable for trolley rope, bell register, arc lamp suspensions, etc. Manufactured from the best grade of cotton yarn and so woven or braided as to give the greatest degree of flexibility, together with the longest wearing quality. It is furnished in all sizes from No. 7 to No. 12, inclusive, the number representing 32ds of an inch diameter. In braiding this cord one strand is furnished in green dyed cotton so inserted that a spiral line of green appears in the finished product on its outside surface. Furnished parafined for out door use or without weather proofing if desired. (See advertisement.)

—STUART-HOWLAND COMPANY, BOSTON, MASS.

SAMSON SPOT WATERPROOFED TROLLEY CORD. The colored "Spot" is the trade mark used only in this extra quality cord which is guaranteed free from imperfections of braid or finish. The smoothness of this cord, together with the extra quality stock, makes it wear much longer than the common grades of cord. It is put up in coils of about 1,200 ft. each, and the sizes most commonly used are:

Number.	8	9	10	12
Diameter..............	$\frac{1}{4}$ in.	9-32 in.	5-16 in.	$\frac{3}{8}$ in
Approximate weight per coil..................	30 lbs.	38 lbs.	48 lbs.	66 lbs

—SAMSON CORDAGE WORKS, BOSTON, MASS.

THE SILVER LAKE COMPANY, BOSTON, MASS. This company has been manufacturing braided cordage for over forty years and its goods have long been recognized as standard. For street railway use the company manufactures the Silver Lake weather-proof trolley cord which is used by many of the large street railway companies throughout the country, and has an established reputation as a first class article for the purpose. Bell and register cord is also made for street railway service.

COTTON DUCK

BOYLE COTTON DUCK. This material is employed for car roofs, covers, used in shipping, tarpaulins, etc. All weights and widths, white and colored. Also striped. (See "Curtain Material.")

—JOHN BOYLE & COMPANY, NEW YORK

COUPLERS, CAR

BRILL RADIAL DRAW-BAR. A draw-and-recoil spring on the bar is the entire drawing and buffing apparatus. No loose parts—the whole bar is removed by releasing the draw-bolt. It is made of wrought iron, with malleable iron mouth and spring seat. The bar is made of channel iron for cars more than 30 ft. over body. Standard size of bar is 4 ft. from center of draw-bolt to center of drop-pin hole; the channel bar, 4 ft. 3 ins. (Advertisements in last pages.)

—J. G. BRILL COMPANY, PHILADELPHIA, PA.
—AMERICAN CAR COMPANY, ST. LOUIS, MO.
—G. C. KUHLMAN CAR COMPANY, CLEVELAND, OHIO
—JOHN STEPHENSON COMPANY, ELIZABETH, N. J.

S. & W. AUTOMATIC COUPLERS. This coupler is calculated to meet a demand for a perfectly reliable automatic coupler for interurban and elevated cars. Made entirely of steel castings and drop forgings. Makes a perfectly rigid coupling with connecting hooks having about four times the section and strength of other types of automatic couplers for street railway service. This coupler allows of a vertical plane movement of 6 ins., without uncoupling, a specially desirable feature, as it takes care of the variation in heights of couplers on different cars on account of heavy loads, unevenness of track or other conditions.

—WALLACE SUPPLY COMPANY, CHICAGO AND NEW YORK.

VAN DORN AUTOMATIC COUPLER. One of the leading features of this well-known coupling bar is an elongated point extending beyond the hook, practically straight on the side opposite the hook, and sufficient in length to interlock between the pin and the inner side of the spring when the springs are under maximum compression. Under no conditions can this style of link be accidentally disengaged when coupled up in train service. It holds under all conditions, on the push or on the pull. The company has brought all of its couplings to a high standard of efficiency, and thickened and widened the faces. Van Dorn couplers are made in twenty-two distinct patterns for any emergency.

—W. T. VAN DORN COMPANY, CHICAGO, ILL.

VAN DORN AUTOMATIC COUPLER. NO. 19 This coupler is the latest achievement in which the company has embodied some new features, both the coupling and the uncoupling works the same, but round pins are used instead of flat pins. The point of the coupling bar is of sufficient size so that when the cars come together to couple the point of the link entering, the mouth of the draw bar strikes

(INDEX TO ADVERTISERS, PAGES 15 AND 18)

the side wall and is deflected past the round pin and locks on the pin. It is built for extra heavy service and couples automatically within 1-32 of an inch. The No. 20 uses the same style link and pin as the No. 19, except that it is made to fit an 80-lb. rail instead of a tail bolt.
—W. T. VAN DORN COMPANY, CHICAGO, ILL.

WASHBURN ELECTRIC RAILWAY COUPLERS. The pin is so arranged that by raising it half way the knuckle is released for uncoupling. If the knuckle is closed and it is desired to throw it open to make a coupling, the pin or lock is raised to the full height. By so doing the knuckle is not only unlocked but thrown open ready for coupling, making it unnecessary to throw the knuckle around by hand. When a coupling is made, the couplers present to each other faces with considerable bearing surface which makes the rigid joint necessary with swivel draw-bars.
—EDWIN C. WASHBURN, MINNEAPOLIS, MINN.

WASHBURN ELECTRIC RAILWAY DRAFT RIGGING. Two forms are made for use with Washburn couplers. In one the draft box is bolted directly to the car body, and in the other the swivel is placed behind the draft box, and the draft box turns with the draw bar. In both types one spring serves to cushion both the buffing and pulling.
—EDWIN C. WASHBURN, MINNEAPOLIS, MINN.

WESTINGHOUSE FRICTION DRAFT GEAR. This device consists of a cylindrical shell, the inner surface of which has "V" shaped grooves; a number of friction strips are made to fit in these grooves and during heavy buffing and pulling strains are made to rub along their surface. A combination of wedges and springs in the center of the device causes the friction due to the rubbing between the strips and the cylinder to increase as the movement of the strips increases, consequently the energy generated by buffing and pulling strains is dissipated by friction, leaving little recoil.
—THE WESTINGHOUSE AIR BRAKE COMPANY, PITTSBURG, PA.

COVERINGS, PIPE AND BOILER

J-M PIPE AND BOILER COVERINGS. This line of asbestos and magnesia pipe and boiler coverings covers the whole range of modern engineering. The prominent coverings for high pressure steam are Asbestos-Sponge Felt, Asbestos Fire Felt, and "85 per cent. Magnesia." There are furnished in addition to these, coverings of air cell and solid construction for low pressure and heating purposes, and a complete line of frost-proof, brine and ammonia insulation. All these coverings are furnished in sectional form for pipes, or blocks and sheets for flat surfaces. (See advertisement.)
—H. W. JOHNS-MANVILLE COMPANY, NEW YORK.

CRANES, HOISTS AND LIFTS

BARRETT MOTOR ARMATURE LIFTS. For the rapid and economical handling of motors and armatures in car barn pits. Particularly adapted to removing and transferring armatures from the motor frame or replacing them in position. Manufactured in two general styles—one with jack mounted on a truck, and the other with a wheel and screw movement, mounted on a truck. The "Jack" style is somewhat quicker in action, but the wheel and screw lift is better adapted to pits where it would be difficult to operate the jack handle. Both motor lifts have a side adjustment of 6 in. and are provided with either flat or cradle tops, or both, which can be interchanged when handling complete motors or armatures separately.
—THE DUFF MANUFACTURING COMPANY, PITTSBURG, PA.

BRILL MOTOR LIFT. A powerful machine for pit work and suited to the heaviest work and roughest usage. It is made entirely of metal and has an oblong bed mounted on small wheels with four pillars which telescope in casings to keep the table horizontal. A vertical screw at the center raises the table eighteen inches and is turned by a crank to which it is geared at a ratio enabling a heavy motor to be raised or lowered quickly, and with comparatively little effort. From floor to top of table in lowered position is 36 ins.
—J. G. BRILL COMPANY, PHILADELPHIA, PA.

BROWN HOIST CRANES. These locomotive cranes are especially suitable for lifting car motors and other heavy objects around a power house or car barn. This company also manufactures electric traveling cranes, overhead trolleys for engine rooms, wrecking and construction cranes for street railways, etc.
—THE BROWN HOISTING MACHINERY COMPANY, CLEVELAND, NEW YORK, PITTSBURG.

BROWNING STANDARD LOCOMOTIVE CRANES. Comprise the most developed standard machines for wrecking, yard service, construction work and for operating automatic grab buckets.
—THE BROWNING ENGINEERING COMPANY, CLEVELAND, OHIO.

CASE MANUFACTURING COMPANY, COLUMBUS, OHIO. Builder of cranes and power transmission appliances. The company is represented in the East by McClave, Rimmer & Company, New York; in the central West by Bradley & Kamschutte, Chicago, Ill., and in the far West by Lilly & Thurston, San Francisco, Cal.

CLEVELAND LIFTING MAGNETS. The magnetic lift finds its widest and most advantageous use in places where large amounts of track or other steel and iron materials must be hoisted quickly. A 22 in. magnet will lift fully 3,500 lbs., and other sizes even more. The magnet itself is a solid steel casting which is practically indestructible.
—CLEVELAND ARMATURE WORKS, CLEVELAND, OHIO.

"MARINE ENGINE" TROLLEY HOIST. A special electric hoist made by this company for shop use.
—MARINE ENGINE AND MACHINE COMPANY, NEW YORK.

NILES CRANES AND HOISTS. These electric traveling cranes are built in capacities from 2 tons to 150 tons. The box girder is the standard bridge construction, but for small cranes, I-beams are occasionally used, and for extra long spans, lattice girders. The gearing on the trolleys is enclosed and runs in oil. Any standard motors can be used. The company's electric traveling hoists are built in capacities from 1 ton to 6 tons, and are arranged to run on a single I-beam or between two channels, if desired.
—NILES-BEMENT-POND COMPANY NEW YORK.

NORTHERN CRANES AND HOISTS. This company builds numerous styles of electric and hand traveling cranes. High grade cranes for power stations a specialty.
—NORTHERN ENGINEERING WORKS, DETROIT, MICH.

VAN DORN & DUTTON ARMATURE AND MOTOR LIFTS. These lifts are made for use in pits of car houses for raising and lowering armatures and motor frames. The frame is made of iron and the saddle has wood rolls to prevent injury to the armature. It is raised and lowered with a powerful screw through a hand wheel. It is easily operated, does not get out of order, and will stay in any position placed. It requires no track to run on if bottom of pit is hard, but where a track is preferred, wheels are furnished with flanges to run on the same.
—THE VAN DORN & DUTTON COMPANY, CLEVELAND, OHIO.

YALE & TOWNE ELECTRIC HOIST. A simple electric portable hoist; swings on a single upper hook; lifts readily at an angle, and may be hooked in trolleys of any type or other overhead supports. All parts under tension or subject to transverse strain are of forged steel or wrought iron. Improved oiling devices preclude heating, or injury from high temperature. It gives good service in inexperienced hands and withstands rough usage. It is as easily wired as an incandescent lamp. All parts are interchangeable. Used in repair shops and manufacturing plants generally.
—THE YALE & TOWNE MANUFACTURING COMPANY, NEW YORK.

YALE & TOWNE TRIPLEX CHAIN BLOCK. Built with frictionless automatic brake and balanced spur gearing—efficiency 80 per cent. Hooks and chains (the vital parts of a chain block) are made of specially tough but ductile iron, which stretches and gives warning before breaking. Every part is made of the best material obtainable and is carefully inspected, making the block absolutely safe. The Triplex lifts quickly, easily and smoothly. One man with a one-ton block can lift 2,000 lbs. four feet in one minute. It may be used in the car barn or by the construction gang independently of weather conditions. Made in fourteen sizes, ½ to 20 tons. (See advertisement.)
—THE YALE & TOWNE MANUFACTURING COMPANY, NEW YORK.

CROSS ARMS

(See "Bracket and Cross Arms")

CROSSINGS, TRACK

(See "Track Work")

CRUCIBLES

McCULLOUGH-DALZELL CRUCIBLES. The line of crucibles made by this company embraces practically every type and size needed for smelting purposes. A large number is used by many electric railway companies operating brass and iron foundries for the manufacture of detail parts.
—McCULLOUGH-DALZELL COMPANY, PITTSBURG, PA.

CURTAINS, CURTAIN FIXTURES AND CURTAIN MATERIAL

(See also Sash Fixtures.)

BOYLE CURTAIN MATERIAL. Especially woven and extra close striped cotton duck for side curtains on open cars. This material has been in successful use for 30 years. It is made in different colorings to harmonize with any car.
—JOHN BOYLE & COMPANY, NEW YORK.

BRILL CURTAIN AND CURTAIN FIXTURES. These companies manufacture or furnish every style of curtain and fixture for closed and open cars.
—J. G. BRILL COMPANY, PHILADELPHIA, PA.
—AMERICAN CAR COMPANY, ST. LOUIS MO.
—G. C. KUHLMAN CAR COMPANY, CLEVELAND, OHIO.
—JOHN STEPHENSON COMPANY, ELIZABETH, N. J.

BRILL CURTAIN-ROLLER SPRING ADJUSTER A useful little tool which enables any workman to determine the proper amount of tension and to tighten all the springs alike in a car. Instead of the nuisance of having cars with some curtains that fly up at the slightest provocation and others that crawl down continually, companies that provide themselves with this tool are able to keep their car curtains in perfect condition for raising and lowering, save them from being pulled out or torn by rough handling of passengers or conductors. The adjuster is 6 ins. long, of simple mechanism that can never get out of order, and will operate with any brace.
—J. G. BRILL COMPANY, PHILADELPHIA, PA.
—AMERICAN CAR COMPANY, ST. LOUIS, MO.
—G. C. KUHLMAN CAR COMPANY, CLEVELAND, OHIO.
—JOHN STEPHENSON COMPANY, ELIZABETH, N. J.

CURTAIN SUPPLY COMPANY'S CURTAIN FIXTURES. For closed cars. The most desirable are the Forsyth roller tip fixture, No. 86, and the Keeler eccentric fixture. For open cars the Acme open car cable fixture, Climax open car cable fixture and the Forsyth open car cable fixture. The advantages of curtain fixtures are many. They hold a curtain in any desired position, remaining level in the window opening; can be operated by anybody, and add greatly to the durability and convenience of the curtains.
—CURTAIN SUPPLY COMPANY, CHICAGO, ILL.

CURTAIN SUPPLY COMPANY'S AUTOMATIC CURTAINS. These curtains are easy to operate, never stick, cannot rattle, do not sway, always hang straight, have no catches nor delicate parts which can get out of order: work quickly and stop exactly where left. They can be made of any kind of curtain material, such as Pantasote, Oakette, Crown, Woolen Terry, etc., etc., and are supplied with any kind of curtain fixture, such as Forsyth roller tip pinch handle fixture, No. 86; Keeler pinch handle fixture; Keeler eccentric fixture; Acme cable fixture; Climax cable fixture; and Forsyth car cable fixture.
—CURTAIN SUPPLY COMPANY, CHICAGO, ILL.

EDWARDS CURTAIN ROLLERS, TIN BARREL. Tin barrel spring rollers and accessories of the highest degree of excellence in material, workmanship and design, including the pawl designs for general shade work, with all patterns of plain brackets, and the ratchet design (without pawls) for use with curtains having frictional holding devices or where a continuous action of spring is desired. The ratchet design can be used with any of the general patterns of plain brackets or with the worm gear brackets, by which the roller can be regulated to any power of spring required without removing the roller from the brackets.
—THE O. M. EDWARDS COMPANY, SYRACUSE, N. Y.

EDWARDS SASH BALANCES AND FIXTURES. Tin spring roller sash balances, special ratchet design and worm gear roller brackets rendering the roller adjustable to the strength of spring required without removal from the brackets. The ratchet design when used as a sash lift or balance avoids the danger of sashes falling, which exists with the pawl design.
—THE O. M. EDWARDS COMPANY, SYRACUSE, N. Y.

EDWARDS WINDOW FIXTURES. Standard and in extensive use upon the leading railway systems, various designs rendering the sashes automatic or balanced and conforming to various requirements and construction. All designs render the windows tight, forcing the sash against the outer stops with yielding pressure, which is self-adjusting to varying conditions such as shrinking or swelling, preventing rattle of the sash, excluding dust and air from the car and rendering the windows easy of operation.
—THE O. M. EDWARDS COMPANY, SYRACUSE, N. Y.

HART DECK SASH RATCHETS. The No. 8 improved ratchet is made with an adjustable foot or pivot which permits of the fixture being applied to and operated in connection with a variety of forms of deck sash, avoids the necessity of a special construction of each particular form, and is designed especially for semi-circular, oval, rectangular and other forms of deck sash. The No. 12 Hart ratchet combines not only the important features as above described, but it is also furnished with a retaining lip extending down over the end of the ratchet segment and retains the sash in position against the action of strong winds and other forces which frequently displace the sashes and cause them to fall out.
—THE DAYTON MANUFACTURING COMPANY, DAYTON, O.

HARTSHORN SPRING ROLLERS. For car work this company has developed the well-known tin barrel, self acting shade rollers. They are made in the following diameters: $\frac{3}{4}$, 1, $1\frac{1}{4}$, $1\frac{1}{2}$ and $1\frac{3}{4}$ ins. For closed cars and railway coaches, where shades are to be hung on windows of ordinary size, the company recommends the use of rollers 1 in. and $1\frac{1}{4}$ in. in dia. For open cars the diameter of the rollers should in no case be less than $1\frac{1}{2}$ in., when the shade cloth in such cars is long or extra heavy, it should invariably be mounted on rollers $1\frac{3}{4}$ in. in dia.
—STEWART HARTSHORN COMPANY, EAST NEWARK, N. J.

NATIONAL CURTAIN FIXTURE. This fixture ocks the curtain against upward pull, is not easily tilted, and as heads are stationary, cannot possibly get out of grooves when finger pieces are compressed. It automatically locks against the tension of spring roller by spring pressed cams, pivoted in the heads or guides at each end of fixture, and bearing against the bottom of the grooves. Strong tension is put on spring roller at the top, and with fixture locked at the bottom, the pull all comes on curtain, causing it to set perfectly smooth, thus preventing a loose, flapping curtain. This strong tension in the roller also insures quick action when curtain is raised, and holds curtain firmly when wind is blowing. The locking against upward pull positively prevents curtain creeping upward; and jarring of car, wind or wear will have no effect on
—THE NATIONAL LOCK WASHER COMPANY, NEWARK, N. J.

PANTASOTE. This material is standard on many important trunk line railway systems and electric traction lines for closed and open car curtains and for seat covers. The company manufactures a great variety of printed and woven fabrics in cotton, wool and silk for car curtains, all coated on the outside with Pantasote, for protection against rain and the dirt and dust of travel. These materials outlast all other car shades many times, and are therefore much the cheapest in the long run, of any materials manufactured.
—THE PANTASOTE COMPANY, NEW YORK.

DAMPER REGULATORS

LAGONDA DAMPER REGULATOR. This device controls the dampers in boilers, whether the damper be in the stack or in the breeching of the boilers. It can also be used to regulate the speed of draught fans and for other similar purposes. It is a remarkably durable machine, simple, easily installed, sensitive and thoroughly reliable. One machine can be used for controlling several dampers.
—THE LAGONDA MANUFACTURING COMPANY, SPRINGFIELD, OHIO.

THOMPSON AUTOMATIC DAMPER REGULATOR. This regulator has the power to move the damper or dampers in both directions by water pressure, and is not of necessity wide open or shut. It will close or open the damper or dampers on a variation of 1 lb. of steam; or will make a partial stroke in either direction and stand at any intermediate point between the open and closed positions. On account of this positive power in both directions, connections to the damper or dampers can be made (if the situation is favorable) by rod direct to damper lever, bell crank, or counter shaft, dispensing with chain, pulleys and counter weights, except in places where the damper cannot be reached otherwise. Every regulator is tested and guaranteed to work as above stated; hence its advantage in the saving of coal, even steam pressure, the preservation of boilers and grate bars. And as a safeguard against excessive pressure, or preventive of explosions its value can hardly be estimated. One of these regulators will govern from one to twenty boilers by working as many individual dampers, or one or more main dampers.
—RICHARD THOMPSON & COMPANY, NEW YORK.

DERAILING DEVICES

(See also Track Work.)

LORAIN DERAILING DEVICES. All the tongue switches of "Guarantee" construction or built up construction, as may be required, and in either girder or tee rail, with chain pull-up box, lever pull-up box, or with upright lever stand, operated from the curb. Alternatively such devices may be operated with lever pull up box or upright stand, operated in advance of car. (See advertisement.)
—THE LORAIN STEEL COMPANY, PHILADELPHIA, PA.

WEIR DERAILERS. This company has ten different designs of derailing devices, to be placed in electric railway track, for the purpose of reminding the conductor of the rule of the company, which makes it imperative for him to leave his car and go forward to cross the steam road track before giving the motorman the safety signal. Some of these derailing devices are arranged with the operating handle on the curb opposite the derailing switch; some with the handle located on the inner side of the steam road track, and some with the handle on the far side of the steam road track. This company can furnish either split switches for use in private right-of-way, or tongue switches for use in paved streets.
—WEIR FROG COMPANY, CINCINNATI, OHIO.

DESPATCHING SYSTEMS

EGRY DESPATCHING SYSTEM. This method of train despatching is extensively and satisfactorily used by prominent interurban lines throughout the country. By this system verbal orders are entirely eliminated, errors and mishaps avoided, life and property protected, schedules maintained and accuracy demanded and obtained from employees. It is economical and extremely convenient.
—THE EGRY AUTOGRAPHIC REGISTER COMPANY, DEPT. D, DAYTON, OHIO.

DISINFECTANTS

(See also Cleaning Powders and Washes.)

CHLORO-NAPTHOLEUM DISINFECTANT. This germicide will not injure, mark or stain fabrics or woodwork. It is non-poisonous, but it will destroy disease germs, foul odors and vermin. It should be sprinkled before sweeping and added to all water used for cleaning. Chloro-naptholeum and this company's automatic disinfecting appliances for toilets are used by the United States Government, leading railroads, corporations, etc., etc.
—WEST DISINFECTING COMPANY, NEW YORK.

DOORS AND DOOR FIXTURES,

BRILL VESTIBULE DOOR CONTROLLER. Until this controller was patented, vestibule folding doors were allowed to swing free in being closed or opened, with liability of striking against passengers, and by a sudden movement of the car, be violently closed or opened, resulting in broken glass and wrenched frames. The extensive use of the dividing rail on vestibuled "Detroit" platforms makes such a device absolutely necessary to prevent defacement of the woodwork of the door by swinging against the railing. The apparatus consists of a roller mounted vertically on the outer leaf of the folding door which moves between guide-rails attached to the lintel of the door, and the folding doors are provided with specially devised spring catches.
—J. G. BRILL COMPANY, PHILADELPHIA, PA.
—AMERICAN CAR COMPANY, ST. LOUIS, MO.
—G. C. KUHLMAN CAR COMPANY, CLEVELAND, OHIO.
—JOHN STEPHENSON COMPANY, ELIZABETH, N. J.

THE "DUPLEX" DOUBLE DOOR FIXTURE. A compact and ingeniously arranged mechanism for operating two sliding doors simultaneously, so that when force is applied to one door it will move the opposite door reciprocally. It is compact and self contained, so it can be applied between bulkheads above the doors in a few moments' time. Cold rolled steel machine cut racks and gear wheel are used in combination with channel iron guideways and malleable iron supporting brackets and hangers in such a manner as to always insure maximum strength, wear, perfect alignment and easy running of all moving parts. (For illustration see advertisement.)
—WALLACE SUPPLY COMPANY, CHICAGO AND NEW YORK.

EDWARDS TRAP DOORS. (EXTENSION PLATFORM.) In general use upon the leading railway systems for covering over the steps in wide vestibule or open platform cars. The door is actuated by torsional spring bars located within the hinge, which may be regulated at will, either to balance the door or render it automatic upon being released by the operating means, the spring bars being held at one end in the hinge and at the other end in a ratchet wheel located in the bracket or journal bearing which supports the end of the hinge. There are various designs conforming to various requirements and construction.
—THE O. M. EDWARDS COMPANY, SYRACUSE, N. Y.

PITT BALANCE DOOR. This door is designed for use in railroad stations, railway cars and other places where an easy means of egress and ingress is required for handling crowds. The doors cannot be blown open by the strongest wind, yet open at the gentlest pressure of the hand and fold closely against the wall, giving the full width of the opening. They work both ways, never "slam" or "bang," shut out dust, and make draughts impossible, simply constructed, quick in action, and wind proof, dust-proof and storm-proof.
—THE PITT BALANCE DOOR COMPANY, NEW YORK.

RIDLON AUTOMATIC LOCK FOR FOLDING VESTIBULE DOORS. This device is of great value in the saving of glass alone, to say nothing about its other advantages. It prevents the doors from swinging and is positive in its action. The first half of the door can be opened without opening the second half. This latter cannot be opened until the first half is folded back against the catch, which unlocks the second half and locks the two doors together automatically, when they both can be swung back together and hooked: or reversing the operation, the two halves remain locked together until, in closing, the second half strikes the catch, when the first half is released, the second half being locked also automatically in its normal closed position. The first half is then free to be closed and locked.
—FRANK RIDLON COMPANY, BOSTON, MASS.

DOORS, STEEL ROLLING

KINNEAR STEEL ROLLING DOORS. A door constructed of steel slats running in guides and having interlocking hinges along its entire length. It coils up at the top of the opening into a small roll, thus occupying no wall nor floor space. It is operated easily and speedily by one man, is entirely fireproof, and very durable. By means of hinged posts, an opening of any width may be divided into convenient sized doors, yet leaving the opening entirely free when doors are open. The trolley connection automatically provides a smooth and continuous path for the trolley when the door is open.
—KINNEAR MANUFACTURING COMPANY, COLUMBUS, OHIO.

DRAFT RIGGING AND DRAW BARS

(See "Couplers, Car")

DRAFT, MECHANICAL

(See Mechanical Draft Apparatus.)

DRYING APPARATUS

(See also Heating and Ventilating Apparatus.)

"ABC" DRYING APPARATUS. For many years the drying of materials of all kinds from which moisture can be successfully extracted by artificial means has been one of this company's specialties. Each of the dryers which it furnishes is especially designed for the work which it is to accomplish, the plans for same embodying the results of the company's extensive and successful experience. In some of the dryers the same types of apparatus are used as are employed in the company's heating and mechanical draft systems; in others, as in the case of the "Moist Air" lumber dryers, the apparatus is entirely different.
—AMERICAN BLOWER COMPANY, DETROIT, MICH.

STURTEVANT DRYING APPARATUS. A positive circulation of air is essential to the successful drying of all classes of material. In this system the apparatus, consisting of a fan and a heater, is placed outside of the drying room. The air is positively drawn or forced through the heater by means of the fan and is discharged under pressure at any desired point or points within the drying chamber. When the material is not excessively moist the air is returned to the heating apparatus and reheated, thereby increasing the efficiency. Special arrangements of the dry room are usually required for each specific material. (See also Heating and Ventilating Apparatus.)
—B. F. STURTEVANT COMPANY, HYDE PARK, MASS.

(CONTINUED ON PAGE XVII.)

DRILLS, TRACK

BROWN TRACK DRILL. This machine is a self-feeding hand-power drill, with a pair of fly wheels on which it can be easily rolled. On reaching the work, the drill is up-ended and placed so that the frame-bars rest across the track rails. Two ordinary laborers can drill holes up to 1 in. as rapidly as with a motor-driven machine Drills holes in vertical or diagonal planes.
—HAROLD P. BROWN, NEW YORK.

DUNTLEY AIR-COOLED ELECTRIC DRILLS. Manufactured in single and tri-motor types with capacities ranging from ⅜ in. to 2½ ins. Friction clutch is used as protection against damage to motors in case drill is fed so rapidly the amperage exceeds the rating. Should this occur drill spindle stops and motors continue at full speed. Slight turn of feed screw or pilot wheel will start drill spindle rotating. (See advertisement.)
—CHICAGO PNEUMATIC TOOL COMPANY, CHICAGO, ILL.

MOORE TRACK DRILL. Some of the advantages of this new drill for heavier rail work are: The adjustable feed attachment permits the feed to be regulated to suit the requirements; the drill bit, which can be quickly fed up to or returned from the work by throwing the feed mechanism out of gear; the top section carrying the upright and the operating mechanism, which can be quickly detached from the lower portion, leaving the same in position but lying below the top of the rail to admit the passing of trains; after the train has passed, the upper portion can be readily attached again. Can also be used for drilling holes in the base of the rail by the substitution of a few parts, and be equipped with either the over or the under clutch rigging, as desired.
—KALAMAZOO RAILWAY SUPPLY COMPANY, KALAMAZOO, MICH.

PAULUS AUTOMATIC FEED TRACK DRILLS. The only practical device whereby the operator may stand erect while drilling. The action of the bit is continuous and the feed is automatic. The heaviest rail may be drilled through without stopping. The drill is attached to the rail by two hooks which go over the top. For trains to pass the hooks are raised and the top collapses backward, the bit remaining undisturbed. A special pattern is made for guard rails.
—BUDA FOUNDRY & MANUFACTURING COMPANY, CHICAGO, ILL.

RIDLON TRACK DRILL. This machine drills ⅞ in. holes in heavy rails for bonding. It is the result of experience gained in drilling the holes for bonding the rails on the new structure of the Boston Elevated Railway. As now constructed, it weighs 185 lbs., and is easily handled by two men. When once adjusted, it may be quickly set in place for each new hole. The parts, while heavy, are not cumbersome, and the gearing is of cut steel. The drill is provided with an automatic friction feed that may be adjusted to feed fast or slow. This also acts as a quick return of the spindle by reversing the cranks and the drill backs out much faster than could possibly be done in any other way.
—FRANK RIDLON COMPANY, BOSTON, MASS.

SHEFFIELD TRACK DRILLS. The No. 5 is a vertical drill operated by means of cranks and insuring maximum speed. The gear wheels are all cast steel. It has a "quick feed" by which the drill bit can be run up quickly against the metal, or withdrawn quickly after hole is drilled, thus saving a great deal of time over other styles. It has also two drilling speeds, the faster being used for soft metals and the slower for hard. The change of speed as above is accomplished in a simple manner—the pushing of a lever by the foot. The upright is removable to allow trains to pass.
—FAIRBANKS, MORSE & COMPANY, CHICAGO, ILL.

SWEET'S TRACK DRILL. This drill works rapidly, has a powerful feed, making the drilling of 1½-inch holes easy in girder or tee rails The motion is uniform and continuous. The feeding and withdrawing of the drill is accomplished by one lever. The construction of the spindle head decreases the friction to a minimum, and the fulcrumed lever furnishes a powerful and variable feed with a quick return. The wheels serve as a truck for moving the drill without carrying
—MICHIGAN MACHINERY MANUFACTURING COMPANY, YPSILANTI, MICH

VAN DORN-ELLIOTT ELECTRIC PORTABLE DRILL. This is designed and built to do rapid work in drilling and reaming holes in tracks and for use about repair shops and power houses. It is constructed with an automatic switch, and is at all times reliable and entirely automatic in its operation. Built for 110, 220 or 500 volts
—THE VAN DORN-ELLIOTT ELECTRIC COMPANY, CLEVELAND, OHIO.

WILSON DRILL. This is a continuous action drill for drilling holes for ½ to ⅞ in. bond wires. It has an automatic feed which is even and continuous forward or back when the crank is turned. The machine is simple and of but few parts. Is attached to rail by means of hooks and may be readily secured to or taken from the rail.
—BUDA FOUNDRY & MANUFACTURING COMPANY, CHICAGO, ILL.

DUST GUARDS

(See Lubricating Devices)

DYNAMOS

(See "Generators")

ECONOMIZERS, FUEL

AMERICAN FUEL ECONOMIZER. Made by Broomell, Schmidt & Steacy Company, York, Pa.

GREEN FUEL ECONOMIZER. An apparatus for heating the feed water for steam boilers by means of the heat that would otherwise be wasted in the flue gases leaving the boilers. This saving varies from 10 to 20 per cent. according to the type of boiler and the method of firing. This apparatus also prolongs the life of the boiler by obviating the use of cold feed water and by precipitating a large part of the sediment that would otherwise enter and encrust the boiler. It further provides a large reserve of feed-water at the evaporative point. (See advertisement for illustration.)
—THE GREEN FUEL ECONOMIZER COMPANY, MATTEAWAN, N. Y.

PARKER ECONOMIZERS. This device is placed between the steam generating tubes and the drums of Parker water tube boilers or it may be used in connection with other types of boilers. It is constructed of straight horizontal charcoal iron tubes and the same junction boxes as used in the Parker boiler. The tubes are connected in series and the water is fed in at the top end. A connection with the drum supplies water for circulation when the feed is stopped. A check valve compels the feed to go through the coil and another forces water from the drum through the coil when blowing out.
—PARKER BOILER COMPANY, PHILADELPHIA, PA.

STURTEVANT FUEL ECONOMIZERS. The metal-to-metal pipe joints insure ease of erection and permanent tightness. There are no gaskets. The staggered pipes completely break up the gas currents and greatly increase the efficiency of the pipe surface. Expansion and contraction are free to occur without straining the joints. These economizers are preferably installed in connection with mechanical draft. They save from 10 to 20 per cent. in fuel, increase the boiler capacity from 20 to 40 per cent., prolong the life of the boilers, purify the feed water and decrease the smoke nuisance.
—B. F. STURTEVANT COMPANY, HYDE PARK, MASS.

ELECTRICAL TESTING

ELECTRICAL TESTING. The recognition of the value and importance of testing and a demand for a competent, independent laboratory prompted the equipment of the Electrical Testing Laboratories. In these laboratories tests are made by skilled experts for the exclusive benefit of patrons. Here are testing facilities which would be otherwise within the reach of few, but by this method are at the command of all. If secrecy is preferred private rooms well equipped for the purpose are available, where customers can make their own tests unobserved.
—ELECTRICAL TESTING LABORATORIES, NEW YORK.

ELEVATORS

BATES PASSENGER AND FREIGHT ELEVATORS. The elevators made by this firm have been in successful use for over twenty-five years. At present the company is installing for the Philadelphia Rapid Transit Company one direct-acting plunger hydraulic freight elevator, capacity 50,000 lbs., at 20 ft. per minute, steel car 12 ft. 6 in. wide, by 42 ft. long.
—F. A. & H. P. BATES, SWARTHMORE, PA.

"MARINE ENGINE" ELEVATORS. All types of electric and hydraulic elevators for passenger, freight and sidewalk service are made by this company, and the special features of the electric elevators are the elimination of keys and pins from the driving mechanism, and the use of the full automatic electric control. The company makes a specialty of the Pratt rail-gripping car safety device, this being a combination of old and tried devices producing a new and effective result.
—MARINE ENGINE AND MACHINE COMPANY, NEW YORK

ENGINES, GAS AND OIL

ALLIS-CHALMERS NURNBERG GAS ENGINES. This gas engine is horizontal, four cycle, double-acting; built as a two-cylinder tandem or twin in units of 300 to 2,500 h.p., and as a four-cylinder twin tandem in units of 600 h.p. to 5,000 h.p., suitable for all fuel gases and all power purposes, including driving line shafting direct coupled to the crank shaft, or by means of belts, ropes, or gearing; driving electric generators, both direct and alternating current, directly connected to crank shaft; operating directly coupled air compressing and blowing cylinders, or pumps. Over 115,000 h.p. in "Nurnberg" gas engines now in construction and operation.
—ALLIS-CHALMERS COMPANY, MILWAUKEE, WIS.

AMERICAN CROSSLEY GAS ENGINE. The rights to build the Crossley gas engine in this country have been acquired by the Power & Mining Machinery Company, New York, successor to the Loomis-Pettibone Gas Machinery Company. Although the American Crossley engine embodies the principal fundamental features of the English engine, several modifications of details have been made, notably in the valve gear. The engine is of the single-acting, four-stroke-cycle type, and is built in single-cylinder, double-cylinder and four-cylinder units of from 50 to 1,300 h.p. rated output. The maximum ability exceeds the rated ability by about 15 per cent.
—POWER & MINING MACHINERY COMPANY, CUDAHY, WIS.

BUCKEYE GAS ENGINES FOR POWER STATIONS.
—BUCKEYE ENGINE COMPANY, SALEM, OHIO.

KOERTING AND HORNSBY-AKROYD INTERNAL COMBUSTION ENGINES. Besides its well-known refrigerating machines, this company builds the following: Koerting two-cycle gas engines, from 400 hp. to 3,000 hp.; four-cycle Koerting gas engines from 65 hp. to 360 hp., and Hornsby-Akroyd safety oil engines which operate on kerosene, crude or fuel oil, up to 125 hp in single cylinder units and 250 hp. in twin units.
—DE LA VERGNE MACHINE COMPANY, NEW YORK.

SECOR OIL ENGINES. See Generating Sets.

WEBER GAS AND GASOLINE ENGINES. See under Gas Producers.

WESTINGHOUSE SINGLE ACTING GAS ENGINES. Built in numerous sizes up to 300 h.p. Operate upon the four cycle principle. Engines of this type are of vertical construction, having two cylinders in the smaller sizes and three cylinders in larger sizes. Mounted upon enclosed crank cases. In the latter the cranks are spaced at 120 deg. regularity, giving a power impulse at each two-thirds revolution. This type is well adapted to generator driving, either D.C. or A.C. in electric parallel. Natural, illuminating, producer or oil gases are suitable for fuel.
—THE WESTINGHOUSE MACHINE COMPANY, PITTSBURG, PA.

WESTINGHOUSE DOUBLE ACTING HEAVY DUTY GAS ENGINES. Built in sizes up to 4,000 h.p., either single crank or double crank, the former with two double acting cylinders arranged in tandem, the latter with this arrangement duplicated, making a four cylinder engine with cranks at 90 deg. The engine operates on the four cycle principle, and, therefore, makes four impulses per revolution. Double acting designs are especially adapted for driving direct connected generators, either of the D.C. or A.C. type, operated either separately or in parallel. The gases suitable for fuel comprise natural, illuminating producer, blast furnace and oil gas.
—THE WESTINGHOUSE MACHINE COMPANY, PITTSBURG, PA

ENGINES, HOISTING

ALLIS-CHALMERS DOUBLE DRUM DIRECT ACTING CORLISS HOISTING ENGINE. Made either with Stephenson links, Gooch links, Allen links or spur gear rolling reverse. Steam actuated. Ball throttle valve obviating the use of special steam cylinder for operating. Under control of governor at all times. Governor safety device in connection with overwinding arrangement, as it is operated in conjunction with it. Automatic safety stop acts in cut off and sets the brake. Post brakes have parallel motion. Standard size of cylinders, 24 in. dia., with 60 in. stroke, with 125 lb. steam, hoists 17,000 lb., equipped with 10 ft. drum and ball friction clutch 9 ft. in dia.
—ALLIS-CHALMERS COMPANY, MILWAUKEE, WIS.

ALLIS-CHALMERS DUPLEX DOUBLE REEL HOISTING ENGINE. On reels 5 ft. in diameter at center 2,500 feet of 5 in. by ⅜ in. flat rope may be wound. Friction clutches. Automatic safety stop prevents overwinding. Clutches, brakes and reversing gear steam operated. All auxiliary steam cylinders have oil cataract cylinders arranged tandem with the steam cylinders to give an easy and

[illegible] positive, complying with special law with regard to such [illegible] and all other accessories supplied direct.
—[illegible]

ENGINES, STEAM

"ABC" TYPE A ENGINES. [illegible] operating blowers, generators, pumps, etc. This performance [illegible] with other unique features of design and construction. Every frictional surface runs on oil, there being no positive contact between metals; hence the wear is almost entirely [illegible] Automatic relief cocks prevent all liability of breaking by water.
—[illegible]

ARMINGTON & SIMS ENGINES. All of these [illegible] strated to be essential to the highest efficiency attainable [illegible] devices and improvements are the multiported self-adjust- [illegible] automatic self-oiling devices and four piece-removable shell self-oiling main bearings. All working parts are adjustable for wear, and are at all times readily accessible for inspection, adjustment and repair. All parts are accu- [illegible] ially designed for the highest attainable economy.
—[illegible] NEW YORK

BALLWOOD CORLISS VALVE STEAM ENGINE. This engine has no releasing gear, having a positive connection between the wrist plate and the valve stem lock arm. The design of valve gear is such that practically the Corliss steam distribution is obtained while the greater [illegible] in higher efficiencies than can be obtained by the slow speed Corliss. The admission valves are controlled by the inertia shaft governor, while the exhaust valves are driven by a separate fixed eccentric. The valves are placed in the cylinder [illegible] that the ports are short and direct, the clearance a minimum, and the valves [illegible] remaining tight for an indefinite period.
—THE BALL & WOOD COMPANY, NEW YORK.

BROWN-CORLISS ENGINES. These engines include heavy duty and girder frame engines. High speed vertical engines in units from 25 to 500 h.p. The company makes a specialty of furnishing complete power plants, including electrical apparatus, either for high speed or heavy duty Corliss engines.
—BROWN CORLISS ENGINE COMPANY, CORLISS, WIS.

BUCKEYE STEAM ENGINES. The engines made by this [illegible] especially suitable for electric railway and other power houses operating under severe conditions. Among these are tandem engines [illegible] horizontal vertical compound engines for direct connection to rail[illegible] current generators of the revolving field type as well as for direct current machines; and high speed, vertical cross-compound engines. Capacities range all the way from 50 hp. to 8,000 hp.
—BUCKEYE ENGINE COMPANY, SALEM, OHIO.

COOPER-CORLISS ENGINES. An economical and reliable type of engine specially adapted for driving direct connected electric light and railway generators in sizes ranging between 100 Kw. and 5,000 Kw., at speeds from 75 r.p.m. to 125 r.p.m. These engines are built in single cylinder, cross and tandem compound, also horizontal-vertical types. (See advertisement.)
—THE C. & G. COOPER COMPANY, MT. VERNON, OHIO

FLEMING ENGINES. This is an automatic self-oiling horizontal engine, comprising sixteen different styles and 900 sizes ranging from 6 to 3,000 hp. capacity, each size particularly adapted to its special service, thus enabling the selection of an engine exactly suited to the conditions. The four-valve particularly stands in a class of its own, being built for hard work and highest efficiency. Separate and direct fired super-heaters also furnished when desired [illegible] complete power [illegible] guarantee tests [illegible]
—HARRISBURG FOUNDRY AND MACHINE WORKS, HARRISBURG, PA.

HAMILTON-CORLISS VERTICAL CROSS COMPOUND ENGINES. [illegible] speeds and any desired steam pressure; run belted or direct [illegible]
—[illegible] COMPANY, HAMILTON, O.

McINTOSH SEYMOUR ENGINES. [illegible] sizes and types, including engines to meet special requirements.
—McINTOSH, SEYMOUR & COMPANY, AUBURN, N. Y.

MURRAY CORLISS ENGINES. [illegible] of the latest design. The frame or beds are of the girder, heavy duty and rolling mill types. The cylinders are cast from [illegible] for which the Murray foundry is famous, and all the castings are of the highest grade. As evidence of this, there has never been a case of a Murray fly, band or rope wheel bursting. The capacity of the works is large and the heaviest engines can be built complete in thirty days if the requirements do not depart from the standard practice of the company. There are about 1,000 engines of this type in use.
—THE MURRAY IRON WORKS COMPANY, BURLINGTON, IA.

PHOENIX ENGINES. This company is a builder of engines of the automatic cut-off type.
—PHOENIX IRON WORKS COMPANY, MEADVILLE, PA.

QUINCY CORLISS ENGINES. Designed especially to meet the exacting requirements of street railway service. Differs from the well-known Corliss type only in the small details, to which special attention has been given. Have many features not commonly found in engines of their type, which are appreciated by both owners and operators.
—QUINCY ENGINE WORKS, QUINCY, ILL.

QUINCY VERTICAL ENGINES. Ideal engines for use with moderate speed generators, and where space is limited. The steam is distributed by four valves, the admission valves being controlled by a shaft governor. In use in some of the best equipped power houses in the country.
QUINCY ENGINE WORKS, QUINCY, ILL.

REYNOLDS CORLISS ENGINES. This type includes the Reynolds horizontal-vertical engine, said to give the best turning movement of any engine built, and is especially adapted for direct connection to electrical generators; Reliance engines, single and compounded, belted and direct connected; heavy duty engines, single and compounded, belted and direct connected; girder frame engines and vertical engines, single and compounded, belted and direct connected.
—ALLIS-CHALMERS COMPANY, MILWAUKEE, WIS.

RICE & SARGENT STEAM ENGINES. Special designs of these engines are made for direct connection to both a.c. and d.c. generators. The Rice & Sargent engine of the Corliss type with releasing gear and belted inertia governor, is adapted to run at speeds up to 150 r.p.m. For higher speeds, the four valve non-releasing type with shaft governor is adapted to speeds up to 250 r.p.m. Both types show small friction, close regulation, low steam consumption, fine workmanship, quiet action, and great durability.
—PROVIDENCE ENGINEERING WORKS, PROVIDENCE, R. I.

ROCKING VALVE ENGINES. Specially designed for service requiring a heavy machine. Built on standard engine frame. Frame and side cast in one piece, having a bearing the full length of the foundation, thus insuring great stiffness. Slide bar bored guides. Pins and wearing surfaces extra large. Cylinders neatly lagged with planished sheet steel. Rocking valve placed at bottom of the cylinder, thus allowing the cylinder to be thoroughly drained. Port openings through the valve and into the cylinder are exceptionally large, preventing wire drawing of the steam. Strong, simple compact, and economical in operation.
—ALLIS-CHALMERS COMPANY, MILWAUKEE, WIS.

RUSSELL CORLISS ENGINES. These engines are high grade four valve semi-Corliss engines designed for heavy duty and especially adapted to driving electric railway generators, where durability, efficiency and economy are required. The company also builds self-oiling engines [illegible] ing surfaces for the moving parts; and, in simplicity of [illegible]
—RUSSELL ENGINE COMPANY, MASSILLON, OHIO

SHEPHERD STEAM ENGINES. [illegible]
—[illegible] COMPANY, [illegible], PA.

STURTEVANT STEAM ENGINES. These are [illegible] represented by a line of vertical simple, vertical compound [illegible] lubrication under 15 lbs. pressure is provided for the bearings and a watershed partition prevents passage of oil from case to cylinder, and of water from cylinder to case. Rites [illegible]
—B. F. STURTEVANT COMPANY, HYDE PARK, MASS.

WHEELER STEAM ENGINES. [illegible] continuous duty of driving centrifugal pumps in connection with condensers, a type of steam engine has been produced, [illegible] pliances for lubrication, etc., while in continuous operation [illegible] heated steam.
—WHEELER CONDENSER & ENGINEERING COMPANY, NEW YORK.

WESTINGHOUSE CORLISS HEAVY DUTY STEAM ENGINES. Built in sizes up to 10,000 h.p. in three types, [illegible] These engines are [illegible] service the first for [illegible] for large and compact plants and the third for exceptionally compact [illegible] either saturated or superheated steam. Either Corliss or poppet valves are employed according to the steam temperature.
—THE WESTINGHOUSE MACHINE COMPANY, PITTSBURG, PA.

WESTINGHOUSE SINGLE ACTING STEAM ENGINES. Built in three styles, Compound, Junior and Standard, in sizes up to 500 h.p., automatic, high speed, either simple or compound. These engines are all of the vertical type with enclosed crank cases and balanced piston valves. Owing to the single acting principle, giving non-reversible stresses, high speed is possible, making this type of engine especially suitable for driving direct connected generators, either D.C. or A.C. The single acting compound engine is suited either for condensing or non-condensing service, although designed especially for the latter. The Junior and Standard types, being simple engines with two cylinders, are suited for non-condensing work.
—THE WESTINGHOUSE MACHINE COMPANY, PITTSBURG, PA.

WETHERILL CORLISS STEAM ENGINES. In this Corliss engine all the elements for the highest economy in the consumption of steam have been most carefully considered, and only those details which the company's long experience in engine building has found to combine simplicity, certainty of action in valve motion, and to reduce cost of maintenance have been adopted. The governing mechanism is prompt and effective, enabling these engines to produce a greater amount of work by maintaining a regular speed under various pressures and conditions of load. The changes made from time to time in the detail and construction of this engine, with the unusual weight of parts, and proper distribution of metal, render them equally stiff and rigid when running either under or over.
—ROBERT WETHERILL & COMPANY, INC., CHESTER, PA.

ENGINE STOPS

KINSMAN AUTOMATIC STATIONARY ENGINE STOP. A modification of the company's automatic locomotive stop, generally known as the Kinsman block system. This device is so arranged that a breakage or the over-loading of the circuit will regulate the steam supply or cut it off entirely. It will also automatically apply a retarding device or brake to the fly wheel when the drive wheel attains too

(INDEX TO ADVERTISERS, PAGES 15 AND 18)

high a speed. In case of failure of governing device causing engine to race and accident is imminent, this feature is of great importance.
—KINSMAN ELECTRIC & RAILWAY SUPPLY COMPANY, NEW YORK.

MONARCH AUTOMATIC SPEED LIMIT. This speed limit is installed in connection with the Monarch engine stop system. It can be applied to any type of engine, steam, oil or gas and of any size or speed: also all types of steam turbines and water wheels. It can be set at any predetermined number of revolutions of the main shaft and will close the valve automatically and shut down the unit when that predetermined point is reached. It checks racing and prevents fly wheel wrecks. It is extensively used in a variety of other ways, such as lighting a red light or sounding a gong when a certain speed is attained.
—CONSOLIDATED ENGINE STOP COMPANY, NEW YORK.

MONARCH ENGINE STOP SYSTEM. This system is a mechanical safety device operated by electricity that can be applied to any type of engine without regard to make, size or speed; also steam turbines and water wheels. It supplements the governor and automatically shuts down the unit at any predetermined overspeed. It also shuts off automatically the steam if the cylinder head blows out. It further provides a means of stopping the engine, turbine or water wheel, or throwing the main switch of a motor from any part of the plant in case of an accident to employes or machinery. It enables the user to get a rebate on liability insurance. It embraces, in addition to the engine stop, an automatic vacuum breaker and circuit breaker trip that operate simultaneously with the shutting down of the unit. The Monarch system surrounds the power end of a plant with complete protection against accidents.
—CONSOLIDATED ENGINE STOP COMPANY, NEW YORK.

EXHAUST HEADS

BURT EXHAUST HEAD. This device is attached to the exhaust pipe, and prevents oil and wet steam from escaping. It is constructed with perpendicular sides, giving a large inside area and providing abundant room for the expansion of the steam, so that there is no back pressure. There is no baffle plate, diaphragm or scrap metal, thus avoiding friction and increasing the life of the apparatus. The head is built of extra heavy iron, lapped, riveted and soldered.
—THE BURT MANUFACTURING COMPANY, AKRON, OHIO.

STANDARD EXHAUST HEAD. This head utilizes centrifugal force for separating the water and oil from the exhaust steam. The incoming steam is given a whirling motion at the top of the head, and the water and oil strike the sides, flow down to the drip outlet at the bottom and therefore do not come in contact with the incoming steam. When the exhaust steam comes in contact with the cold air, some of it is condensed into water, which drips down the collar, is caught in trough-shaped lugs and flows down into copper tubes which carry it to the outlet at the bottom.
—THE BURT MANUFACTURING COMPANY, AKRON, OHIO.

EXTINGUISHERS, FIRE

(See "Fire Extinguishers")

FANS

(See "Mechanical Draft Apparatus")

FEED-WATER APPARATUS

(See "Heaters and Purifiers, Feed-Water")

FELTS, FIREPROOF

"NIAGRITE." A flexible strip of fire-proof felt to encase high and low tension electrical cables to prevent, in case of short-circuiting or arcing, flames setting fire to adjacent cables. It is furnished in strips 3 ins. wide, approximately 15 ft. long, and 3-32 in. to ¼ in. thick, with sufficient immersing and finishing fire-proof glue with which to adhere the strips to the cables, thus doing away with all metallic fastenings. The company's fire-proof glue thoroughly impregnates the "Niagrite" felt. When dry the entire casing becomes hard like stone, thus carrying away the heat generated in the cables without danger of melting the insulation. (See advertisement.)
—H. W. JOHNS-MANVILLE COMPANY, NEW YORK.

FENCES

WHEELOCK FENCE. Made of No. 8 and No. 9 galvanized wires, locked at intersections with Wheelock fence clamp, galvanized. Wires tightened with automatic ratchets at end of each stretch, giving absolute control of the whole stretch. As wires are left loose in the staples, the stretch of fence may be tightened in a moment with a common wrench. Wires are strung singly, hence uneven ground is as easy to fence as level ground. Can be built any desired mesh, with as many wires and uprights placed as often as desired, according to requirements. Easy to handle and easy to build. Boys' work. (For illustration see advertisement.)
—WRIGHT WIRE COMPANY, WORCESTER, MASS.

WOVEN WIRE FENCE. This woven wire fence is now used on almost all steam and electric railways in the United States. It is one of the most effective designs ever devised for the protection of the right of way of railroads, and has taken the place of many other forms of fencing for railroad use. It assures the maximum of protection at the minimum of cost. The company's No. 3 railroad catalogue contains useful suggestions for fence builders. The rapid strides which have been made in recent years in reducing the cost of production puts this material within the reach of all.
—AMERICAN STEEL & WIRE COMPANY, NEW YORK.

FENDERS AND WHEEL GUARDS

CHAMPION FENDER. This car fender possesses many desirable features, among them being strength, lightness, ease of operation, positive action, economy in installation, low maintenance and reasonable price.
—THE STAR BRASS WORKS, KALAMAZOO, MICH.

CLARK AUTOMATIC FENDER. A simple spring scoop truck fender adapted to both single and double trucks, city or interurban cars, of all speeds; consists of four 2 ins. by ½ in. spring steel arms, to which a steel frame is attached, holding the galvanized netting made of No. 16 wire ½ in. mesh, galvanized after weaving, which solders the netting where wires cross. It never fails to save life. Has no complicated mechanism, having no trips nor triggers to get out of order and fail to work when needed. It works automatically, the obstruction striking the point of fender, which is carried from 2 ins. to 3 ins. above rail, and springs backward and downward to rail or road bed.
—CLARK'S AUTOMATIC CAR FENDER COMPANY, DECATUR, ILL.

ECLIPSE FENDER. The platform of this fender stands at an angle of 45 deg., with a hollow rubber hose 4 ins. in dia., stretched across the lower end, which rides about 3 ins. from the ground, but can be adjusted either higher or lower if desired. Any person on the track in front of the car will be struck about the ankles first by this tube or hose. This blow takes up the first jar, knocking the man's feet and legs from under him and giving him somewhat the momentum of the car, dropping the weight of the body back against the platform. The platform, which swings on a pivot, immediately falls back, bringing the front end with the roll on about 20 ins. above the ground, while the rear end is about 6 ins. to 8 ins. lower, thus forming a basket from which a man cannot get out without assistance.
—ECLIPSE RAILWAY SUPPLY COMPANY, CLEVELAND, O.

HIPWOOD CAR FENDER. The fender in ordinary use is carried clear of road-bed. The distance from rails easily and quickly regulated by motorman. It can be dropped to the road bed instantaneously. This fender can be removed from car in a few seconds and can be placed in position for use in the same short time. When housed under car it takes up no extra space in car depot and does not interfere with the free use of the draw bar or any other equipment. Manufactured at Lakeport, N. H.
—HIPWOOD-BARRETT FENDER COMPANY, LAKEPORT, N. H.

PARMENTER FENDER. This fender is built entirely of metal, and can be easily folded and transferred to the other end of the car. It projects in front of the car for a short distance, and is under the absolute control of the motorman, who can, by a slight motion of his foot, drop the fender to the track, thus enabling a person to be picked up even if lying prostrate.
—PARMENTER FENDER AND WHEEL GUARD COMPANY, BOSTON, MASS

PARMENTER WHEEL GUARD. This wheel guard makes it absolutely impossible for the car wheels to pass over a body, The device consists of a trigger placed immediately under the front end of the platform and so designed that it will be pressed back by any object on the track. When pressed back the trigger operates an arm, which in turn permits the guard to drop to the rail immediately in front of the wheels.
—PARMENTER FENDER AND WHEEL GUARD COMPANY, BOSTON, MASS.

PROVIDENCE FENDER AND WHEEL GUARD. Composed of two distinct parts—the cradle and the cushion The cradle is formed of curved steel rails, parallel to the car axis. The back of this cradle is hinged to the front fo the platform, and may be turned up against the dash rest with its front edge on the track, or occupy any intermediate position. The front edge of the cradle has rubber rolls. The cradle may be instantly dropped to the ground by pressing a foot latch or trigger. The cushion is a resilient steel band shield covering the bumper and all other projecting parts of the platform to cushion the blow when a person is struck.
—THE CONSOLIDATED CAR FENDER COMPANY, NEW YORK.

PROVIDENCE WHEEL GUARD. Made on the same lines as the Providence fender, but is attached to the truck of the car directly in front of the wheels. It can be dropped to the track at the same time, and by the same action on the part of the motorman, by which the front fender is dropped. If desired, an automatic attachment can be used which operates entirely independent of the motorman. The wheel guard is practically a small front fender without the cushion, and attached to the truck of the car close to the wheels, hence the name.
—THE CONSOLIDATED CAR FENDER COMPANY, NEW YORK.

STERLING FENDER. This fender has been in use seven years. A pilot-shaped life guard, attachable to any truck, it throws prostrate persons and other objects off the track, preventing contact with wheels and motors, thus saving lives and preventing severe injuries. Many thousands in use. It is strongly made, inexpensive and economical to maintain.
—STERLING-MEAKER COMPANY, NEWARK, N. J.

FIBER

AMERICAN VULCANIZED FIBER. This company manufactures vulcanized fiber of a special grade suitable for insulating purposes, which owing to its remarkable toughness and strength permits its use where other insulating materials fail to stand the strain. Vulcanized fiber is made in sheets, tubes, rods, and special shapes, and is, in addition to its uses as an insulator, especially adapted for dust guards and oil box covers, owing to its strength and the fact that it is absolutely unaffected by oils or grease.
—AMERICAN VULCANIZED FIBER COMPANY, WILMINGTON DEL.

FIELD COILS

(See "Armature and Field Coils"

FILTERS, OIL

(See also Oil and Waste-Saving Machines.)

AMERICAN OIL FILTER. This is a round-bodied filter recommended especially for purifying heavy oils. The hot water in the chamber at the top surrounds the entering oil and renders it easy flowing. To operate the filter, warm water is poured in at the top until it flows out of a certain faucet, after which the upper chamber is filled with water and exhaust steam connections made. The waste oil then enters and undergoes purification as in the Cross oil filter described elsewhere in this dictionary.
—THE BURT MANUFACTURING COMPANY, AKRON, OHIO

AMERICAN OIL FILTERING SYSTEM. The oil is fed to the different bearings by gravity from an overhead oil reservoir. After passing through the bearings, it is piped to oil filter or filters in the basement and upon being purified is again pumped to the reservoir. The oil flow is continuous and the machinery thus gives the best results, as a liberal supply can be used in the bearings without loss. This system can be constructed and put into operation by any power plant engineer.
—THE BURT MANUFACTURING COMPANY, AKRON, OHIO.

CROSS OIL FILTERS. The dirty oil is poured into an upper chamber, passes down through waste, which collects the heavier impurities, and thence goes through a perforated bottom into a tube and to a filter plate under which it spreads out in a very thin film. The latter constantly changes in surface and grows thinner as it travels from the center to the outer edge of the plate, thus exposing every particle of waste oil to the action of the water. This process is repeated on two other plates, after which the oil again filters through a stratum of waste and enters the pure oil reservoir.
—THE BURT MANUFACTURING COMPANY, AKRON, OHIO.

LIBERTY FAMOUS OIL FILTER. This filter uses a temperature bath to precipitate the impurities in the oil. The oil is heated by either a steam or electric jacket, which surrounds the filtering chamber. These jackets are not placed near the bottom of the filtering chamber, but at the sides of it, and are so arranged that the action is not violent. This causes the clean oil to rise to the top

[illegible] consisted of six of these filters. (See advertisement.)
[illegible]

TURNER OIL FILTER. [illegible] is poured into a pan in section 1, and descends through [illegible] passes up through filtering material and water into a cone. [illegible] running from section 1 to 2, passes into section 2, repeating the same operation as in section 1, and so on until section 4 is reached, when it enters a pipe in the cylinder of this section, descending through filtering material into the oil reservoir. The arrangements of the dirt chambers in [illegible]

"UNIT TYPE" AMERICAN OIL FILTER. [illegible] unit is so constructed that it can be used in connection with, [illegible] can be added without changing the original piping. These [illegible] with any oiling system.
[illegible]

WARDEN OIL FILTER. [illegible] chamber is filled with water heated by a steam pipe. The [illegible] of waste which collects nearly all of the impurities. The [illegible] perforated filter plate over which it spreads in a thin film of ever changing surface. Every particle of waste oil is [illegible] the remaining impurities have settled by gravity, the clean oil is ready [illegible]
—[illegible] COMPANY, AKRON, OHIO.

WILTBONCO-HOGAN WASTE OIL FILTER. [illegible] chamber is filled with steam-heated water to a certain height. The waste oil is poured [illegible] wire screen which removes the heavier impurities. Then it flows through [illegible] chamber, from whence [illegible] the oil spreading in a thin film on their lower surfaces with the result that it is completely scoured by the water. The pure oil, after leaving [illegible] the upper portion of the chamber where it is drawn off.
—THE WM. T. BONNER COMPANY, BOSTON, MASS.

FIRE EXTINGUISHERS

[illegible] AUTOMATIC SPRINKLER EQUIPMENTS. [illegible] which, aside from the high property loss, cannot be quickly replaced for traffic handling, little excuse exists for not installing an efficient sprinkler system. The experience [illegible] to furnish and install all the necessary apparatus for this purpose.
—H. G. VOGEL COMPANY, NEW YORK, PHILADELPHIA, BOSTON, [illegible]

GRINNELL AUTOMATIC SPRINKLERS. These [illegible] fireproof. Opening automatically by the heat of the fire, they thus confine the damage, whether by fire or water, to a limited area and minimum amount. The saving, effected in the reduced cost of insurance soon pays for a sprinkler equipment.
—GENERAL FIRE EXTINGUISHER COMPANY, PROVIDENCE, R. I.

INTERNATIONAL AUTOMATIC SPRINKLERS. The protection afforded by a modern, carefully planned and approved system of the sprinklers is the highest form of fire protection known. The underwriters of the entire world approve this system and allow substantial reductions in insurance rates wherever same is installed, for it is fully automatic and is always in service when required. Each device used is manufactured under exceedingly careful supervision, and of the highest grade of materials. These systems are protecting property valued at $100,000,000.
—INTERNATIONAL SPRINKLER COMPANY, PHILADELPHIA.

"MANUFACTURERS" SPRINKLER SYSTEM. [illegible] acceptable supplies. The sprinkler heads are distributed [illegible] normal temperature of the space protected. When a fire [illegible] melting of the fusible solder, the head is opened—viz., a [illegible] space. Built for both wet and dry systems.
—[illegible] NEW YORK.

FIREPROOFING MATERIALS

(See also Lumber, Artificial)

ELECTROBESTOS. [illegible] which is asbestos. It is hard, fire-proof material, not brittle like porcelain nor inflammable like rubber. It has been used successfully in all places where fire proofing for electric conductors is desired and is especially adapted for housing or encasing electrical trolley feed wires, and wires common to electric car service. Made in channels for separating electrical wires, lamp rosettes, grooves for insulating and protecting electric light wires, buttons for grid work, socket rings of incandescent lamp sockets, cements for sealing joints of insulating pieces, and in sheets for mounting electrical parts and various forms where high heat resistance is required. Capable of being molded into any desired shape. (Illustrated in Electrical Catalogue No. 14; see also advertisement.)
—H. W. JOHNS-MANVILLE COMPANY, NEW YORK.

TELEPHONE "TRANSITE." A specially prepared fire and water resisting sheet finished with a smooth, black insulating surface. It is hard and tough, being so designed to meet the requirements of telephone operating and manufacturing companies for partition linings for fireproof barriers to eliminate the spread of fire from one set of conductors to another, and for similar uses common to this service. These sheets are made in standard sizes, 40 in. by 40 in., 42 in. by 44 in., and from $\frac{1}{8}$ in. to $\frac{1}{2}$ in. thick. Telephone "Transite" has been adopted by many large companies, among them the New York Telephone Company. (See advertisement.)
—H. W. JOHNS-MANVILLE COMPANY, NEW YORK.

FORGES

STURTEVANT FORGES. A complete line embracing both the portable and stationary types. The former are particularly adapted for local repair work and are operated by hand, by belt or by blast from independent blower. The stationary forges are larger, are provided with either down-draft or up-draft hoods and are substantially built of cast-iron, except in the largest sizes which are of heavy steel plate. The tuyeres in these forges are carefully designed to prevent clinkering and to give the maximum blast.
—B. F. STURTEVANT COMPANY, HYDE PARK, MASS.

FROGS, TRACK

(See "Track Work")

FUEL ECONOMIZERS

(See "Economizers, Fuel")

FUSES

D. & W. FUSES. This company's non-arcing fuses and safety devices are made in a wide range of capacities [illegible] direct current circuits. These cover cartridge fuses, cut-outs, fuse clips, telephone and telegraph protectors, and numerous devices used in connection with fuses. For details see Lists Nos. 9 and 10.
—D. & W. FUSE COMPANY, PROVIDENCE, R. I.

GENERAL ELECTRIC FUSES. The General Electric Company manufactures a most extensive line of National Electrical Code Standard enclosed fuses and cut-outs. These fuses comply in all details with the standard set by the national underwriters. They may be obtained for capacities from 30 to 600 amps., for both 250 and 600 volts. [illegible]

"NOARK" ENCLOSED FUSES. [illegible] is attended by absolutely no noise, flash or arc. They [illegible] which combines with the metal at the moment of blowing, [illegible] circuits or in cut-out blocks for the protection of heating [illegible]
—H. W. JOHNS-MANVILLE COMPANY, NEW YORK.

SHAWMUT FUSES. Each railway cutout equip- [illegible] for protection from the weather, containing a slate base [illegible] standard fuses.
—[illegible]

WESTINGHOUSE FUSES AND FUSE BLOCKS. The fuses, both open link and enclosed, with suitable fuse [illegible] 60 amp. size. The larger sizes have at the ends simple knife [illegible] knife-switch jaw type. Each fuse has an indicating device which [illegible] meet the requirements of the National Board of Fire Underwriters, and are rated at 80 per cent of their maximum continuous [illegible]
—WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, PITTSBURG, PA.

GAGES, OIL AND WATER

REFLEX WATER GAGE. The principle of this reflex glass depends upon the total reflection of light when [illegible] power. Grooved facets cut in the inner surface of the [illegible] the glass, but light passes through that portion of the grooves covered with liquid. Thus a sharp clear line marks the height of the liquid, above which the [illegible] space has a bright mirror-like appearance, while the liquid takes the color of the chamber background, usually black.
—THE WM. T. BONNER COMPANY, BOSTON, MASS.

WILLIAMS GAGE DEVICES. These include the Williams quick [illegible] rotating regrinding [illegible] operated the spiral causes the stem to rotate and regrind the seat.
—THE WILLIAMS GAGE COMPANY, PITTSBURG, PA.

GAS PRODUCERS

AMERICAN-CROSSLEY SUCTION GAS PLANT. This apparatus gets its name from the principles on which it operates, as the air used in generating gas is "sucked" through the [illegible] by the suction of the engine piston, and consequently gas is generated only as required. The fuel is [illegible] raw gas, which must be purified before being sent to the engine [illegible] which it contains. These are absorbed and the gas cooled by wet and dry scrubbers and a hydraulic box. A large part of the heat of the gases is saved by a saturator in the top of the gas generator, and the steam [illegible] is passed through the [illegible]
—POWER & MINING MACHINERY COMPANY, CUDAHY, WIS.

GAS PRODUCERS. Made by Broomell, Schmidt & Steacy Company, York, Pa.

LOOMIS-PETTIBONE GAS PRODUCER. Capable of burning all kinds of wood, coal and coke. Parts include two gas generators, a vertical boiler, water-cooled valves, producer gas valve and water gas valve. In starting fires in generators, a 5 ft. layer of coal or coke is put in and ignited at the top, the exhauster creating a downward draft.

After ignition fuel is added to make a permanent 8 ft. layer. Air is admitted, drawn by exhauster through the burning fuel, converted to producer gas, cleaned and delivered to gas holder. When, and during the time, the fuel is incandescent, water-gas is produced by passing steam through the hot coal.
—Power & Mining Machinery Company, Cudahy, Wis.

WESTINGHOUSE AUTOMATIC GAS PRODUCER. Built in sizes up to 500 h.p. in two types, water sealed bottom and enclosed bottom, the former for continuous and the latter for intermittent operation. Suited to the use of non-bituminous fuel. The complete equipment consists of a producer, boiler, combination scrubber and drier. It is self-contained, automatic and does not require a gas holder. The producer utilizes its waste heat for making steam, no extra coal being used. Gas production is automatically proportioned to the demand, the producer responding instantaneously to load changes.
—The Westinghouse Machine Company, Pittsburg, Pa.

WEBER GAS PRODUCER POWER PLANTS. In his system three cylinder vertical gas engines are used in combination with a suction gas producer, which automatically generates gas from pea anthracite coal, coke, charcoal, lignite, peat, etc. It is especially adapted for heavy duty power plants.
—Weber Gas & Gasoline Engine Company, Kansas City, Mo.

GATES, CAR

BRILL FOLDING GATE. The gate is constructed on the pantagraph or lazy-tongue principle and is made of flat iron, strongly riveted together at the joints. It is unequaled for compactness, strength and adaptability to all conditions. It is made for any width of opening and for any height. The gate may be attached to the car-body, vestibule or dasher, and may be arranged to fold on the outside of the vestibule or dasher. When mounted on the platform steps it increases standing room on the platform. (Advertisements in last pages.)
—J. G. Brill Company, Philadelphia, Pa.
—American Car Company, St. Louis, Mo.
—G. C. Kuhlman Car Company, Cleveland, Ohio.
—John Stephenson Company, Elizabeth, N. J.

PITT DOUBLE-ACTING GATE. A gate designed for use on surface railway cars, so arranged that it always swings away from the passengers, whether they are crowding on or off the car. In discharging passengers the latch is lifted and the gate swings outward, away from the outgoing passengers. When the car arrives at a point where crowds are waiting to board the car, the latch is lifted and the gate swings inward away from the passengers. The latch is arranged to hold the gate firmly in place in any of its three positions.
—The Pitt Car Gate Company, New York.

PITT DUPLEX GATE. This gate consists of two gates, one on the front and one on the rear platform. These are connected under the car seats, both gates being absolutely under the control of the motorman, and neither can be opened or closed by conductor or passengers, thus forming a safeguard against claims for damages by the passenger who says, "The car started too soon and threw me off." These gates are operated without difficulty, are positive in action and easily opened and closed, even on crowded car platforms.
—The Pitt Car Gate Company, New York.

PITT ELEVATED RAILROAD GATES. These gates insure safety and comfort to passengers, while their easy, rapid opening and closing save more than half the landing time of trains during rush hours. In discharging passengers, the gates are opened without the slightest disturbance to those on the platforms, and when the flow is into the cars, these gates permit as many as the platform will hold to get on, and then are closed behind the last passenger without difficulty.
—The Pitt Car Gate Company, New York.

WOOD'S SAFETY GATE. The single folding gate is especially adapted to cars with narrow platforms, while for very wide platforms, the double folding gate may be preferred. The simplicity of its construction and the few working parts make the cost of maintenance little or nothing. Either style of gate makes a neat and attractive appearance and a very desirable fixture to a first-class car.
—The R. Bliss Manufacturing Company Branch, Pawtucket, R. I.

GATES, WATER

(See "Valves and Gates")

GEAR CASES

BLISS COMBINATION GEAR CASES. These gear cases are made with specially treated wood sides and sheet steel top and bottom, with wrought steel lugs. They are made to fit on standard motors, and weigh only about one-third as much as a malleable iron case. They do all that a malleable case will do, the special advantage being that when meeting with any obstruction on the road they do not jam under the car, thus throwing it off the track or damaging the gears, pinions or motor, but the lower half simply gives way, and the car proceeds. The standard types of these cases are carried in stock, their cost being considerably less than the malleable cases.
—E. W. Bliss Company, Brooklyn, N. Y.

CORBETT GEAR CASES. Improved sheet steel as well as steel and wood gear cases are made by this company.
—Elmer P. Morris, New York.

GENERAL ELECTRIC GEAR CASES. These gear cases are made of malleable iron, precluding danger of breakage. Radiating from the points where it is attached to the motor frame are strengthening ribs to prevent the case from cracking. Both the top and bottom halves of the case are bolted to the lower magnet frame. With this construction the gear case is not affected by loose bolts in other parts of the motor, and as excessive vibration is prevented, liability of breakage is reduced to the minimum. So successful has been this method of suspension that it is considered a salient feature in the construction of the General Electric Company's motors.
—General Electric Company, Schenectady, N. Y.

LYON SHEET STEEL GEAR CASES. Made entirely of sheet steel, each section so riveted and seamed as to give strength where needed. Re-inforced at both ends by heavy plates both inside and out, and all brackets brace triple re-inforced, making it impossible to work loose from vibration. A case being made of steel is 75 to 100 lbs. lighter than cast iron or malleable ones and is therefore more easily adjusted. Non-breakable; in case of accident they become bent or dented, not broken, like malleable cases and can be hammered into shape without injury.
—The Lyon Metallic Manufacturing Company, Chicago, Ill.

GEARS AND PINIONS

BLISS GEARS. Motor gears are now made in two types, namely, split, i.e., made in two halves to bolt over axle, and solid, i.e., made in one piece and pressed on axle by removing car wheel. The gears are made from open hearth steel castings best suited for this work. Split gears are made in halves, and are held together with eight heavy bolts of high tensile strength and elastic limit. The bolt nuts are locked by lock-washers and a cotter pin is put through each bolt to prevent the nut from coming off. Crown nuts are supplied when desired. Solid gears are made in one piece, no bolts being used. They are forced on the axles by pressure, the bore being usually made a shade under the size of the axle. All gears are finished to the same dimensions as the standards supplied by the motor manufacturers, and are machined and cut by the most up-to-date methods. The standard types are kept in stock.
—E. W. Bliss Company, Brooklyn, N. Y.

BLISS CUT PINIONS. These pinions are made from individual forged billets, of high grade open hearth steel of high carbon. They are most accurately machined and cut on the most up-to-date machinery. The pinions fit on the armature shaft of the motors, and are made to the same dimensions as those supplied by the motor manufacturers. They mesh with the gear which fits on the car axle, and as they revolve five or six times while the gear is making a single revolution, and as the power is supplied from the pinion to the gear, it is most essential that they be made strong and durable, and of high grade stock. Standard types are carried in stock.
—E. W. Bliss Company, Brooklyn, N. Y.

BLISS PRESSED PINIONS. These pinions are made of a high grade, high carbon open hearth steel. Individual billets are used, and the teeth are formed by forcing the steel into dies by hydraulic pressure of over 1,000,000 lbs., which greatly solidifies and toughens the metal, making it thoroughly homogeneous. The skin of the billet is retained, and the process admits of using very hard steel, and a pinion of great strength and durability is produced. Standard pinions are carried in stock.
—E. W. Bliss Company, Brooklyn, N. Y.

FALK GEARS AND PINIONS. The steel used in these gears is made in the company's open hearth steel foundry. The facilities of the company enable it to produce any type of gear on receipt of drawing showing dimensions. The pinions are made of hammered steel. The best grade of open hearth steel billets, of high carbon, is used, thus producing a strong and long-lived pinion. (See advertisement in this issue.)
—The Falk Company, Milwaukee, Wis.

FOGARTY SECTIONAL GEAR. This gear wheel is a radical departure from the other gears now in use, as the hub and rim are cast separately. After pressing the hub in position on the axle, it will stay there until the axle is worn out. When the rims are worn out it is a simple matter to put on a new one instead of purchasing a complete gear wheel.
—James H. Fogarty, New York.

GENERAL ELECTRIC GEARS AND PINIONS. Are made of a superior grade of cast steel, and pinions of forged steel, extra hammered to improve the quality of the metal. The teeth are accurately cut by tools specially designed for doing this work, a fact which assures long life and smooth running. The finished product is carefully gaged, and rigidly inspected before shipment. The high class of material used is expensive, but the increased cost of manufacture is more than offset by greater reliability in service. Cast iron gears, even at lower first cost, are decidedly more expensive per car mile.
—General Electric Company, Schenectady, N. Y.

NEW PROCESS RAWHIDE PINIONS. This company's rawhide pinions have attained considerable popularity owing to their long life, noiseless running and general reliability. They also tend to prolong the life of the metal gear wheels.
—The New Process Raw Hide Company, Syracuse, N. Y.

NUTTALL GEARS AND PINIONS. These are now made in many designs, weights and ratios. To meet successfully the varied haulage conditions all these items must be taken into consideration, as well as the grade of material and workmanship. The split type of gear is at present most in evidence, but since the more general use of large axles, solid gears are rapidly gaining favor. The pinion part of the transmission is equally important. The use of only the very highest grade of open hearth cast steel for gears, and a special grade of hammered steel for pinions, is absolutely necessary.
—R. D. Nuttall Company, Pittsburg, Pa.

VAN DORN & DUTTON GEARS AND PINIONS. The best quality of open hearth steel castings is used in making these gears. Heavy patterns are employed, either split or solid, as required, for all types of motors. The pinions are made from hammered steel billets, high in carbon, accurately machined and teeth cut with standard B. & S. cutters. (See cut in advertisement.)
—The Van Dorn & Dutton Company, Cleveland, Ohio.

GENERATORS, ALTERNATING CURRENT

BULLOCK BELTED TYPE ALTERNATORS. All of these generators are of the revolving field type; belted machines are made in a wide range of sizes for 60 cycles and 25 cycles, single, two or three phase. The largest 3-phase belted alternator is 750 Kw at 360 r.p.m. the smallest, 50 Kw. at 1,200 r.p.m. Fields are of copper strip wound on edge and are designed for 120 volt excitation. The collector rings are of cast copper with at least two carbon brushes for each ring. All armature coils are insulated by a special process whereby the insulation is formed under pressure in steam heated moulds.
—Allis-Chalmers Company, Milwaukee, Wis. (Electrical Department, Bullock Electric Manufacturing Company, Cincinnati, Ohio.)

BULLOCK ENGINE TYPE ALTERNATORS. These alternators are built for 60 or 25 cycles, single, two or three phase, in sizes from 110 Kw. at 277 r.p.m., to 3,500 Kw. at 75 r.p.m. Wound for all standard voltages and designed for direct connection to high or low speed steam engines. They are not provided with base, bearings or shaft, but adjustable sole plates are supplied whereby the stator can be accurately centered. In machines of large diameter, the stator frame is split horizontally and the copper collectors rings for large machines are made in halves. The field poles are attached to a spider that is entirely separate from the engine flywheel.
—Allis-Chalmers Company, Milwaukee, Wis. (Electrical Department, Bullock Electric Manufacturing Company, Cincinnati, Ohio.)

BULLOCK FLYWHEEL ALTERNATORS. These are similar to engine type machines except that the field

poles and coils are mounted directly on the rim of the engine flywheel [illegible] They are built in the larger sizes only, 500 Kw. at 100 r.p.m., being the smallest standard machine, and 5,000 Kw. at 75 r.p.m., the largest. [illegible] field winding, etc., is the same as for engine-type alternators. [illegible]

—Allis-Chalmers Company, Milwaukee, Wis. (Electrical Department, Bullock Electric Manufacturing Company, Cincinnati, Ohio.)

BULLOCK TURBO-ALTERNATORS. These turbo-alternators are designed for direct connection to Allis-[illegible] to 7,500 Kw. [illegible] radial slots in which the field exciting coils are placed. [illegible] The stator is built up of annealed sheet steel punchings, and ducts are provided in the core through which air is forced by the revolving field. Standard turbo-alternators are [illegible] 25 [illegible]

—Allis-Chalmers Company, Milwaukee, Wis. (Electrical Department, Bullock Electric Manufacturing Company, Cincinnati, Ohio.)

BULLOCK WATER-WHEEL TYPE GENERATORS (ALTERNATING CURRENT). These genera-[illegible] in having only two bearings. The shaft is extended for [illegible] The general construction is the same as for belted machines, but in some cases where peripheral speeds are very high, the field spider is made with a laminated rim. The outputs range from 50 Kw. at 1,200 r.p.m. to 5,000 Kw. at 300 r.p.m. The arrangement of collector rings and brushes is the same as for belted machines, and excitation is at 120 volts.

—Allis-Chalmers Company, Milwaukee, Wis. (Electrical Department, Bullock Electric Manufacturing Company, Cincinnati, Ohio.)

GENERAL ELECTRIC ALTERNATING-CURRENT GENERATORS. These are made in all types. Direct driven, belt driven, revolving field and revolving armature. The direct driven revolving field alternator is particularly adapted to street railway station work. The concentration of energy in large size alternators of this class insures high efficiency with economical operation. The stationary armature mounted on rails may be moved, exposing field windings for easy inspection or repair. The armature coils are readily replaceable in case of accident. The field coils in the larger sizes are wound of copper ribbon on edge, insuring great solidity and low temperature rise. The company's alternators are adapted to winding for very high or low potentials.

—General Electric Company, Schenectady, N. Y.

NATIONAL ALTERNATORS. These are all of the revolving field type, the armature being stationary and easily accessible. The difficulties of properly insulating the armature coils of high tension alternators are, therefore, eliminated, as the windings are not subject to any mechanical strains, nor are sliding contacts necessary for the armature current. The revolving fields on the engine type machines are of large diameter, which gives additional flywheel effect to the engine. The construction of the field coils makes them practically indestructible, and being supplied with a low voltage current, they can be easily insulated.

—National Electric Company, Milwaukee, Wis.

WESTINGHOUSE ALTERNATING-CURRENT GENERATORS. The alternating-current generators of this company range from 30 kw. capacity up, with either field or armature rotating, and for direct connection or belt driving. The successful construction of alternating-current generators for the Niagara Falls power plant and for the Manhattan and Subway Divisions of the Interborough Rapid Transit Company of New York, of much larger capacity than ever built before, demonstrates the ability of this company to design and construct machines of any capacity demanded by modern practice

—Westinghouse Electric & Manufacturing Company, Pittsburg, Pa.

WESTINGHOUSE TURBINE TYPE GENERATORS. The high economy of the steam turbine at light loads has made practicable the installation of larger units in central stations, with the result that fewer units are necessary and a great saving in equipment cost and better commercial efficiency made possible. They are constructed in sizes and with winding appropriate for every class of alternating-current work. Five 7,500 kw. machines are now in course of construction by this company.

—Westinghouse Electric & Manufacturing Company, Pittsburg, Pa.

GENERATORS, DIRECT CURRENT

BULLOCK ENGINE TYPE GENERATORS (DIRECT-CURRENT). [illegible] coils are held in place by wedges, thus dispensing with [illegible]

—Allis-Chalmers Company, Milwaukee, Wis. (Electrical Department), Bullock Electric Manufacturing Company, Cincinnati, Ohio.

BULLOCK RAILWAY GENERATORS. These railway generators, both belted and engine types, are similar in general construction to the standard lighting and power generators, but the overload and sparking guarantees are more liberal. They will stand safely momentary overloads of 75 to 100 per cent. Standard generators are over compounded to give a rise in voltage from 525 volts [illegible] range from 100 Kw. at 900 r.p.m. to 500 Kw. at 375 r.p.m. engine type generators are built for any output from 85 Kw. up.

—Allis-Chalmers Company, Milwaukee, Wis. (Electrical Department, Bullock Electric Manufacturing Company, Cincinnati, Ohio.)

CROCKER-WHEELER GENERATORS. Absolute reliability in severe conditions [illegible] generators. This company has developed a line of machines especially for this service, which in design, material and workmanship cannot be improved upon, and which are therefore thoroughly reliable. Its patented brush-holder (one of the many strong features of the C-W railway generator) is in use on a number of different competitors' machines; improvement in operation has resulted in each case. The company publishes bulletins fully describing its railway generators and various notable plants where they are installed. (See advertisement).

—Crocker-Wheeler Company, Ampere, N. J.

GENERAL ELECTRIC GENERATORS, DIRECT CURRENT. Direct current generators are manufactured for all purposes, and in all desirable types, including belt driven and direct driven. The latter are built in a form particularly suited to railway power generation. The field poles may be slipped out laterally without disturbing the armature. The pole tips are so shaped as to secure sparkless commutation. Excellent ventilation is attained by fan blades which are cast integrally with the spider The compounding is so arranged that with proper engine governors, machines in parallel divide all load fluctuations in exact ratio with their relative capacities, without manipulation of field rheostats. (See also Alternators.)

—General Electric Company, Schenectady, N. Y.

NATIONAL DIRECT CURRENT GENERATORS. Built for lighting, power or railway service in all capacities. Combine those features of design, material and construction which have been found most desirable by past experience. They are liberally rated, compact, substantial in construction and present a neat and pleasing appearance. The mechanical as well as the electrical features have received careful consideration. The design is such that there is no superfluous metal, thus reducing the weight to a safe minimum for a given output, and making these generators efficient and reliable.

—National Electric Company, Milwaukee, Wis.

WESTINGHOUSE DIRECT-CURRENT GENERATORS. These generators are manufactured in the self-contained and engine types, both having the same mechanical and electrical features, such as multipolar frames, bolted-in pole pieces, slotted armature cores, balanced magnetic circuits, and the arrangement of brush holders and shifting devices. Designed for railway, lighting or industrial service at 125, 250 and 550 volts. The self-contained machines are alone adapted for belt driving, while both types may be run direct connected. Engine type generators have been built from 6 kw. to 2,700 kw., and machines with bearings are standard from 100 kw. to 300 kw. although larger capacities may be obtained if desired. Type S direct-current generators with bracket bearings are built from 2 kw. to 85 kw.

—Westinghouse Electric & Manufacturing Company, Pittsburg, Pa.

GENERATORS, GAS

(See Gas Producers.)

GENERATING SETS

SECOR OIL-ELECTRIC GENERATING SETS. The Secor oil-electric generating plants are well adapted for [illegible] "peak load" hours. These plants [illegible] oil into [illegible] in amperage or temperature.

—Marine Engine & Machine Company, New York.

STURTEVANT GENERATING SETS. Constructed in thirty-six sizes [illegible] from 5 to 100 kw. direct connected. The vertical [illegible] engines were designed to meet the rigid [illegible] the U. S. Navy [illegible] efficiency of 31 pounds per kw. hour. These engines, as [illegible] carrying 50 per cent. momentary overload and 25 per cent. excess for two hours without sparking or undue heating. The smaller [illegible] adapted to service as boosters. (See also Engines, Steam.)

—B. F. Sturtevant Company, Hyde Park, Mass.

GENERATORS AND MOTORS, SPARE PARTS OF

CROCKER-WHEELER SPARE PARTS FOR GENERATORS AND MOTORS. As this company's [illegible] spare parts may be ordered from stock and supplied without delay. [illegible] parts of assembled machines, and undergo, before shipment, the same exacting tests.

—Crocker-Wheeler Company, Ampere, N. J

GLASS

ZAHFEST GLASS. Extra tough, non-breakable. A special annealed glass particularly adapted for ventilators, car windows, lamps, peep holes and other places where rough usage or extreme variations in temperature make the use of ordinary glass impracticable or impossible. By combining certain rare metals with the usual ingredients required for making high grade glass and afterward passing the product through a special annealing or toughening process, a glass of great strength is produced. "Zahfest" glass, as it is called, can be hammered or thrown about with impunity, and even when heated to the temperature of high pressure steam may be plunged into cold water without fear of breakage. Having very great tensile strength with a maximum degree of transparency and refractive power, it is particularly well adapted for the manufacture of the "Reflex" water gages now so generally used with high pressure steam boilers.

—The Wm. T. Bonner Company, Sole U. S. Agents, Boston and New York.

GRATES

(See also Mechanical Stokers.)

THOMPSON'S DUMPING GRATE. With this grate a fire can be cleaned in from four to six minutes—according to size—without waste. It is fitted up with a very substantial [illegible] everything being independent [illegible] It is made to dump in two, four or six sections according to size of furnace, and is very easily handled. The frame and rockers are not subject to intense heat and are practically indestructible, the grates are interchangeable and can be renewed when necessary at very small cost.

—Richard Thompson & Company, New York.

THOMPSON'S TWENTIETH CENTURY SHAKING AND DUMPING GRATE. This grate is very simply and substantially constructed. It is fitted up with a frame and adjustable legs in the same manner as the Thompson dumping grate. This, however, can be used for shaking and dumping, and is preferable for the larger grades of anthracite and bituminous coal, where a shaking grate is efficient and practicable. For small furnaces this grate is operated in one and in very large furnaces in four sections.

—Richard Thompson & Company, New York.

(INDEX TO ADVERTISERS, PAGES 15 AND 18)

GONGS

(See "Bells and Gongs")

GRAPHITE PAINTS

(See Paints and Varnishes.)

GREASES

(See "Lubricants")

GRINDERS

BROWN EMERY WHEELS. Special emery wheels for slow speed work with the Brown hand power grinder and flexible shaft. Will save time and money over the ordinary wheel made for shop use at high speed. (See advertisement.)
—HAROLD P. BROWN, NEW YORK.

PORTABLE HAND POWER GRINDERS. These strong, simple and compact machines are designed for use with the Brown flexible shafts on track construction, rail bonding, etc. They are very largely used for preparing rail contacts for plastic and soldered rail bonds, electric and cast welding. Two laborers with this machine can do cheaper work than the sand blast in preparing contacts. (See advertisement.)
—HAROLD P. BROWN, NEW YORK.

ROYAL CARBORUNDUM GRINDER. A hand power machine geared to high speed, easily put into position along track or in the shop; designed for maintenance of way work, rail bonding or bridge work. Grinding wheel is carborundum, fastest cutting abrasive known; will not glaze, light pressure required. All spindles are steel. Size of wheel, 4 in. dia., 1 in. face. Size of machine, 11 in. high, 7½ in. wide. Will sharpen all kinds of tools, including drills. (See illustration in advertisement.)
—ROYAL MANUFACTURING COMPANY, LANCASTER, PA.

GUARDS, CATTLE

(See Stock Guards.)

GUMS

CLARK JOINT GUM. This material is cut from pure sheet rubber. It is put up in ½ lb. boxes in strips about 1 ft. long and ⅝ in. wide.
—EASTERN ELECTRIC CABLE & WIRE COMPANY, BOSTON, MASS.

GUTTA PERCHA OR RUBBER INSULATION

(See Insulators and Insulating Compounds.)

HANDLES, CONTROLLER

(See "Controller Regulators")

HARPS, TROLLEY

BAYONET DETACHABLE TROLLEY HARP Consists of stem firmly riveted in pole and harp head which is instantly attached or detached by passing sleeve of head over stem, compressing lock spring until lock pin passes through vertical internal grooves to upper face of collar and the head is given a quarter turn, when the lock spring firmly seats the lock pin in the locking recess. Being instantly interchangeable, a head, with wheel and parts all properly adjusted, is usually carried in car so that delays on account of broken wheel or worn out parts are entirely eliminated. No tools necessary to make change.
—BAYONET TROLLEY HARP COMPANY, SPRINGFIELD, OHIO

KALAMAZOO TROLLEY HARPS. These harps are made to collect the current from the wheel and deliver it to the motor through the intervening pole and wire, with the least possible friction. To do this successfully the contact surfaces are large enough to insure a free flow of the current. To prevent injury to the contact springs, they are placed outsides the harp, and do not come in contact with the wheel at any time except through the medium of the heavy washers, which take all the wear. These are easily changed when worn out.
—THE STAR BRASS WORKS, KALAMAZOO, MICH.

LIBERTY TROLLEY HARP. This harp permits the wheel to turn freely in rounding curves, thereby avoiding the grinding contact which rapidly wears out the wheel and wire. Other important advantages are the arrangements for readily removing and replacing the trolley wheel, and for insuring continuous contact between the wheel and harp to prevent arcing. The ease in rounding curves is secured by the use of a spring in the harp shaft carrying the wheel.
—FRANK RIDLON COMPANY, BOSTON, MASS., GENERAL U. S. SELLING AGENTS.

MULTI-AMPERE TROLLEY HARP. This harp is made for high speed roads where high amperage is used. Consists of very large area of contact for the trolley wheel, having a 3 in. contact for each side of the wheel. This is also a perfectly detachable harp, containing only one additional part over the ordinary standard harp.
—THE RECORDING FARE REGISTER COMPANY, NEW HAVEN, CONN.

UNION STANDARD TROLLEY HARP. The Union Standard list of harps includes twenty-five forms capable of accommodating a wide range of wheels; all are fitted with patented contact springs or brushes, hardened steel axle pins and cold-rolled steel shank. The frames are made either of brass or a special grade of malleable iron and designed to combine strength and light weight, two very necessary features to be considered in modern street railway practice.
—R. D. NUTTALL COMPANY, PITTSBURG, PA.

HEADLIGHTS

CROUSE=HINDS HEADLIGHT. One of the strongest objections to an arc headlight on a double-track system is the fact that when two cars meet, each motorman is blinded by the headlight on the other car. In this interurban type headlight this difficulty has been overcome by constructing the reflector so that the light is projected in a narrow beam down the track, and not spread over both tracks. As many cities do not permit the use of arc headlights within the city limits, this headlight is provided with an incandescent attachment which can readily be turned on or off at will by the motorman.
—CROUSE-HINDS COMPANY, SYRACUSE, N. Y.

DAYTON INCANDESCENT HEADLIGHTS. Are either set into or attached on the outside of dash; provided with an adjustable socket holder, whereby lamp can be adjusted so as to be in focus and obtain best results. These headlights are practically indestructible, as the case is made of heavy cast iron. The glass holder is of cast bronze or malleable iron, as desired, so there is absolutely nothing to get out of order.
—THE DAYTON MANUFACTURING COMPANY, DAYTON, O.

DAYTON ARC HEADLIGHTS. Designed for use on urban and interurban traction lines. Made to hang on the outside of dash or to set in the dash; manufactured in several sizes, 10 in. being the smallest, 16 in. the largest. Are simple in construction, made strong and durable, have many recent improved features, generate from two to five thousand candle power, consume three amperes, prevent accidents, eliminate slitigation, and enable the motorman to see well and feel easy.
—THE DAYTON MANUFACTURING COMPANY, DAYTON, O.

GENERAL ELECTRIC HEADLIGHTS. These arc headlights are designed for street railway, suburban and interurban service, and are made of sheet steel, strengthened by a heavy cast iron door frame. They are compact but of sufficient depth to insure proper reflection. Simple clutch mechanism is used for feeding carbons. The light may be run in series with incandescent lamps, or with a resistance. It is easily trimmed and focussed. The enclosing globe is mounted with springs, avoiding breakage, due to jars. The arc throws a light 1,000 or 1,500 feet ahead of car. A screen can be provided to modify the strength of the light where necessary. The headlights are provided with suitable handle, hooks, rubber bumpers and connecting cable.
—GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

RIDLON INCANDESCENT HEADLIGHT. This is a neat and durable headlight, the case being made of cast iron and the reflector of planished copper nickel plated. The outside rim is a brass casting and therefore not easily bent or broken. The outside diameter of the rim is 10¾ in. and takes a glass of 10 in. in dia. The headlight attaches to the outside, thus doing away with the necessity of cutting away the dasher. These lights are furnished with porcelain receptacles for Edison base lamps unless otherwise specified.
—FRANK RIDLON COMPANY, BOSTON, MASS.

ST. LOUIS ARC HEADLIGHTS. This headlight weighs 22 lbs., complete, and is easily carried from end to end of car. It gives a strong, steady light of 2,500 cp. As an equalizer or governor it is necessary to use a very compact resistance in connection with these lights to take up the difference in voltage across the arcs and the voltage of the line. The resistance coils are wound according to the number of lights which are desired in series. The mechanism of the lamp is positively automatic; construction simple and strong; low cost of maintenance; economy in current consumption; steadiness of light, and longevity are some of the features of this arc headlight.
—ST. LOUIS CAR COMPANY, ST. LOUIS, MO.

S-H STANDARD HEADLIGHT. This headlight consists of a malleable iron shell cast in one piece having a lug formed to take a standard porcelain receptacle and a flange cast integral with the shell to support the highly polished parabolic reflector furnished. This reflector is recessed at base to permit the incandescent lamp to enter the receptacle through it, and so arranged as to bring the point of greatest brilliancy of the filament at the focus of the parabola. A bronze ring containing the glass front is held to the frame by a spring catch so that it can not jar loose. (See advertisement.)
—STUART-HOWLAND COMPANY, BOSTON, MASS.

HEATERS, CAR (ELECTRIC)

CONSOLIDATED ELECTRIC HEATERS OF SPECIAL TYPES. Among these are the following: Heater No. 118M, originally designed to meet the specifications of and adopted by The Manhattan Railway Company, of New York City, and contains the company's standard spiral coil construction, but there are three independent circuits through each heater, while the coils are all alike and regulation is secured by the operation of one, two or three circuits, as required. Nos. 118WS and 115W for longitudinal seats without risers; No. 143LL and No 146F for longitudinal seats with risers; and No. 192MS for motorman's cab.
—CONSOLIDATED CAR HEATING COMPANY, ALBANY, NEW YORK, CHICAGO.

CONSOLIDATED ELECTRIC HEATERS FOR CROSS=SEAT CARS. The heater known as No. 192 was recently designed for use where a small heater operated at a comparatively low temperature is required. With this type, all lead wires are brought out at one end of the heater, and then carried in moulding along the side of the car. This is accomplished by running a copper wire through the porcelain spindle, connecting it at one end to the heater coil, and at the opposite end to the lead wire, This heater is considerably longer than many cross-seat heaters, and operated at a comparatively low temperature to prevent any overheating of seats. The cases are of heavy, perforated sheet steel, and ends of cast iron. Other styles for this service are No. 118W, No. 192H and No 192W.
—CONSOLIDATED CAR HEATING COMPANY, ALBANY, NEW YORK, CHICAGO.

CONSOLIDATED ELECTRIC HEATERS FOR CROSS=SEAT CARS AND PARLOR CARS. This heater (No. 93T) is designed to attach to the truss plank, occupying about the same space as steam pipes in a railroad coach. It is particularly adapted to cross-seat cars and parlor cars. The heating element consists of the company's standard spiral coil. The lead wires are carried directly from the heater to a grooved moulding, there being no exposed wires. Coils are covered by an insulated iron case of attractive design, finished in gold bronze. For private cars having dark trimmings, the heater case is sometimes finished in copper. With this heater it is impossible to overheat the seats, the heaters being placed near the floor and the maximum consumption of a 30 in. heater being only 500 watts. This heater is also adapted for express compartments of combination cars. Other types for this work are No. 203H and No. 203M.
—CONSOLIDATED CAR HEATING COMPANY, ALBANY, NEW YORK, CHICAGO.

GOLD ELECTRIC HEATER FOR BAGGAGE AND CROSS SEAT CARS. This heater is designed for attachment to the riser or heel board when undesirable to set heater in panel, for use in baggage and cross seat cars where it is necessary to place a heater between the seats and against the truss plank. The construction permits a very free circulation of air through and around the resistant coils. The air in passing through the heater is thoroughly divided by the heater wires and each little particle of air, by reason of the rapid circulation developed, carries its share of the heat out into the space to be heated
—GOLD CAR HEATING & LIGHTING COMPANY, NEW YORK.

GOLD IMPROVED STANDARD ONE DEGREE ELECTRIC HEATER. This heater is fitted with one coil and arranged to provide only one degree of heat. The company is now furnishing this type of heater for the London Underground Railways, where only one intensity of heat is required. There are a number of places where this type of heater may be used. In localities where but little heat is needed, just enough to take the chill off the car, and even in cities where a large enough number may be supplied per car, such an equipment should prove very satisfactory.
—GOLD CAR HEATING & LIGHTING COMPANY, NEW YORK.

GOLD PANEL TYPE ELECTRIC HEATER. In this heater three degrees of heat are obtained by the use of two coils, the smaller one of which provides one-third of

the heat and the larger one two-thirds. Both heaters taken [illegible]
[illegible]
—GOLD CAR HEATING & LIGHTING COMPANY, NEW YORK.

GOLD RESISTANT COIL AND SUPPORT USED IN ELECTRIC HEATERS. The insulated crimped steel [illegible] of sediment to rest upon it. This latter feature makes it very sanitary and much more desirable than a bulky support that fills with dust and causes the diffusion of un[illegible]
—GOLD CAR HEATING & LIGHTING COMPANY, NEW YORK.

J-M CAR HEATERS. In the [illegible] system of electric car heating, the heaters are distributed over [illegible] vice. The resistance wires are wound upon specially [illegible] The metal casings are steel or iron japaned, silver or gold bronzed as per specifications. All of the car heaters are controlled by the manufacturers' double break knife switch. [illegible] closed fuse. (See advertisement.)
—H. W. JOHNS-MANVILLE COMPANY, NEW YORK.

McELROY SPIRAL HEATER COILS. All of the resistance coils used in this company's heaters are made of specially galvanized iron wire, which experience has [illegible] of the large radiating surface which is made possible by the McElroy Spiral coil construction, which gives the [illegible] is only heated to a moderate degree, thus avoiding the excessive temperature to which a high resistance wire is necessarily subjected, and which invariably crystallizes the wire, especially when accompanied by vibration. A property [illegible] rise of temperature. By reason of this property these [illegible]
—CONSOLIDATED CAR HEATING COMPANY, ALBANY, NEW YORK, CHICAGO.

SIMPLEX ELECTRIC CAR HEATERS. These are enameled heaters consisting of cast-iron plates, on one side of which is embedded the resistance wire in enamel fused to the iron. The enamel holds the wire firmly in place, furnishes high insulation, yet permits quick conduction of heat. The most compact and desirable form for cross-seat cars. For side-seat cars, the standard "F" type Simplex panel heaters have the heating coils made only of nickel-copper wire which will not rust nor oxidize and coils cannot creep nor produce arcs.
—SIMPLEX ELECTRIC HEATING COMPANY, CAMBRIDGEPORT, MASS.

HEATERS, CAR, HOT WATER AND STOVES

DORNER CAR HEATERS. The Dorner combination coil and water jacket hot water heater heats quickly, uses minimum amount of coal, requires little attention, has self-feed, take up small space and will keep car at 70 degs. in the coldest weather. (See advertisement.)
—THE DORNER MANUFACTURING COMPANY, CHICAGO, ILL.

GOLD SEALED JET ACCELERATOR SYSTEM OF HOT WATER CIRCULATION. Used for warming interurban cars and cars of similar or larger capacity. Its arrangement is simple and its operation very easy. It takes up no space within the car nor on the platform and it warms the car in the most effective manner. The apparatus is protected by a special safety valve. The generator is located beneath the floor, where it is out of the way and able to work more effectively than if placed within the car or on the platform. Being outside the car, no dirt or ashes, so noticeable with other heaters, can accumulate. The fire area is large and ample and the magazine will hold enough coal to operate the system for twelve hours. The water jacket above and surrounding the fire space gets the full benefit of all the coal used.
—GOLD CAR HEATING & LIGHTING COMPANY, NEW YORK.

PETER SMITH HOT WATER HEATERS. Made in three sizes and three styles, viz.: Magazine coil heater, magazine water jacket heater, and open fire coil heater. [illegible]
—[illegible]

"RADIANT" CAR FURNACE. [illegible] inside car. (See advertisement.)
—[illegible]

HEATERS AND PURIFIERS, FEEDWATER

(Including Feed-Water Regulators.)

COCHRANE FEEDWATER HEATERS AND PURIFIERS. Cochrane heaters are valuable appliances in railway plants, whether the engines are operated condensing or non-condensing. They will heat the feed water to the boiling point with about one-seventh less exhaust steam than is required by the ordinary type of heaters, or where the supply of exhaust steam is limited they will heat the feed water to a higher temperature than will the ordinary heaters. They will, therefore, save more coal than can a closed heater under the same conditions. They also save water—usually from 10 to 15 per cent. of all the water required by the boilers. Over 3,000,000 hp. of "Cochranes" in present successful and satisfactory operation [illegible]
—HARRISON SAFETY BOILER WORKS, PHILADELPHIA, PA.

GOUBERT WATER TUBE FEEDWATER HEATERS. This apparatus is [illegible] iron water chambers, connected by a cluster of seamless drawn brass tubes rigidly secured at their ends to the tube plates by a roller tube expander, in the same manner that boiler tubes are secured to the heads. These are the only heater parts under boiler pressure. The cast iron shell surrounding the tubes merely provides an envelope for the exhaust steam and is not subjected to any particular pressure. It does not interfere with the expansion of the tubes.
—THE GOUBERT MANUFACTURING COMPANY, NEW YORK.

MURRAY FEEDWATER HEATERS AND PURIFIERS. Murray feedwater heaters are made of both the closed and open types and are effective and durable. Not being patented they are sold at lower prices.
—THE MURRAY IRON WORKS COMPANY, BURLINGTON, IA.

PHOENIX HEATERS. Feedwater heaters for power stations are among the manufactures of this company.
—PHOENIX IRON WORKS COMPANY, MEADVILLE, PA.

SORGE-COCHRANE FEEDWATER SYSTEM. This system is a comprehensive and practical method for preventing the formation of hard scale in boilers, while heating the feed supply to the highest temperature obtainable with exhaust steam. It takes the place and performs all of the functions of a feed water heater, while providing means for both mechanical and chemical treatment of the impure water. It is a hot-treatment process, with all [illegible] cost for obtaining thorough purification. It is simple, easy to operate and requires no extra attendants.
—HARRISON SAFETY BOILER WORKS, PHILADELPHIA, PA.

STILWELL FEEDWATER HEATER. A device in which the exhaust steam from the main engines or the auxiliaries is used to heat the boiler-feed water. This not only effects a considerable saving in fuel and feed water, but heating the water precipitates most of the matter that would otherwise incrust the boiler, thus obviating much of the expense and labor usually required for cleaning and repairs. The heater itself is arranged to be easily cleaned and recent improvements in this heater absolutely prevent oil in the exhaust steam from reaching the boiler.
—PLATT IRON WORKS COMPANY, DAYTON, OHIO.

WAINWRIGHT FEEDWATER HEATERS. These represent the most advanced ideas in heater construction. Even flow of both steam and water in counter currents through straight, clean, tight corrugated tubes. The high rate of flow over the corrugated surfaces gives a rate of heat transmission per sq. ft. of surface said to break all records and provides a scouring and cleaning action on the tubes. [illegible] Perfect accessibility for any repairs and the cleaning of water chambers. A large amount of horse power in a small space.
—ALBERGER CONDENSER COMPANY, NEW YORK.

WETHERILL OPEN FEEDWATER HEATER. [illegible] of feed supply. The water after being heated flows to the [illegible]
—ROBERT WETHERILL & COMPANY, CHESTER, PA.

WETHERILL PATENT FEEDWATER HEATER. [illegible] as the coils are made without joints and united at ends to brass manifolds, forming inlet and outlet pipes. The [illegible] contract and expand without liability to fracture, while [illegible] practically indestructible. The coils are encased in steel [illegible] arranged to set either horizontal or vertical.
—ROBERT WETHERILL & COMPANY, CHESTER, PA.

WETHERILL VERTICAL WATER-TUBE FEEDWATER HEATER. [illegible] drawn copper, expanding in steel tube heads; these being subjected to internal pressure cannot collapse or leak. There is no straining action from contraction and expansion of the parts; one end only of the nest of tubes is rigidly secured, the other end is free to move and adjust itself to temperature variations. The feed-water enters the bottom, which, in the upward passage through the tubes [illegible] exhaust steam, raises the feed-water to the highest temperature and allow [illegible] tate to bottom and collect in settling chamber, where they can be blown off, thus purifying the feed-water in its passage through the heater.
—ROBERT WETHERILL & COMPANY, CHESTER, PA.

C. H. WHEELER IMPROVED FEEDWATER HEATER. Vertical and horizontal designs; closed type; steam chamber provided with a special steam belt; tubes of seamless drawn brass.
—C. H. WHEELER CONDENSER AND PUMP COMPANY, CHICAGO, PHILADELPHIA, NEW YORK, SAN FRANCISCO.

WHEELER FEEDWATER HEATERS. The higher in temperature that feed water for the boilers can be fed to them, the [illegible] tion. Feed water heaters are designed to accomplish this purpose, by transferring the heat in the exhaust steam in the auxiliary machines to the feed water. These are built in various sizes, either of the vertical or horizontal type, for any pressure, and can be arranged either in primary, auxiliary system or compound. A long experience in this line has enabled this company to perfect its designs, with the most economical results.
—WHEELER CONDENSER & ENGINEERING COMPANY, NEW YORK.

WILLIAMS AUTOMATIC FEEDWATER REGULATOR. This feed water regulator permits a fluctuation in the water level not exceeding ½ in. in most cases. The results of keeping a constant water level are: A fuel saving of at least 3 per cent, decreased engine repairs and a smaller oil bill, both due to the use of dry steam, less boiler repairs, due to the lessened expansion and contraction.
—WILLIAMS GAUGE COMPANY, PITTSBURG, PA.

HEATING AND VENTILATING APPARATUS

(See also Mechanical Draft.)

AMERICAN DISTRICT STEAM COMPANY, LOCKPORT, N. Y. Originator of central station heating by underground pipes, constructor of heating plants and manufacturer of all steam devices; also builder of systems of underground piping for railroad car yard heating.

(CONTINUED ON PAGE XXV.)

HEATING AND VENTILATING APPARATUS—Continued.

"ABC" HEATING AND VENTILATING APPARATUS. This company's fan or blower system is especially adapted to the heating of large buildings, including railway shops and barns. The steam pipes are banked into heaters and not scattered around the building. A uniform temperature and frequent air change are among other advantageous features. In car barns the system is frequently so arranged that a current of heated air is forced into the car pits, rendering it easy to thaw out cars that are frozen up, and to dry out "grounded" cars in wet weather.
—AMERICAN BLOWER COMPANY, DETROIT

GREEN AIR HEATER. This device operates on the same principle utilized in the Green fuel economizer, in that it makes it possible to use the heat otherwise wasted in the flue gases from the boilers to heat air for drying out insulation, heating car barns, round houses, etc. The heated dry air when delivered into the pits under the cars during winter weather quickly melts off the snow and ice and reduces the time required for repairs and inspection. This apparatus may be installed in connection with the fuel economizer.
—THE GREEN FUEL ECONOMIZER COMPANY, MATTEAWAN, N. Y.

STURTEVANT HEATING AND VENTILATING APPARATUS. The hot blast apparatus consists of a steel plate fan arranged to be driven by belt or by direct attached engine or motor, and a steel pipe heater through which the air is drawn or forced, and thence discharged through ducts to the points of delivery. The high velocity of the air across the pipes increases their efficiency from three to five times that secured with direct radiation. The entire heating surface is massed under the control of a single valve. The apparatus utilizes either live or exhaust steam. An excess of pressure is maintained within the building, and outward leakage is the result.
—B. F. STURTEVANT COMPANY, HYDE PARK, MASS.

HOISTS

(See "Cranes, Hoists and Lifts")

HOSE BRIDGES

"OHIO BRASS" HOSE BRIDGE. This fire hose bridge accommodates four lines of fire hose. Made entirely of steel and malleable iron. Can be quickly attached to tee or girder rails. Will bear weight of heaviest interurban cars. (See page 626 of Bulletin No. 1; also advertisement.)
—THE OHIO BRASS COMPANY, MANSFIELD, OHIO.

HOSE, COTTON

BOYLE COTTON ELECTRIC HOSE. Used for insulating purposes. This hose is of full standard size and quality, especially close woven and full weight.
—JOHN BOYLE & COMPANY, NEW YORK.

HYDRAULIC MACHINERY

ALLIS-CHALMERS STANDARD OIL GOVERNORS FOR WATER TURBINES AND IMPULSE WHEELS. Self-contained automatic governors, operating with oil pressure produced in a pump attached to the governor, are entirely independent of the operating water. Can also be made with all parts perfectly interchangeable. They are provided with fly-balls or speed recorders. They have a synchronizing attachment which permits of paralleling the generators easily from the switchboard. Each governor is a complete piece of apparatus that does not require skilled attention during operation.
—ALLIS-CHALMERS COMPANY, MILWAUKEE, WIS.

ALLIS-CHALMERS RELIEF VALVES FOR HYDRAULIC POWER PLANTS. Hydraulic power plants, utilizing high falls, have penstocks of considerable length. Effective automatic governors close the speed gates of the turbines or impulse wheels within a few seconds. This causes a dangerous shock to the penstocks. In an effort to prevent these shocks, a relief valve is generally used, which is operated by a spring adjustable to the maximum pressure allowed. A spring, however, can not operate the valve until it is compressed by the increased pressure in the penstock. Dangerous shocks result therefore from the use of such devices. The Allis-Chalmers relief valve ("pressure regulating apparatus") has no spring, but is directly connected with the governor, so that it opens without increase of pressure. The valve does not open when the governor closes the speed gate slowly, and if opened slowly closes itself even if the governor remains in its former opened or closed position. This apparatus is a water saving relief valve and passes just sufficient water to prevent shocks.
—ALLIS-CHALMERS COMPANY, MILWAUKEE, WIS.

FRANCIS TYPE CENTRAL DISCHARGE HYDRAULIC TURBINES. Escher-Wyss & Company designs are particularly adapted for direct-connection to electric generators for power production and easily subject to close regulation. Adapted to high or low heads of water and made in any size required. Set horizontally or vertically as may be required and adapted to the use of draft tubes. Special attention is called to the design and fitting together of the guide vanes in these turbines so that when the speed gate is closed it forms, with the revolving runner, a hydraulic brake and stops the turbine without the need of a friction brake.
—ALLIS-CHALMERS COMPANY, MILWAUKEE, WIS.

ESCHER-WYSS IMPULSE WATER TURBINES. Turbines for the utilization of waters with high heads and made with several shapes of buckets or vanes according to the height of fall, quantity of water and the amount and character of work to be performed. Choice of the proper design can be made only by engineers of skill and experience. The experience gained by Escher-Wyss & Company and the skill of their licensees guarantee success.
—ALLIS-CHALMERS COMPANY, MILWAUKEE, WIS.

VICTOR TURBINE WATER WHEELS. These wheels are built singly or in pairs and with horizontal or vertical shafts. They are built in a great variety of sizes and styles, including both low-head work and high-pressure work, such as is encountered in some of the recent power developments on the Pacific coast. More machines of this type are in use than of any other make.
—PLATT IRON WORKS COMPANY, DAYTON, OHIO.

INDICATORS, STEAM

TWENTIETH CENTURY INDICATOR. The general design of this indicator is not new, but in construction the company has made such changes as its experience has shown to be desirable. Great care has been taken to have each part properly proportioned for the duty to be performed, giving strength and weight where required, and the working parts of such light weight that a quick and accurate response to the steam pressure is always insured. The body of the indicator is made strong without undue weight, so that there will be practically no vibration of the instrument when in use. The company makes but one grade, on the principle that the best is none too good.
—RICHARD THOMPSON COMPANY, NEW YORK.

IMPREGNATING COMPOUNDS

(See also "Vacuum Impregnating Apparatus")

STANDARD IMPREGNATING COMPOUNDS. These compounds are solids and used only in connection with vacuum drying and impregnating apparatus. They require liquefying under heat and in this state are forced by atmospheric pressure into a previously exhausted chamber. Possess high dielectric strength and ability to resist moisture. Made with dropping points from 90 deg. C. to 150 deg. C., and especially designed for impregnating railway motor field coils, magnet coils, air cooled transformer coils, etc. SPECIALTIES FOR ELECTRIC RAILWAY WORK—Impregnating Compounds Nos. 1, 2, 3 and 4.
—STANDARD VARNISH WORKS—NEW YORK, CHICAGO, LONDON—OR INTERNATIONAL VARNISH CO., LTD., TORONTO, CANADA.

O. B. TRANSFORMER COMPOUNDS. Used for impregnation of transformer coils designed to operate in oil baths. Possess high insulating properties and absolutely resist the action of hot mineral oils.
—STANDARD VARNISH WORKS—NEW YORK, CHICAGO, LONDON—OR INTERNATIONAL VARNISH CO., LTD., TORONTO, CANADA

INSTRUMENTS, ELECTRICAL MEASURING

KEYSTONE ELECTRICAL INSTRUMENTS. This line comprises indicating voltmeters, ammeters, wattmeters differential voltmeters, ground detectors, millivoltmeters, milliammeters and bond testers in switchboard and portable form for either direct or alternating current circuits. Made in all possible ranges from the lowest to the highest, the complete line covering seven distinct types of switchboard instruments in all standard and special finishes and five types of portables. Every instrument is accompanied by a signed certificate guaranteeing accuracy, durability and workmanship. (See illustrations in advertisement.)
—KEYSTONE ELECTRICAL INSTRUMENT COMPANY, PHILADELPHIA, PA.

SANGAMO WATTMETERS. These meters, of the mercury motor type, are simpler in construction than other direct current meters, owing to the absence of commutator, brushes, wound armature and heavy weight on the jeweled bearing. The armature shaft has a thrust of only one-fifteenth ounce against the jewel, which, therefore, suffers no injury from vibration or pounding of the meter support under the most severe conditions of service. The Sangamo meter is, therefore, well suited to the measurements of power taken by car motors. A valuable feature is the use of shunts with large capacity meters, rendering them very easy to install. (See advertisement.)
—SANGAMO ELECTRIC COMPANY, SPRINGFIELD, ILL.

SIMPLEX DIRECT CURRENT INSTRUMENTS. Unlike the ordinary instruments, these have no needle-sharp steel pivots to become rusted by moisture; no delicate jeweled bearings to become fractured by jars or continued vibration. The moving coil and the Simplex instrument are supported by yielding straight band conducting filaments. These filaments are made of a highly resilient and non-oxidizable patented bronze alloy. These two features, the yielding supports and the non-oxidizable conducting filaments, protect these instruments from any damage by jar, continued vibration or atmospheric change. They assure permanent accuracy in any position and under any condition.
—THE SIMPLEX COMPANY, NEWARK, N. J.

THOMSON RECORDING WATTMETERS FOR RAILWAY SERVICE. These wattmeters are constructed for permanent installation upon cars, for the purpose of recording accurately the energy used. High torque is secured by the use of laminated iron fields and a soft iron armature coil. An extremely light moving element and the use of diamond jewels ensure satisfactory operation under most severe operating conditions. The General Electric Company also manufactures a complete line of recording wattmeters up to 10,000 amps. capacity for measuring generator and total station output. The entire current is carried through copper field coils of highest conductivity, a construction which gives minimum losses and maximum accuracy. These meters are highly finished and arranged for mounting on the front of switchboard panels.
—GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

WESTINGHOUSE MEASURING INSTRUMENTS. This company manufactures instruments for direct and alternating current, of the switchboard, portable and precision type—including frequency meters; ammeters; voltmeters; integrating, indicating and prepayment wattmeters; ground detectors; power factor meters, and synchroscopes. The portable instruments are especially adapted for general testing purposes, and the precision instruments for accurate measurements in general laboratory work and the calibration of other instruments. The switchboard instruments are finished in different types, are in dust-proof cases and have long scales with large divisions.
—WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, PITTSBURG, PA.

WESTON ELECTRICAL MEASURING INSTRUMENTS. In all of the instruments the moving element is a light coil of wire on which is mounted an index or pointer, and through which a proper proportion of the current passes, tending to cause rotation of the coil in the magnetic field by which it is encompassed. For the direct current instruments, a permanent steel magnet is utilized for the field, and its design furnishes the means of producing a uniform field. The alternating current instruments call for a different type of field; a coil of wire suitably designed to give the required lines of force, effecting, in conjunction with the moving element, an operation on the "dynamometer principle." Notable characteristics of Weston instruments are their accuracy and economy of current consumption, combined with the excelling degree of mechanical and electrical workmanship and design. These instruments are made up as voltmeters, ammeters, wattmeters, ground detectors, milli-voltmeters, bond testers, galvanometers, laboratory standards, etc.
—WESTON ELECTRICAL INSTRUMENT COMPANY, WAVERLY PARK, NEWARK, N. J.

WESTINGHOUSE PREPAYMENT WATTMETERS. The principle of this wattmeter is the same as the integrating wattmeter, with the addition of the coin mechanism. The latter consists of a circular dial and pointer, indicating the amount of money remaining to the customer's credit, and a coin slot arranged with contacts for closing a switch and allowing current to flow upon the insertion of a coin. The dial is marked in ten divisions, each representing 25 cents. Up to ten quarters may be used, the current paid for at any time being indicated by the pointer's position. The pointer is so connected with the train recording the consumption, as indicated on four

smaller dials, that as the current is consumed the larger pointer travels backward until the amount paid for is used and the pointer reaches zero, when the current is automatically cut off.

—WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, PITTSBURG, PA.

WESTINGHOUSE TESTING INSTRUMENTS. This company manufactures a portable incandescent lamp-testing volt-wattmeter which is very popular with central station operators and others for testing a lamp in actual service. The lamp is removed from its socket and placed in the receptacle upon the instrument. The leads are attached to the socket from which the lamp was taken, and the voltage is read. The switch button is turned and the voltage noted, thus giving all the data necessary to determine whether the lamp employed has the proper characteristics to give the best service.

—WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, PITTSBURG, PA.

WHITNEY ELECTRICAL INSTRUMENTS. These comprise a full line of portable and switchboard voltmeters and ammeters for both direct and alternating current; also ohmmeters which are suitable for use in testing out car wiring and motor fields. Wheatstone bridges for general work, and "testers" for tracing out connections and performing in a more efficient manner the work ordinarily allotted to a magneto. (See advertisements in current numbers for various types.)

—WHITNEY ELECTRICAL INSTRUMENT COMPANY. MACHADO & ROLLER, NEW YORK, N. Y., GENERAL SALES AGENTS.

INSTRUMENTS, RECORDING

BRISTOL RECORDING INSTRUMENTS FOR PRESSURE, TEMPERATURE AND ELECTRICITY. Automatic registering instruments which make permanent records in ink on a moving chart of changes that occur in the pressure, temperature and electricity in any power or industrial plant. This company has developed a very extended line of these recorders, covering over five hundred different varieties, so designed as to be extremely accurate and durable when placed in operation, without sacrificing extreme sensitiveness and delicacy. The operative part is either directly connected to the marking pen or with the least possible number of parts, thus avoiding possibilities of friction and liability of being thrown out of adjustment. Thousands of these recorders are in use throughout the world.

—THE BRISTOL COMPANY, WATERBURY, CONN.

GENERAL ELECTRIC RECORDING INSTRUMENTS. These instruments are particularly adapted for the study of phenomena of quick acceleration, and in the investigation of motor losses, efficiency, etc. They record accurately on a continuous chart rapidly fluctuating current and voltage values. They will operate satisfactorily when subjected to severe shocks and vibration, occasioned by a car moving at high speed over a rough track. They have an exceptionally high torque so that the friction of the pen on the chart is negligible, and are perfectly damped, which prevents over-running of the pen, notwithstanding violent and sudden changes in the quantities being measured. The company also manufactures a complete line of indicating instruments for all classes and conditions of service.

—GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

INSULATIONS AND INSULATING COMPOUNDS

(See also Paints and Varnishes.)

AETNA INSULATING COMPOUND. This compound is manufactured especially for electric railway insulation. The various forms in which it is made are obtained by pressing the compound in dies under high pressure. The finished product, as used for insulation in trolley line suspensions, strain insulators, third rail insulators, etc., is extremely tough, and impervious to weather exposure. It is the first of this class of insulating compounds for electric railway use, and has come into extensive use in all civilized parts of the world.

—ALBERT & J. M. ANDERSON MANUFACTURING COMPANY, BOSTON, MASS.

BISHOP GUTTA-PERCHA INSULATION. This company makes high-grade rubber insulations for all purposes. Its india rubber or gutta-percha insulation does not need lead to protect it from moisture.

—BISHOP GUTTA-PERCHA COMPANY, NEW YORK.

ELECTROSE INSULATION. After careful and exhaustive tests made by some of the foremost experts in electrical engineering, it is conceded that "Electrose" is one of the best insulating materials on the market. It has been in practical use for a sufficient number of years to give it thorough weather and wearing tests and the company is pleased to inform its patrons that it has fulfilled all requirements in a highly satisfactory manner. It possesses the highest insulating qualities, therefore assuring efficiency, strength and durability. The company is now prepared to furnish this insulating material in all forms of overhead line fixtures, insulators, etc.

—WESTERN ELECTRIC COMPANY, NEW YORK AND CHICAGO.

GENERAL ELECTRIC INSULATING COMPOUNDS. The General Electric Company uses a special water-proof insulating compound which guarantees all armature and field magnet winding proof against moisture.

—GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

J-M INSULATING COMPOUNDS. The insulation is a very essential part of electrical machinery, because the best designed machine is useless if the insulation fails. Many years of experience have demonstrated that Vulcabeston is one of the best insulating compounds for general use in electrical apparatus. It can be furnished in sheets of convenient size, or moulded in a large variety of forms, with great accuracy in dimensions. (See advertisement.)

—H. W. JOHNS-MANVILLE COMPANY, NEW YORK.

MACON ELECTROLAC. A plastic black insulating compound for coil insulation where water, oil and heat resistance are desired. It is a permanently plastic compound and will not become hard or brittle under the severest service conditions. When used on armatures its pliable nature allows the replacing of burned out coils without injury to insulation on coils "lifted." To obtain best results it should be baked for eight or ten hours at 175 deg. to 195 deg. (80 deg. to 90 deg. C.)

—MACON-EVANS VARNISH COMPANY, PITTSBURG, PA.

MACON-EVANS PARAFFINE INSULATING COMPOUND. This company's black paraffine insulating compound for coil insulation is a new material that air dries in a short period, yet retains indefinitely its plastic properties so essential for street railway work where short circuited coils may be replaced without injuring the insulation of the coils "lifted."

—MACON-EVANS VARNISH COMPANY, PITTSBURG, PA.

M. I. C. COMPOUND. This is a black enamel, acting as a perfect insulator, wet or dry. It is both durable and elastic and it is made in four grades: No. 1, for armature coils, field magnet coils, wires, cables, etc.; No. 2, for all out door work, generators, motors, arc lamps, overhead line constructions, etc.; No. 3, same purpose as No. 2, but a quicker dryer; No. 4, a rapid dryer adapted for quick work on coils, magnets, etc., street car trucks and fenders, armatures and transformers, discs and plates.

—MICA INSULATOR COMPANY, NEW YORK.

OKONITE. "The standard for rubber insulation." Okonite insulation for wires and cables is not affected by extremes of temperature, commercial acids or alkalis, is flexible and tough, and made to give uniformly high and satisfactory service.

—THE OKONITE COMPANY, LTD., NEW YORK.

"OZITE." An insulating compound composed of inorganic substances, with a lower specific inductive capacity than any other kind of insulating material suitable for or now used in connection with lead covered cables. It can also be subjected to high temperature without deterioration. It is furnished in various degrees of hardness depending upon service requirements and is largely used for filling joints terminals, converters, etc. No. 1 melts at approximately 190 deg. F., No. 2, 150 deg. F., and No. 3, 115 deg. F., and special terminal compound melts at not less than 200 deg. F.

STANDARD UNDERGROUND CABLE COMPANY, PITTSBURG, PA.

RUBEROID MOTOR WIRE INSULATION. The wires are laid in a strip of motor cloth, cut sufficiently wide to go once and a half around. The cloth, which is soft and flexible, is then wrapped tightly about the wires, the whole bound together with P. & B. insulating tape and all given an exterior coat of P. & B. electrical compound, which sufficiently excludes dust and dirt and also prevents the entrance of water. The result is a positive insulation and protection for the wires. The tape is tough, strong and absolutely water-proof, being thoroughly saturated with a water-proof and acid-proof compound and, preserving permanently its peculiar adhesiveness, can be depended upon to maintain a perfect bond with the Ruberoid motor cloth. The latter material is a high grade canvas of great strength, every fibre of which is thoroughly impregnated with Ruberoid water-proof and acid-proof compound.

—THE STANDARD PAINT COMPANY, NEW YORK.

WESCO INSULATING COMPOUND. Used in connection with this company's trolley and feed wire appliances, is elastic, non-brittle, durable, tough and strong. It has great resistance to cracking strain and high non-conductive properties. It is superior in its resistance to high temperature and exclusion of moisture. Where galvanizing is required the malleable parts are cold galvanized by a process which enables the coating of the threaded parts and still preserves the strength without injury. With hot galvanizing this has been impossible.

—WESCO SUPPLY COMPANY, ST. LOUIS, MO.

INSULATING PAPER AND CLOTHS

AMERICAN INSULATING PAPER. This company supplies the very best grades of insulating paper and "Laminite" which can be furnished in rolls or sheets of such width and thickness as may be desired and in red, black, and gray colors. The softness or flexibility can be varied to suit the purpose required.

—THE AMERICAN VULCANIZED FIBER COMPANY, WILMINGTON, DEL.

EMPIRE CLOTH AND PAPER. These are linseed oil coated materials made to endure the extended, increased temperatures which insulations have to stand in practice. The base of Empire cloth is of the finest woven muslin. The company has adopted numbers for its various cloths, the number denoting the thickness in thousandths of an inch. The standards are: No. 5, No. 7, No. 8, No. 10, No. 12, No. 15, No. 16. The standard grades of Empire paper are: No. "D," .005 thick, manilla; No. "E," .005 thick, bond; No. "F," .009 thick, gray rope. (See advertisement.)

—MICA INSULATOR COMPANY, NEW YORK.

GENERAL ELECTRIC INSULATING PAPER AND CLOTH. All paper and cloths supplied for insulating purposes on field and armature windings are of selected materials, combining strength and durability and are the result of careful experimentations.

—GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

GIANT AND P. & B. INSULATING AND SHEATHING PAPERS. These papers are guaranteed to be entirely waterproof. It is impossible for moisture to penetrate, for every fibre is thoroughly saturated with a water-repelling compound manufactured by this company. The moisture never gets beyond the surface, for the compound-filled pores reject it, and it is thence absorbed by the air. The papers are therefore perfect non-conductors. They are uninjured by atmospheric changes, acids, alkalies or gases. These papers are also air-tight.

—THE STANDARD PAINT COMPANY, NEW YORK.

MACON-EVANS INSULATING CLOTHS. This company handles a complete line of insulating cloths of various thicknesses treated with Macon insulating varnish. These cloths possess the highest insulating properties and retain their flexibility for an indefinite period, the same care being exercised in selecting the cloth on which varnish is applied as in the manufacture of the varnish itself.

—MACON-EVANS VARNISH COMPANY, PITTSBURG, PA.

SLEEVING. All grades, sizes and colors used in the construction and repairing of electrical apparatus.

—HOPE WEBBING COMPANY, PROVIDENCE, R. I.

STERLING INSULATING CLOTHS AND PAPERS. The company's products are used for coating cloths and papers by many of the largest producers of such articles.

—STERLING VARNISH COMPANY, PITTSBURG, PA.

INSULATING TAPES

GENERAL ELECTRIC INSULATING TAPE. This tape is made in two styles, Paragon, for outside work, and Acme, for taped joints in dynamos or motors. Paragon tape is thoroughly impregnated with a water-proof compound and has great adhesive qualities. It is furnished in black only and wrapped in tin foil. Acme friction tape is used for armature and field windings, and for general splicing work where a friction tape is desired. It is furnished in black or white, packed in tin boxes. No substance is used in either tape which has an oxidizing effect.

—GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

HOPE TAPES AND WEBBINGS. For the construction and repair of dynamos, motors, etc.

—HOPE WEBBING CO., PROVIDENCE, R. I.

LINOTAPE. An insulating tape whose coating consists of a film of oxidized linseed oil. It is put up in rolls containing 72 yds. and is cut to any width desired. The widths ¾ in. and 1 in. are kept in stock. The thickness of the tape is .010 in and is cut either lengthwise or on the bias. Another form of tape made by this company is its

cable linotape, a thoroughly impregnated linseed oil tape, The oxidization of the oil is carried to the utmost limit rendering its surface smooth and slippery, so as to allow a sharp bending of the cable insulated with this material. The ohmic resistance and puncture voltage are high. (See advertisement.)
—Mica Insulator Company, New York

INSULATING TAPE. P. & B. tape has been in successful use in all parts of the world, under all climates. Its specific advantages are its permanent flexibility and the fact that it does not dry out. Its flexibility ensures permanent resistance against mechanical damage; ease of application in difficult places, and the use of the material over and over again. Its non-drying out qualities ensure storing without risk of deterioriation, and lasting insulation power.
—The Standard Paint Company, New York.

INSULATORS, INCLUDING THIRD RAIL

(See also Line Material.)

BOURBON STRAIN INSULATORS. Made with a view of withstanding the greatest strain and at the same time securing high insulation resistance. The metal parts are two steel chain links of special shape with a porcelain spreader to separate and insulate the links. Around the metal parts and porcelain spreader is moulded by hydraulic pressure a high grade insulating compound, which thoroughly seats the metal parts and protects the whole from the weather, giving a long surface distance between metal parts and a high puncture test. These strain insulators are made in sizes to stand strains up to 3,000 lbs. breaking strain.
—The Creaghead Engineering Company, Cincinnati, Ohio.

GENERAL ELECTRIC THIRD RAIL INSULATORS. These insulators are furnished for standard or special work. Malleable iron supports are used with reconstructed granite or vitrified clay forming the insulator proper.
—General Electric Company, Schenectady, N. Y.

HEMINGRAY INSULATORS. These insulators are of the screw glass type with special drip petticoats.
—The Hemingray Glass Company, Covington, Ky.

J-M THIRD RAIL INSULATORS. Reconstructed granite consists of selected orthoclase granite pulverized, moulded into any desired form under heavy pressure, and then fused into a solid mass at a temperature approxiing 3,000 deg. F. It is highly glazed, and being vitreous, does not contain or absorb moisture. It is of unlimited durability, not being affected by heat, cold or any commercial acids or alkalies. Its crushing strength is about 15,000 lbs. per cu. in., and its tensile strength 1,000 lbs. per sq. in. of cross section. After years of severe test in all sorts of climatic conditions, it has been generally adopted throughout the world for third rail insulation. (See Catalogue No. 14; also see advertisement.)
—H. W. Johns-Manville Company, New York.

"OHIO BRASS" THIRD RAIL INSULATORS. Made from semi-porcelain, which possesses great mechanical strength, best of insulating qualities, and is low in cost. The castings are all of malleable iron. A large number of types of third rail insulators are made to suit various re quirements. (See pages 637 to 648, Bulletin No. 1.)
—The Ohio Brass Company, Mansfield, Ohio.

RECONSTRUCTED GRANITE INSULATORS. Composed of selected orthoclase granite, pulverized, moulded into any desired form under heavy pressure, and then fused into a solid mass at a temperature approximating 3,000 deg. F. They are well vitrified, highly glazed, and possess unlimited durability, not being affected by hot or cold nor by acids. The material shows high crushing strength and high ohmic resistance. The company controls several patented types of third rail insulators, among which are the "Courtenay," "Lawrencourt" and "Crossbar" varieties, and also makes a specialty of executing orders for insulators from the owners of other types.
—Reconstructed Granite Company, New York.

VICTOR INSULATORS. That electric current may be confined to the circuit which shall convey it, glass or porcelain in the form of shells nested and cemented together is introduced between points of high pressure. The inherent qualities of the glass or porcelain prevent puncture and design of the shells is such as to, at all times, insure dry surface between opposite sides of a high pressure circuit, thus preventing passage of current.
—Locke Insulator Manufacturing Company, Victor, N. Y.

VICTOR LINE INSULATORS. Used for the support of high tension power transmission wires and almost invariably made of several shells of highly vitrified porcelain nested together and cemented in place.
—Locke Insulator Manufacturing Company, Victor, N. Y.

VICTOR STRAIN INSULATORS. Designed to give maximum mechanical strength by allowing pin to be fastened at both ends with line wire about the middle.
—Locke Insulator Manufacturing Company, Victor, N. Y.

VICTOR WALL ENTRANCE INSULATOR. Designed to permit entire closing of aperture about line wire and should present ample dry surface even in face of severe blowing rain. Mounted in slate or cement panel.
—Locke Insulator Manufacturing Company, Victor, N. Y.

WESTERN ELECTRIC THIRD RAIL INSULATORS. In the company's catalogue of electric railway material for 1904-5 it illustrates three specific types of patented third rail insulators in which its well-known "Electrose" insulating material is employed in combination with the metal parts. The types shown provide a strong and at the same time a slightly flexible support for the conductor rail, thereby insuring a more constant and perfect contact between the collector shoe and the rail; sparking and loss of current is thereby avoided; ample scope for the expansion and contraction of the rail is also provided.
—Western Electric Company, New York and Chicago.

JACKS

(See also "Cranes, Hoists and Lifts")

BARRETT JACKS. Made in many sizes and styles for railway track and car work, comprising track jacks, car jacks, pit jacks, journal jacks, bridge jacks, emergency jacks, etc. Single and double acting jacks are the two types—single acting jacks raising their load on the downward movement of the lever only, while double acting jacks raise on both upward and downward movement. Special pit jacks are manufactured for removing the trucks and axles of street railway cars, and journal jacks for removing the brasses. Special forms of car emergency jacks are also included in this line of Barrett jacks for the equipment of each car of an entire system.
—The Duff Manufacturing Company, Pittsburg, Pa.

BARRETT GEARED RATCHET LEVER JACKS. Lever jacks for heavy lifting of 25 and 35 tons capacity. They are compounded to permit ease of operation as well as quick action. These geared jacks are essential for the rapid handling of heavy cars or heavy loads of any character, and are popular with railroads for handling either empty or loaded cars and coaches.
—The Duff Manufacturing Company, Pittsburg, Pa.

BARRETT LEVER JACKS. Made in "trip" and "automatic lowering" types for all kinds of track work, car repairing, wrecking, etc. A large number of different modifications, ranging in capacity from 1 to 15 tons. A special pit jack is made for electric railroads, for use in removing motors from trucks. Lifting racks are steel, frame malleable iron, pawls forged steel.
—Fairbanks, Morse & Company, Chicago, Ill.

BARRETT SCREW JACKS. Cone bearings permit of the raising of loads from 10 tons and upward easier and much more quickly than the hydraulic. They are more dependable, always ready, strong and durable.
—Fairbanks, Morse & Company, Chicago, Ill.

BRILL "HERCULES" CAR JACK. Two wooden uprights, well braced and bracketed with iron, contain the raising mechanism consisting of a lever handle which operates a ratchet wheel cogged to a large wheel on the shaft of which is wound a chain; the chain passes over a sheave and a pair of hooks at the end engage a steel-plated plank upon which the heaviest car is easily raised by one man at each lever. The jack occupies little space, can be operated in a crowded car barn, and may be readily moved. Besides raising cars, it will serve a variety of other purposes.
—J. G. Brill Company, Philadelphia, Pa.

BUCKEYE TRACK JACKS. These jacks are compound lever track and automobile lowering jacks. All parts are interchangeable and broken parts are easily replaced by inexperienced track men.
—The Buckeye Jack Manufacturing Company, Louisville, Ohio.

BUDA JACKS. Ratchet, friction, ball bearing and cone bearing. In all sizes and for special and general purposes. All tested beyond rated capacity—an important feature, eliminating danger of accidents from breakage.
—Buda Foundry & Manufacturing Company, Chicago, Ill.

DORNER PIT JACKS. Used in moving commutators from motors. Made of cast iron, with brass bushing and steel screw, wood rollers in cradles for handling armatures and flat top for handling motor cases. Flat or flanged wheels. Very convenient for use in car houses. (For illustration see advertisement.)
—The Dorner Manufacturing Company, Chicago, Ill.

DUFF ROLLER BEARING SCREW JACKS. Improved roller bearing screw jacks manufactured with capacities from 15 to 70 tons for every purpose and for the safe and economical handling of railway equipment or machinery. They displace hydraulic jacks and other forms of screw jacks, as they are cheaper to operate, more reliable and will give longer service. Two special roller bearings are employed in each jack, permitting these jacks to operate at least 15 per cent. easier than other screw jacks under the same load.
—The Duff Manufacturing Company, Pittsburg, Pa.

KALAMAZOO JACKS. In form and weight these jacks are easily portable by one person. The shape and dimensions of bases and the heights of standards are arranged for their respective duties; the broad and long rectangular bases enable operator to reach loads inaccessible with round base; the same feature makes the jack safe against tilting with load. Two pawls are provided, one which is engaged in teeth of rack while other is traveling for load, thus obviating the chance of sudden collapse to the injury of operator. Standards are made of choice malleable iron. Lifting racks are of forged steel with machine-cut teeth to give even finish and accuracy in operation otherwise unattainable. Pawls are of drop forged steel, fulcrum pins of crucible tool steel and all bearings of hard machinery steel. Tripping jacks are intended, and are preferable for purely track work. Reversing jacks lower loads without chance of accidental precipitation and are especially recommended for electric railways.
—Kalamazoo Railway Supply Company, Kalamazoo, Mich.

MERRILL-STEVENS STANDARD JACKS. These railway jacks are made to combine positive action, ease of movement, strength and durability.
—Merrill-Stevens Manufacturing Company, Kalamazoo, Mich.

SHAW JACKS. This company manufactures jacks of all types for railway work.
—Shaw Engineering & Manufacturing Company, New York.

WATSON-STILLMAN JACKS. Built in nearly three hundred styles for all classes of lifting work.
—Watson-Stillman Company, New York and Chicago.

JOINTS, EXPANSION

(See "Pipe Fittings")

JOINTS, RAIL

ATLAS RAIL JOINTS. Made in various forms; The compromise joint is made to connect any style of rails; made suspended or supported. Joint No. 1 has a double truss; it is composed of two like sections, one on each side of the rail and made to fit any rail or rails.
—Atlas Railway Supply Company, Chicago, Ill.

CONTINUOUS RAIL JOINTS. These joints are rolled from best steel billets to any desired length and to fit any section of either "Tee" or "Girder" rail. They provide for contraction and expansion, support the rail base perfectly, maintain rail alignment, eliminate low joints, communicate the load wave uninterruptedly from rail to rail and perfectly control all vertical action between the rail ends, preventing crystalization and consequent breaking of copper bonds or terminals. This results in easy riding and economy of maintenance of both track and rolling stock. The cost is but little more than angle bars and the life of the joint is twice as long. (See illustration in advertisement.)
—The Continuous Rail Joint Company of America, Newark, N. J.

FALK CAST-WELDED RAIL JOINTS. This rail joint makes a continuous track, saves current, rails, equipment, does away with track maintenance entirely, and makes a delightful smooth riding track. There are no copper bonds to get loose and divert the electric current, and actual tests show twenty (20%) per cent. greater conductivity at the joint than in the rail itself. Hundreds of thousands of joints are in use the world over, and many of the leading systems, both in this country and abroad, have welded all of their track. (See advertisement in this issue.)
—The Falk Company, Milwaukee, Wis.

HEIL RAIL WELDING. The outfit required for making cast-welded joints by this process consists of the following: A wagon-mounted cupola for casting the joints, having a capacity of ten tons of iron in six hours, a platform in the wagon for carrying iron; a box for holding the coke; a sand-blast apparatus for cleaning the rail ends, consisting of a motor-driven compressor and sand hopper; and motor-driven apparatus for filing the rail and joints. This company's work includes also the construction of self-supporting smokestacks for power houses and the manufacture of steel tanks for gasoline, oil, water and storage purposes.
—HEIL RAIL JOINT WELDING COMPANY, MILWAUKEE, WIS.

LORAIN ELECTRICALLY WELDED RAIL JOINTS. This joint consists of two rolled steel bars on each side of the web of the rail across the joint and electrically welded at three points. The area of each weld is about 3½ sq. ins. The standard size of bars used is 1 in. by 3½ ins. by 18 ins. for new rail with ends left blank for welding. For rail having bolt and bond holes the bars are made long enough to reach beyond the holes. These joints are applied by special apparatus mounted on trolley cars which move along the track from joint to joint. Current is taken from the trolley and converted to a low voltage for welding. The joints are applied by the track welding department of the company. (See advertisement.)
—THE LORAIN STEEL COMPANY, PHILADELPHIA, PA.

THERMIT RAIL JOINTS. This joint consists of a steel shoe weighing 5 lbs. to 12 lbs., according to rail section, fused with the web and rail flange to one homogeneous mass. The steel is run into a sand mold out of a magnesia-lined crucible placed directly over the gate of the mold and tapped from the bottom. In the crucible itself takes place the chemical reaction of finely divided aluminium with iron oxide, which produces this liquid steel, at a temperature of about 5,000° F., without supply of heat or power from outside. The whole outfit consists of crucible with tripod, sand molds, mold clamps and the Thermit necessary to weld any given section. (See advertisement.)
—GOLDSCHMIDT THERMIT COMPANY, NEW YORK.

WEBER RAIL JOINT. This is a base support joint giving perfect surface and line. It preserves the rail's life by reducing excessive wear at the ends, thus making it uniform throughout. The bolts and nuts do not become loose, as the wood filler (which does not decay or otherwise fail), being under constant compression, and practically enclosed in steel, preserves a tension in the bolts which prevents any movement in the parts. (See advertisement.)
—THE WEBER RAILWAY JOINT MANUFACTURING COMPANY, NEW YORK.

JOURNAL BOXES

BRILL JOURNAL BOX. This journal box is self oiling and will run six months without re-oiling. It has a record of fourteen months without re-oiling on one of the New York lines. The box is strongly and simply constructed, readily removed and replaced, and easily inspected. It is made dust-proof by a method that is singularly effective in operation. The fault with most journal boxes is that the connection between the collar and the inside rim is too loose. In the Brill box the small amount of dust that is not trapped in a groove in the rim and gets under the collar, is deposited upon a fiber washer which in turning around drops it out again.
—J. G. BRILL COMPANY, PHILADELPHIA, PA.
—AMERICAN CAR COMPANY, ST. LOUIS, MO.
—G. C. KUHLMAN CAR COMPANY, CLEVELAND, OHIO.
—JOHN STEPHENSON COMPANY, ELIZABETH, N. J.

SYMINGTON JOURNAL BOX. Now being applied on most of the leading high speed electric cars built during the past year. It is exclusively an M. C. B. type of box for M. C. B. trucks, having been successfully developed on the steam roads of the United States. Its points of excellence are a simple, durable, dust-proof lid with machined joint and central spring pressure; a lid spring which will not fail in long service, and an arrangement of interior ribbing that will positively prevent any settling of waste packing away from the journal. It is made of a tough resilient metal which resists abrasion at all wearing points. (For illustration see advertisement.)
—THE T. H. SYMINGTON COMPANY, BALTIMORE, MD

JOURNAL LUBRICATORS

(See "Lubricating Devices")

LABORATORIES, ELECTRICAL

LABORATORIES. To the manufacturer tests are of great benefit and are as necessary to a secure future as careful accounting; but to the intelligent purchaser, tests are even more necessary to know whether the claims of a salesman are fulfilled by the goods or that the specifications under which the purchase was made are fully met. The goods sold will be more carefully selected if the shipper knows that they must pass certain inspections and tests before they will be accepted. It was for the purpose of helping the buyer as well as the manufacturer that these testing laboratories were instituted and their past work already has shown the value of their assistance along these lines.
—ELECTRICAL TESTING LABORATORIES, NEW YORK.

LAMPS, ARC AND INCANDESCENT

(See also Headlights.)

BANNER INCANDESCENT LAMPS. These lamps are manufactured under the latest improved processes known to the business, and this, coupled with skill and knowledge acquired by extensive experience in the manufacture of high grade lamps, has resulted in the production of a lamp suited to the most exacting requirements. The lamps are subjected to the most extensive and exacting tests before they leave the factory, and only perfect lamps are permitted to bear the "Banner" label. The most critical attention is given to specifications in filling orders, and Banner lamps are guaranteed in every particular. (See advertisement.)
—BANNER ELECTRIC COMPANY, YOUNGSTOWN, OHIO

CREAGHEAD INCANDESCENT LAMPS. Made under expert supervision and with the most approved apparatus. The selection is such as is demanded by the most careful buyers and to meet the most severe conditions. Lamps for street railway circuits are carefully selected for series burning. The spiral "Mill type" lamps are especially designed for factory use. These lamps are furnished in all voltages, candle powers and bases that are in demand. The "Creaghead Special" type lamp is made for a larger tip candle power, having a filament with one extra coil.
—THE CREAGHEAD ENGINEERING COMPANY, CINCINNATI, OHIO.

GENERAL ELECTRIC ARC LAMPS. These series of arc lamps are especially suited to railway work, and are known as the Parallel Rod Edgewise Wound Type. They operate two in series on 220 volts or five in series on 550 volts. They may also be operated on 110 volts by a simple adjustment. The number of parts is reduced to a minimum. The construction is practically indestructible. The insulation is ideal, as all insulating pieces are of porcelain and there is but one flexible cable in the lamp and it is insulated with glass beads. The regulation of the arc length is obtained by a simple mechanical device, no shunt magnets being used. These lamps will operate over a wide range of voltage. All fittings for lamps are interchangeable in all parallel rod and center type lamps.
—GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

GENERAL ELECTRIC INCANDESCENT LAMPS The General Electric Company manufactures all types and varieties of incandescent lamps. The company's latest development in incandescent lighting is a high efficiency metallized carbon filament lamp known as the "G. E. M." This lamp supplies the need for an intermediate lighting unit between the ordinary incandescent light and the arc lamp. It is furnished in three sizes, each equipped with two styles of Holophane Pagoda reflectors for concentrating or distributing the light as required. The efficiency of the new units is 20 per cent. higher than ever before obtained for best incandescent lamps.
—GENERAL ELECTRIC COMPANY, MAIN LAMP SALES OFFICE, HARRISON, N. J.

SAWYER-MAN INCANDESCENT LAMPS. The incandescent lamps sold by this company are manufactured by the Sawyer-Man Electric Company of New York City. The makers of these lamps have the benefit of twenty-four years experience and continuous experiment. The desirable and valuable qualities of long life, small energy consumption, and uniformity in candle-power and voltage are secured by close attention and skill during the intricate process of manufacture, supplemented by great care and accuracy in the final testing and selection.
—WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, PITTSBURG PA

"STERLING SPECIAL" RAILWAY LAMP. This lamp is designed especially to overcome the swinging of the filament caused by oscillation, at the same time producing an equal light from all light-giving points of the bulb. The formation of the filament being spiral, fully anchored the entire distance, prevents any drooping or swinging, thereby producing a long life and efficient lamp. Vibration cannot affect a lamp made in this manner and vibration must be considered in railway lighting. Tested in series and fully guaranteed.
—STERLING ELECTRICAL MANUFACTURING COMPANY, WARREN, OHIO.

SUNBEAM STREET RAILWAY LAMP. This lamp has attracted a great deal of favorable attention among street railway men during the past year. Its strong feature recommending it particularly to railway men of long experience is strength. Both in design and quality of material the filament and connections are as near perfection as the science of the day permits, and as for uniformity both in candle power and life performance the Sunbeam is guaranteed to meet and even exceed the requirements of standard specifications for street railway work.
—THE SUNBEAM INCANDESCENT LAMP COMPANY, NEW YORK. WESTERN ELECTRIC COMPANY, NEW YORK AND CHICAGO, SOLE SELLING AGENT.

WESTERN ELECTRIC ARC LAMPS. Up-to-date lamps for all voltages and all classes of service. Characterized by rigidity of construction, certainty of action, interchangeability of parts and economy of operation. Recent improvements in all lines place this company's present products ahead even of its past high standard. All lamps have a narrow waist separating the globe from portion containing mechanism. Parts are accessible for adjustment. A special metal is used for castings, giving strength with lightness. Carbons can be changed without removing globes, when desired.
—WESTERN ELECTRIC COMPANY, NEW YORK AND CHICAGO

WESTINGHOUSE ARC LAMPS. The lamp shells are made of heavy corrugated copper. Combustion of the carbon takes place in a chamber which is entirely separate from that containing the lamp mechanism, thus permitting a low operating temperature. The lamps are dust, weather and bug proof, strong and serviceable, and of high efficiency. They are made for operation on all alternating current and direct current circuits.
—WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY PITTSBURG, PA.

LAMP PARTS

(See Clusters and Sockets")

LIFTERS, CAR STEP

MILLEN CAR STEP LIFTER. A lifting device attached to the underside of a car, and connected with both platforms of the same, so that the motorman or conductor, by lifting up a handle, can turn up the long step of an open car, fasten it up and also let it down again with out leaving the platform.
—THE CONSOLIDATED CAR FENDER COMPANY, NEW YORK.

LAUNCHES AND BOATS

(See Park Attractions.)

LIFTS

(See "Cranes, Hoists and Lifts.")

LIGHTING SYSTEMS, CAR

KINSMAN AUXILIARY CAR LIGHTING SYSTEM. This auxiliary car lighting system comprises means for keeping a car illuminated even when the main current is cut off The apparatus consists of a number of auxiliary lamps, a storage battery, a charging switch and an automatic change-over switch. When the main current is cut off the change-over switch immediately places the auxiliary lamps in circuit with a small storage battery. A flexible cord and lamp is also used in connection with the battery circuit to enable car inspection while the main power circuit is dead ; also keeps marker and headlights in service during break downs.
—KINSMAN ELECTRIC & RAILWAY SUPPLY COMPANY, NEW YORK.

LIGHTNING PROTECTION

AJAX LIGHTNING ARRESTER. A protective device for direct current apparatus of 650 volts potential, or less, consisting, essentially, of a magazine of fusible lightning arresters becoming operative successively, one fuse for each lightning discharge. The fuse consists of two pieces of No. 0 B. & S. soft brass wire lapped at their inner ends to form a discharge gap which is hermetically enclosed in a small glass tube. One end of each fuse rests upon a common ground terminal, the other being connected to the line terminal through a small carbon ball which is operated by gravity.
—ALBERT & J. M. ANDERSON MANUFACTURING COMPANY, BOSTON, MASS.

GARTON-DANIELS LIGHTNING PROTECTION. The arresters made by this company are of the "circuit-breaker" type. The air-gap is fixed and the circuit is opened in an enclosed chamber. This allows the use of a small air-gap, insuring the discharge an easy path to earth. The circuit-breaker is positive, automatically reset and instantaneous in operation. A resistance is used, in series with the arrester coil to limit the current flow, and in shunt to provide a non-inductive path around the coil for the discharge. Parts so mounted on base to avoid breakdown of surface distances between parts of opposite potential.

—GARTON-DANIELS COMPANY KEOKUK, IA.

GENERAL ELECTRIC LIGHTNING ARRESTERS. This lightning arrester is suitable for all direct current systems whether railway, light or power. In railway systems it is installed in the station, on the cars or on poles carrying feeder lines. It consists of two rounded terminals, forming an adjustable spark gap, a non-inductive resistance and a magnetic blow-out coil, all enclosed in a porcelain box. Choke coils should be interposed between the point where the arrester is connected to the circuit and generator or motor to be protected. The spark gap terminals are mounted on the underside of the cover of the porcelain box, rendering them readily accessible for inspection and cleaning. For outdoor service the arrester is enclosed in a substantial wooden box.

—GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

SHAW NON-ARCING LIGHTNING ARRESTERS. These arresters are composed of a series of special carbonized rings placed alternately in series with mica rings on an insulating tube supported by two circular serrated metal caps on brackets secured to the insulating base. The composition and shape of the carbonized rings afford an inner as well as outer discharge circuit for the static current, but will not permit arcs to form or a dynamic current to precede or follow. The arresters have no moving parts. They are always ready for operation. They are made for all voltages.

—LORD ELECTRIC COMPANY, BOSTON, MASS.

WESTINGHOUSE LIGHTNING PROTECTION. An installation of lightning arresters, choke coils, or both, for the protection of electrical apparatus against lightning or other abnormal rises of potential. The choke coil tends to flatten out the potential wave, and the arrester offers an easy path to ground and also prevents the line current from following the discharge. For railways having high voltage transmission, the low equivalent arresters afford excellent protection. For cars or lines of 500 volts to 750 volts, the M. P. arrester is used. It is small and compact, has no moving parts, is weather and fireproof, and will operate without attention for an indefinite time.

—WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, PITTSBURG, PA.

LINE MATERIAL

(See also Brackets and Cross-Arms, Insulators and Wires and Cables.)

ANDERSON LINE MATERIAL, This company's overhead material for electric railways includes a complete line of trolley line suspensions, of West End, Boston, cap and cone, and round top types, together with Brooklyn strains, wood strains, and many other forms of strain insulators of thoroughly tested construction, also trolley wire ears and splicing sleeves in great variety for both round and grooved wire. The Aetna insulating compound furnishes the insulation for this line material.

—ALBERT & J M. ANDERSON MANUFACTURING COMPANY, BOSTON. MASS.

CREAGHEAD LINE MATERIAL. A complete line of material for overhead construction of electric railway and power transmission lines.

—THE CREAGHEAD ENGINEERING COMPANY, CINCINNATI, OHIO.

CREAGHEAD "ARMORED CAP-CONE" TROLLEY HANGERS. Have a spark gap of 24,000 volts, with very high surface insulation (long surface distance), and high puncture test. Their simplicity and strength recommend them. The hanger will not shake loose as is the case with many other designs.

—THE CREAGHEAD ENGINEERING COMPANY, CINCINNATI, OHIO.

ELECTRIC RAILWAY EQUIPMENT COMPANY'S LINE MATERIAL. Embraces iron and steel poles, feeder arms, cross-arm supports, iron pole tops, bands and collars, pole brackets for wood and iron poles, malleable iron fittings, etc. See also Wirelocked Swedged Joint Poles and Hercules Brackets.

—ELECTRIC RAILWAY EQUIPMENT COMPANY, CINCINNATI. O.

ELECTROSE OVERHEAD LINE MATERIAL. Electrose overhead line material has received the approval and endorsement of the best engineers in America and Europe. After a number of years of the most severe service on some of the leading roads it has been demonstrated that it is superior electrically and mechanically to any other material now on the market. The company is constantly adding to its regular line new and improved devices. The metal parts used in these overhead line fixtures are uniformly tough and strong and of the best quality of metal obtainable. This material can also be supplied on customers' special forms.

—WESTERN ELECTRIC COMPANY, NEW YORK AND CHICAGO.

GENERAL ELECTRIC LINE MATERIAL. The company's line comprises a complete assortment. Liberal design and an ample factor of safety insure great mechanical strength and durability. The insulating material for suspension and strain parts retains its insulating properties under varying climatic conditions. All castings used are of standard composition for railway engineering. Fittings have been devised and standardized for catenary construction work, for both high speed direct and alternating current.

—GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

J-M LINE MATERIAL. A desirable property for an insulator for overhead work is resistance to the weather, and while mechanical strength, electrical insulation and heat resistance are essential, these properties must be combined with the weather resisting property to make an efficient insulator for all-around work. These properties are combined to the greatest extent in the well-known moulded mica line material. It was one of the very earliest insulators on the market and has the advantage of many years of service under the severest conditions. (See Catalogue No. 14; also advertisement.)

—H. W. JOHNS-MANVILLE COMPANY, NEW YORK.

MACALLEN LINE MATERIAL. Overhead line material for electric railways is the specialty of this company. This also includes materials in connection with high potential insulation.

—W. T. C. MACALLEN COMPANY, BOSTON, MASS.

MAYER & ENGLUND LINE MATERIAL. Keystone insulation for overhead line material, which was developed some years ago by this company, has proved to be very successful. The high grade material used in its manufacture and the careful process employed in making it, impart to the compound the necessary heat resisting quality, and makes it absolutely immune to the effects of moisture. Its mechanical strength is exceptionally high. It is moulded into all standard forms of overhead fittings and in many special ones.

—MAYER & ENGLUND COMPANY, PHILADELPHIA, PA.

MORRIS LINE MATERIAL.—This line covers practically everything required for overhead work, such as brackets, cross arms, poles, insulators, pull-offs, etc. Made both in standard and special types.

—ELMER P. MORRIS COMPANY, NEW YORK.

"OHIO BRASS" LINE MATERIAL. "Dirigo" insulation is used in this overhead line material. This insulation is the result of over eleven years of experience in this branch of manufacture. It has great tensile strength, resists heat and has exceptional insulating properties, combined with toughness and elasticity. This company's line of hangers, ears, strain insulators, etc., is very complete, including the most approved single phase construction material. (See Catalogue No. 6 and Bulletin No. 1; also advertisement.)

—THE OHIO BRASS COMPANY, MANSFIELD, OHIO.

PORTER & BERG'S TRUSS PIN. This pin is made of malleable iron, japanned or galvanized, and has been designed with the idea that the pin is primarily a part of the mechanical construction and should be made strong and durable; the insulator alone is depended upon for insulation. The pin top is specially designed to insure greatest possible "holding surface" for the insulator, which is fastened to the pin with cement. The base of the pin is designed with a flange to protect the cross arm from the weather and to prevent absolutely any turning of the pin. Bolted to the cross arm, it is a permanent piece of construction. Over 50,000 are now in use supporting Locke insulators. (See Catalogue No. 2.)

—PORTER & BERG, CHICAGO, ILL.

RECORDING FARE REGISTER COMPANY'S LINE MATERIAL. Consists of various styles of ears, mechanical clips, bracket arms, etc.

—THE RECORDING FARE REGISTER COMPANY, NEW HAVEN, CONN.

S-H LINE MATERIAL. This overhead line material is manufactured in either malleable iron or bronze in three distinct types complete, viz.: "Cap and Cone," "Boston" and "Gem," all of which are made for both single and double trolley systems. The insulation is of the highest grade; the metal parts are neat in design, substantial and especially well and carefully made. The entire line is made with a view to standing any excessive strain to which it may be subjected. (See advertisement.)

—STUART-HOWLAND COMPANY, BOSTON, MASS.

LOCKERS, METAL

LYON STEEL LOCKERS. A sheet steel locker for factories of all kinds. Made entirely of sheet steel with angle iron at top, bottom and sides, making it strong and durable. A locker that is not affected by hard usage. It is heavily coated with the best black varnish, with a permanent glossy black finish, absolutely insuring against rust, disease germs, bad odors, etc. Made in all sizes and combinations. Over 50,000 in use.

—LYON METALLIC MANUFACTURING COMPANY, CHICAGO, ILL.

MERRITT METAL LOCKER. Few things contribute so much to the comfort of the shop and barn employe as cleanly lockers, both for his personal effects and the storage of material. The lockers and material closets made by this company are of expanded metal and sheet steel, possessing great durability, cleanliness and safety.

—MERRITT & CO., PHILADELPHIA, PA.

MEYERS' SANITARY METAL LOCKERS. These lockers are made to have thorough ventilation, no dark corners, no accumulation of dirt and dust. They are made entirely of steel and will not absorb germs. They are perfectly secure as well as neat and attractive. These lockers are made in single or double tier.

—THE FRED. J. MEYERS MANUFACTURING COMPANY, HAMILTON, OHIO.

WRIGHT WIRE CLOTHES LOCKERS. These wire clothes lockers are largely used by street railways and manufacturing establishments all over the country. They are made of either wire or expanded metal, and can be fitted with the company's 3-point locking device, with Yale lock, or with a hasp for padlock.

—WRIGHT WIRE COMPANY, WORCESTER, MASS.

LOCK NUTS AND WASHERS

(See "Nuts and Bolts")

LOCOMOTIVES, ELECTRIC

AMERICAN LOCOMOTIVE COMPANY, NEW YORK. Builders of electric locomotives for passenger and freight railways and industrial purposes. A recent development by this company is the construction of steel motor trucks, for definition of which see "Trucks."

BALDWIN-WESTINGHOUSE ELECTRIC LOCOMOTIVES. The use of electric locomotives is becoming more extensive every year, supplanting in many cases the steam locomotives, especially in the congested terminals of large cities. Short railroad lines, tunnels, switching, shops, lumber yards and mines furnish a place where they are very useful. The union of the Baldwin Locomotive Works and this company in the manufacture of electric locomotives has resulted in the highest type of construction. While a large variety of standard designs fill all ordinary requirements, the companies are equipped for building ocomotives of special construction. (See advertisement.)

—WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, PITTSBURG, PA.

—BALDWIN LOCOMOTIVE WORKS, PHILADELPHIA, PA.

BRILL ELECTRIC LOCOMOTIVES. The company builds every type of electric locomotive for hauling freight and baggage cars and for industrial purposes, including mine locomotives. Some are built for hauling only, and are furnished with a commodious cab while others have space for carrying large loads. Locomotives are frequently designed to combine with other purposes such as freight, express, construction and snow plow service. A useful type of locomotive which has been designed for manufacturing plants includes a crane which is operated by the truck motor.

—J. G. BRILL COMPANY, PHILADELPHIA, PA.

—AMERICAN CAR COMPANY, ST. LOUIS, MO.

—G. C. KUHLMAN CAR COMPANY, CLEVELAND, OHIO.

—JOHN STEPHENSON COMPANY, ELIZABETH, N. J.

GENERAL ELECTRIC LOCOMOTIVES. These electric locomotives are manufactured for mining, freight haulage and passenger service. The latest type built in conjunction with the American Locomotive Works is the

100 ton 2,200 hp. locomotive for the New York Central & Hudson River Railroad. These locomotives have developed under test a maximum draw bar pull of 38,400 lbs., and have hauled a 551 ton train at 62 miles an hour. Electric locomotives are adaptable, convenient, safe, economical and reliable. Liberal figures give a cost of maintenance less than half cost for steam locomotive. These locomotives are particularly efficient for heavy, short distance haulage.

—GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

LUBRICANTS, OIL AND GREASE

DEARBORN OILS. The lubricants made by this company embrace a wide variety of greases, mineral stocks, lard, neatsfoot and tallow oils (odorless and free from water), adapted for special requirements. Each oil is distinguished by being named after some fort. The large laboratories conducted by this company enable it to prepare specifications and formulae for proper oil for certain purposes.

—DEARBORN DRUG & CHEMICAL WORKS, CHICAGO, ILL.

GALENA OILS. Compounded of the highest grade of petroleum (unrefined), combined by the company's special process with whale oil and oxide of lead, forming efficient lubricants for all branches of electric and steam railway lubrication. They are the result of over thirty years' experience. The company will furnish, on application, list showing where its oils and greases are being successfully used on the largest railroad systems in the United States. The cost of lubrication with these oils and greases absolutely guaranteed. The company offers the benefit of years of experience on the subject of lubrication. (See advertisement.)

—GALENA-SIGNAL OIL COMPANY, FRANKLIN, PA.

HARRIS LUBRICANTS. As a manufacturer of lubricating oils of many years' standing, this company has bestowed special attention on the requirements of street railways and supplies a full line of high class lubricants, meeting all their needs. Harris valve oils prepared specially for simple and compound engine cylinders and Harris engine oil for external parts, furnish the most satisfactory results in the power house. Harris dynamo and machine oil is extensively used for motors and dynamos; Harris transformer oil is specially prepared for transformers; H. S. machine oil for axle and motor bearings has the lubricating properties and stability required for this purpose and is specially adapted for use in automatic car and motor lubricators; Harris signal oil burns bright, clear, steady and smokeless in signal lamps and yardmen's lanterns; Harris curve grease helps cars around curves, with least strain on wheels, boxes and axles in any weather.

—A. W. HARRIS OIL COMPANY, PROVIDENCE, R. I.

MONITOR DYNAMO AND ENGINE OILS. This company makes a specialty of oils and greases for electric railway machinery.

—THE MONITOR OIL COMPANY, CLEVELAND, O.

LUBRICATING DEVICES

ARMSTRONG JOURNAL OILER. To prevent the carbonization and hardening of the ordinary wick or pad oilers used in journal bearings, this company uses a combination of cotton and wool woven into a plush pad in which a set of buttons in the pad press against the journal, so that the "pile" of the plush brushes it but lightly. The pressure of the journal, therefore, is taken up by the buttons, the "plush" "pile" giving up its oil freely and uniformly.

—ARMSTRONG OILER COMPANY, PHILADELPHIA, PA.

ECONOMY JOURNAL LUBRICATOR AND DUST-GUARD. The lubricating device consists of a steel or fiber wheel provided with ball bearings, carried by a cradle so as to have its upper rim in contact with the lower side of the journal, and its lower portion below the surface of the oil in the bottom of the journal box. The cradle is carried at one end by a stud (having conical bearings) attached to one side of the box, and spring supported at the other end by a hook stud secured to the corresponding side of the box, the whole arranged to cause an upward pressure of the oil wheel against the journal. The contact between the wheel and the journal causes the former to revolve and carry oil to the under side of the journal, whence it is carried up to the edge of the brass and distributed throughout its entire length. The amount of oil supplied to the journal is obviously greatly in excess of that actually required for lubrication, and to prevent waste the maker has devised an oil and dust-guard which has proven most effective. (See advertisement.

—RAILWAY JOURNAL LUBRICATING COMPANY, NEW YORK, MILWAUKEE, CHICAGO.

ECONOMY OIL AND DUST-GUARD. Consists of two malleable iron plates, male and female, separated by four compression springs. The male plate is accurately milled on the exposed side to form a perfect joint against the boss in the dust guard slot of the journal box. This boss, which is on the inside of the outer wall of the dust guard slot, has an annular oil groove in the center, the face of this boss being accurately milled. The opening in the male plate is bored 1-32 in. larger than the dust guard fit on the axle and in this opening are two annular grooves forming an oil-packed joint around the axle, thereby retaining the oil and excluding all dirt. On the lower part of the inside of the female plate, a V-shaped wiper is secured in a movable holder for removing the surplus oil from the axle and returning same to box. The wearing point of the wiper is of soft brass and has a fiber insert, thus assuring long life without cutting the axle. When the exert a total pressure of about 300 lbs., thereby insuring a perfect joint at all times between the milled surfaces of the guard and boss; this pressure or tension also carries the weight of the guard so that it does not rest on the axle, thereby removing the objections to the collapsible type of guards. (For illustrations see advertisement.)

—RAILWAY JOURNAL LUBRICATING COMPANY, NEW YORK, MILWAUKEE, CHICAGO.

HANCOCK AXLE LUBRICATOR. This lubricator consists of a steel frame with parallel bars extending from the cross-bar near the bottom to the top, which act as guides for an oil well within which a disc is pivoted. In the lower portion of this well an opening is provided through which the lubricant passes into the well and after straining is taken up by the disc to the journal. The wheel within the well is adapted to bear against the shaft through the opening in the bottom of the bearing, and, as the journal revolves, the oil is conveyed by the disc to the bearing.

—AXLE LUBRICATOR COMPANY, SAVANNAH, GA.

JOLT OIL CUP. In this cup the jolting of the car operates the feed mechanism, oil being supplied only when the car is in motion. The feed valve is controlled by a spiral spring, a weight resting on the valve stem in such a way that it strikes a hammer-like blow at each jolt of the car, opening the valve to allow a small quantity of oil to escape. This lubricator may be placed inside of regular armature or axle bearing grease cups.

—THE JOLT LUBRICATOR COMPANY, PROVIDENCE, R. I.

LIBERTY GREASE CUPS. The cup for stationary bearings has an automatic spring feed which forces the grease into the bearings. The action of this can be regulated to suit the requirements. The cup for moving bearings has an automatic feed. This can be used on eccentrict, crank pins, cross head, and will lubricate any bearing having a reciprocating motion. The feed of the cup is controlled by the motion of a pendulum on the cup actuated by the reciprocating motion. This action of the pendulum turns a worm attached to a plunger, which forces the grease into the bearing. (See advertisement.)

—LIBERTY MANUFACTURING COMPANY, PITTSBURG, PA.

STAR ARMATURE AND AXLE BEARING OILER. This oiler has been constructed to meet all the demands of a perfect lubricator for armature and axle bearings. It has no parts to get out of order; requires no adjusting; feeds automatically when car is in motion, and shuts the feed off when the car is at rest. It is made to fit every style of standard motor, requires no fastening to, nor any change whatever in the grease cup; can be put in and taken out of the grease cup without any trouble, and is easily cleansed when necessary.

—STANDARD AUTOMATIC LUBRICATOR COMPANY, PHILADELPHIA, PA.

LUMBER, ARTIFICIAL

ASBESTOS BUILDING LUMBER. The insulating quality of this material is very high, and it is being largely used to insulate wires and cables under cars; also for barriers, third-rail insulation, panels, oil switch compartments, circuit-breaker boxes, etc. Being composed largely of asbestos fiber, it is naturally a tough material, not only for electrical work, but for building uses as well. Nails may be driven through it, quite close to the edge, without danger of fracture. It is sufficiently elastic to allow of marked tension due to vibration, expansion and contraction of surrounding parts, wind pressure, etc., without cracking or breaking. One great and desirable feature of asbestos lumber, however, is that it can be successfully joined, fitted, etc., by ordinary mechanics. It can be used for car interiors, and painted, grained, veneered or otherwise treated to make a handsome finish.

—WENDELL & MACDUFFIE, NEW YORK.

"TRANSITE" ASBESTOS FIRE-PROOF LUMBER. Made from especially prepared asbestos and fire-proof binding composition, formed into a hard, firm, fire resisting sheet of great strength and toughness. This material is fire proof, water proof, acid proof and germ proof. For all practical purposes it can be worked like ordinary wood, as regards turning, chiseling, planing, etc. Capable of being oiled, grained, painted or otherwise decorated and can be made in bent or curved sheets. Transite is used extensively for fire proofing electric cars, lining switch boxes, cut-out boxes, controller car linings, roofing, side wall construction, fire proof doors, mouldings, controller covers, etc.

—H. W. JOHNS-MANVILLE COMPANY, NEW YORK.

MACHINE TOOLS

McCABE DOUBLE-SPINDLE LATHES. These double lathes are built for unusual strains, free and easy in their workings, although it will handle any 48 in. lathe job ever done on a 48 in. lathe, the lower swing will also do 20 in. work with every convenience of a lathe of that size. This lathe is used in hundreds of street railway repair shops all over the country.

—J. J. McCABE, NEW YORK.

NILES-BEMENT-POND MACHINE TOOLS. This company makes a specialty of complete machine tool installation for street railway repair shops. It manufactures everything in the line of metal working machinery. The machine tools in most of its recent installations have been driven by direct connected motors.

—NILES-BEMENT-POND COMPANY, NEW YORK.

NILES-BEMENT-POND DRILLS. These machines include vertical drills, radial drills and multiple drills. The Pond radial drill is particularly adapted for heavy work. For lighter work, the Niles universal radial drill has many desirable features.

—NILES-BEMENT-POND COMPANY, NEW YORK.

NILES HYDRAULIC WHEEL PRESSES. These wheel presses are especially designed for pressing electric car-wheels on and off their axles. They will take wheels up to 42-in. in dia. on the tread. This company also builds both larger and smaller presses than the size mentioned.

—NILES-BEMENT-POND COMPANY, NEW YORK.

NILES-BEMENT-POND LATHES. These lathes are built in sizes from 10 in. to 125 in. swing, including precision lathes for the tool-room, rapid reduction lathes for taking off large amounts of metal per minute, turret lathes for manufacturing from the bar, bolts, studs, screws and similar articles, axle lathes for turning both ends of a car axle simultaneously, and car wheel lathes for truing up steel-tired car wheels.

—NILES-BEMENT-POND COMPANY, NEW YORK.

NILES-BEMENT-POND PLANERS AND SHAPERS. These tools are built in all styles and sizes, including shapers for tool room use, crank planers for work up to 24 in. long, and standard planers for work of larger dimensions.

—NILES-BEMENT-POND COMPANY, NEW YORK.

NILES WHEEL BORERS. The 36 in. car wheel borer is especially designed for street railway work and will take wheels up to 36 in. in diameter on the tread. It may be provided with power crane and power hub facing attachment.

—NILES-BEMENT-POND COMPANY, NEW YORK.

MACHINISTS' TOOLS

PRATT & WHITNEY TOOLS. The machinists' tools in this line include taps, dies, milling cutters, reamers, drills, punches, gages and standards. The company's patent process taps, adjustable dies, high speed milling cutters, eccentric relief reamers and high speed drills have earned an enviable reputation.

—NILES-BEMENT-POND COMPANY, NEW YORK.

MECHANICAL DRAFT APPARATUS

(See also Heating and Ventilating Apparatus.)

"ABC" BLOWERS. The term "blowers" is commonly used to describe any kind of machine used for handling air, and hence covers apparatus capable of many applications. The "ABC" steel plate fans and blowers are used in connection with heating, ventilating, drying, cooling and mechanical draft plants; shavings exhausters for the removal of shavings and refuse in wood-working shops; volume blowers for supplying draft to steam boilers and forges, etc; cast iron exhausters for gritty dust from emery wheels, tumbling barrels, etc.; pressure blowers

(INDEX TO ADVERTISERS, PAGES 15 AND 18)

for furnishing draft to cupolas and forges; disc fans for cooling, removing of fumes, etc.
—AMERICAN BLOWER COMPANY, DETROIT.

"ABC" MECHANICAL DRAFT APPARATUS. As applied to boiler practice, the term " mechanical draft " is generally employed in connection with two well-known systems: Forced draft, in which the draft is increased by forcing the air beneath the grates by a blower; and induced draft, in which an exhaust fan draws the gases through the flues and smoke connections, discharging into the chimney, the effect being the same as natural draft, only stronger and always uniform. "ABC" apparatus insures uniform draft, enables the use of cheaper fuel; obviates the necessity for tall stacks; increases boiler capacity; utilizes waste gases; and prevents smoke.
—AMERICAN BLOWER COMPANY, DETROIT.

FOSTER FAN ENGINE OR BLOWER REGULATOR. Governs the speed of the fan, and maintains a practically uniform boiler pressure, with a small percentage of variation. The fan engine type is best adapted for boiler pressure of 100 lbs. or less, and is made of iron, in sizes 1½ in. and larger, while the blower valve is better adapted to the higher boiler pressures, and is fitted with composition body. In both types, provision is made for preventing engine stopping on center or "race" if boiler pressure falls below normal.
—FOSTER ENGINEERING COMPANY, NEWARK, N. J.

GENERAL ELECTRIC MOTOR BLOWERS AND EXHAUST FANS. Have a special field of usefulness in ventilating buildings. The company manufactures both direct current and alternating current motor blower sets adapted to meet given conditions. The motors are constructed with self-oiling and self-adjusting bearings, and renewable dust-proof covers, and are easily accessible for repairs. Blower sets with induction motors or direct current motors can be mounted on the ceiling, floor or wall, as desired. In special cases specifications and prices can be prepared for out-of-ordinary equipments
—GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

GREEN-MATTEAWAN STEEL EXHAUSTER AND PRESSURE BLOWERS. These exhausters and blowers are provided with cast iron housings and are especially designed for high-pressure and high-speed work. The bearings of the exhausters are entirely removed from the action of the material being handled and both exhausters and blowers are of very ample proportions.
—THE GREEN FUEL ECONOMIZER COMPANY, MATTEAWAN, N. Y.

INDUCED DRAFT FANS. Made by Broomell, Schmidt & Steacy Company, New York.

STURTEVANT BLOWERS. These blowers are built in several hundred types and sizes for handling air up to 1 lb. pressure per sq. in. Steel pressure blowers deliver air at high pressure but in small volume. Monogram type blowers and exhausters operate at somewhat less pressure but discharge more air. Steel plate fans are primarily designed to handle large volumes at very moderate pressures. They are especially adapted for ventilating, heating and drying systems, mechanical draft, cooling transformers and the like, and are arranged to be driven by belt or by direct attached engine or motor. Electric propeller fans are designed for pressures under one-half ounce per square inch.
—B. F. STURTEVANT COMPANY, HYDE PARK, MASS.

STURTEVANT FANS. The term "fans" includes all classes of blowers, but particularly applies to the cased steel plate type constructed for the general purposes of ventilation, heating, drying, mechanical draft and the like. They are extensively employed for cooling transformers. Electric propeller fans, designed for light ventilating work requiring operation up to ½ oz. pressure per square inch, are equipped with Sturtevant motors. The advantage of large, slow-running fans is shown by the fact that doubling the speed increases the power required eight-fold. (See also Blowers.)
—B. F. STURTEVANT COMPANY, HYDE PARK, MASS.

GREEN-MATTEAWAN MECHANICAL-DRAFT APPARATUS. Many large power plants are now fitted with mechanical draft, which is especially favorable to the use of the Green fuel economizer, since, as the heat of the flue gases is no longer needed for draft, it may be used in heating feed water, while at the same time the economizer helps the fans, as it greatly reduces the temperature and volume of the gases to be handled.
—THE GREEN FUEL ECONOMIZER COMPANY, MATTEAWAN, N. Y.

STURTEVANT MECHANICAL DRAFT. Mechanical draft is produced by means of a fan and may be introduced either as forced draft or induced draft. It does what an ordinary chimney is incapable of doing. Its cost is from 20 to 40 per cent. of that of a chimney; its intensity permits of the burning of finely divided or low grade fuel; it makes possible the utilization of the heat of the flue gases which a chimney wastes in producing draft; it is independent of the weather; is automatically regulated to maintain constant steam pressure, decreases smoke, increases the capacity of an existing plant, and serves as an auxiliary to a chimney already overburdened; saves space and is portable.
—B. F. STURTEVANT COMPANY, HYDE PARK, MASS.

GREEN-MATTEAWAN STEEL PLATE EXHAUSTERS. Exhausters are distinguished by having only one inlet opening, which is on the side opposite from the bearings, while fans and blowers have an inlet opening upon each side. The exhausters are built with any style of discharge and with the bearings upon either the right or left hand side, as may be desired. The bearings of these exhausters are outside the casing and are not exposed to the action of the material handled, such as dust, hot air, flue gases or exhaust steam.
—THE GREEN FUEL ECONOMIZER COMPANY, MATTEAWAN, N. Y.

GREEN-MATTEAWAN STEEL PLATE FANS. The side plate and housing of these fans are made from a high grade of steel plates, carefully rolled true and flat. The angle iron frame to which the plates are riveted and bolted is so designed and braced as to give rigidity where most needed and prevent the plates from warping and buckling. Larger sized fans which it is necessary to take to pieces for shipment or for taking into buildings are specially constructed to facilitate erection.
—THE GREEN FUEL ECONOMIZER COMPANY, MATTEAWAN, N. Y.

MICA AND MICA COMPOUNDS

MICANITE. This covers a line of insulations made from exceedingly thin laminations of mica and an adhesive cement. The standard form is in flat sheets from .005 in. and upward, and in two grades: No. 1, for commutator rings, armature troughs, cylinders, tubes, etc., so that the adhesive cement softens under heat, and the plate is easily moulded; No. 2 for commutator segments and other purposes where moulding is not desirable. The company also manufactures flexible micanite, micanite cloth and paper, commutator rings and segments, armature troughs, field spools, tubes, etc. (See advertisement for other materials.)
—MICA INSULATOR COMPANY, NEW YORK.

SCHOONMAKER SOLID SHEET MICA. This mica, for electrical work, embraces white India, white domestic, green India, and Canadian amber. It can be furnished in uncut sheets, block mica or cut to any size, from 1 in. by 1 in. to 12 in. by 12 in. Segments can be furnished for any commutator, also mica washers or tubings, mica plate, flexible mica cloth or paper, insulating cloths and papers, and mica rings for any commutator can also be furnished.
—A. O. SCHOONMAKER, NEW YORK.

MOTORS, ELECTRIC

BULLOCK SMALL MOTORS AND GENERATORS. Small motors and generators, known as Type "N" and "B," are made by this company. The cast steel magnet yoke is cylindrical and the bearings carried in housings bolted to the yoke. Type "N" motors are designed especially for direct connection to machine tools. Either can be made semi-enclosed or totally enclosed by using suitable shields on the end housings. Slow speed "B" motors, open type, range in output from 1 h.p. at 1,100 r.p.m. to 25 h.p. at 775 r.p.m.; moderate speed-range from 2 h.p. at 1,800 r.p.m. to 35 h.p. at 1,175 r.p.m. Type "N" range in output from ½ h.p. at 300 r.p.m. to 100 h.p. at 900 r.p.m. Both types have laminated poles bolted to the magnet yoke.
—ALLIS-CHALMERS COMPANY, MILWAUKEE, WIS. (ELECTRICAL DEPARTMENT, BULLOCK ELECTRIC MANUFACTURING COMPANY, CINCINNATI, OHIO.)

BULLOCK BELTED TYPE DIRECT-CURRENT MOTORS AND GENERATORS. The standard belted motors and generators for direct-current, Types "H" and "HI", are made in sizes from 7.5 Kw. at 390 r.p.m., 120 volts, to 500 Kw. at 400 r.p.m., 500 volts. Machines having armatures 31 in. in diameter and over are provided with three bearings. In Type "H" machines, the brush rocker is carried on the bearing pedestal, while with Type "HI" it is carried by the magnet yoke. Both types have cast iron magnet yokes with laminated poles bolted in place. "H" and "HI" machines are wound for standard pressures of 110, 240 and 500 volts.
—ALLIS-CHALMERS COMPANY, MILWAUKEE, WIS. (ELECTRICAL DEPARTMENT, BULLOCK ELECTRIC MANUFACTURING COMPANY, CINCINNATI, OHIO.)

BULLOCK CAR EQUIPMENTS, MOTORS, CONTROLLERS, ETC. This company makes railway motors of the usual standard sizes for operation on 500 volt direct current, and is prepared to furnish complete car equipments, including controllers, car circuit breakers, and other auxiliary devices. The motors, which are of modern design, include a number of new and desirable features. The controllers are very substantially constructed and are of the magnetic blow-out type.
—ALLIS-CHALMERS COMPANY, MILWAUKEE, WIS. (ELECTRICAL DEPARTMENT, BULLOCK ELECTRIC MANUFACTURING COMPANY, CINCINNATI, OHIO.)

CLEVELAND DYNAMOS AND MOTORS. The electrical machinery made by this company is direct current only, and ranges in capacity from eight to one hundred and fifty 16 C.P. lights and ½ h.p. to 10 h.p. The machines have cast iron frames, semi-enclosed, steel poles, toothed armature, reaction brush holders, and self oiling bearings.
—CLEVELAND ARMATURE WORKS, CLEVELAND, OHIO.

CROCKER-WHEELER MOTORS. Every power requirement in the machine or repair-shop can be readily met by one of this company's extended line of motors. During the past seventeen years it has developed a line capable of meeting the most intricate and exacting conditions. One of the most celebrated motors is the Form L, built for small power requirements. This form is described in the company's Bulletin No. 160.
—CROCKER-WHEELER COMPANY, AMPERE, N. J.

GENERAL ELECTRIC MOTORS. These motors are built for all kinds and conditions of service. The company's latest product for street railway service is known as the G.-E. 80. It is a 40 hp. motor combining all the best mechanical and electrical features of older designs, in addition to improvements of exceptional value. It has split bearings lubricated with oil and packed waste, large bearing surfaces, and wide gear and pinion faces. The gear case is suspended from three points, and extra large bolts are used throughout to insure strong and rugged construction. Cast-iron parts are eliminated.
—GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

INTER-POLE VARIABLE SPEED MOTOR. It appeals most strongly to electric railways as it is a variable speed motor which operates successfully on a 550 volt circuit. This enables repair shops to run their machine tools by electric drive, whether singly or in groups, as best indicated by conditions. It is claimed that the inter-pole motor is absolutely sparkless at any speed within its range, which in a 7½ hp. motor is from 300 to 1,200 r.p.m. and will not spark even under 100 per cent. overload. Its compactness, capacity and lightness are most remarkable when compared with other motors and an efficiency of from 91.5 per cent. at one-half load to 92 per cent. at three-quarter load needs no argument.
—THE ELECTRO-DYNAMIC COMPANY, BAYONNE, N. J.

STURTEVANT ELECTRIC MOTORS. Although these motors are built for independent service, a specialty is made of attaching them to fans which demand special combinations of speed and power. These motors are built in a line of bi-polar, four-pole and eight-pole types, dependent upon size and requirements. The enclosed type prevails for fan propulsion where there is considerable dust. They range in output up to 125 horse-power. The rigid specifications of the U. S. Navy Department, under which many fan motors have been constructed, have established an exceptionally high standard which is maintained in all work.
—B. F. STURTEVANT COMPANY, HYDE PARK, MASS.

WESTINGHOUSE DIRECT-CURRENT RAILWAY MOTORS. The application of electricity as a motive power on steam roads has created a demand for larger motors, so that now motors of 300 h.p. capacity and able to withstand considerable overload are being built by this company. A type of motor recently furnished the Pennsylvania, New York & Long Island R. R. has an output of 200 h.p., at 300 amps. and 550 volts. The armature alone weighs 1,980 lbs. and the motor complete 6,450 lbs. Up to the present time the Westinghouse Electric & Manufacturing Company has furnished approximately 75,000 railway motors, aggregating a total capacity of 2,500,000 h.p.
—WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY PITTSBURG, PA.

WESTINGHOUSE INDUCTION MOTORS. Induction motors as a class are characterized by the ruggedness of their construction and the small amount of atten-

tion required in operation. The flexibility of the alternating-current system has brought these machines into great favor. This company manufactures these motors in a number of different types for both constant and variable speed work. Type CCL motors have the well-known squirrel cage rotor, while the HX, HI and LX have secondary windings similar to those of a polyphase generator and have their speed varied by inserting resistance in the secondary circuit.

—Westinghouse Electric & Manufacturing Company, Pittsburg, Pa.

WESTINGHOUSE SINGLE-PHASE RAILWAY MOTORS. These motors do not differ greatly in appearance from the direct current series motors. A laminated core of steel punchings with inwardly projecting poles is held in a cylindrical frame of cast steel. The poles are wound with coils of heavy wire or copper strap, and an auxiliary compensating winding is also provided threaded through slots in the pole tips and field frame. All field and armature windings are in series. The armature differs but little in appearance from a direct current railway armature. These motors are made up to 225 h.p. and operate on line voltages as high as 6000. The controlling devices may be so arranged that a car may operate on alternating current when in the country and on direct current over city lines. (See advertisement.)

—Westinghouse Electric & Manufacturing Company, Pittsburg, Pa.

WESTINGHOUSE STATIONARY DIRECT CURRENT MOTORS. Type S direct current motors are made from 1½ h.p. to 120 h.p. for 110, 220 or 500 volts, and with series, shunt or compound windings, for constant or variable speed, and for service on single, double or multi-voltage circuits. A wide range of speed may be obtained by shunt field control. They are used for the driving of machinery of every form. Type S motors may be either open, semi-enclosed or entirely enclosed. The three forms are convertible, which is a decided advantage where desirable to shift a motor from one place to another. These motors are easily adapted for wall or ceiling mounting. They may be arranged with back gears or vertical shafts, for direct connection or for driving by belts.

—Westinghouse Electric & Manufacturing Company, Pittsburg, Pa.

MIRRORS FOR MOTORMEN

BROWN MIRRORS FOR MOTORMEN. These mirrors enable the motorman to see side of car to the rear platform without moving from his position or turning his head. They save money by preventing accidents caused by starting signals given by conductor while collecting fares inside of crowded cars. The mirrors are cork-cushioned and mounted on double spring hinges so as to swing clear when struck by vehicles or obstructions. (See advertisement.)

—Harold P. Brown, New York.

MOVERS, CAR

(See "Pushers, Car")

MULTIPLE UNIT CONTROL

(See "Control Systems")

NUTS AND BOLTS

BLISS CROWN NUTS. The crown nut is made of very tough malleable iron and is hexagonal in shape, having five or six prongs on the top, is tapped and threaded for standard dimensions, and faced on the underside. The nut is screwed home and the cotter pin is then inserted through a hole in the bolt and between the prongs on either side of it, thus securely locking the nut from jarring loose. Lock washers are unnecessary with this nut. Nuts for ⅞-in. and ¾-in. bolts are carried in stock.

—E. W. Bliss Company, Brooklyn, N. Y.

COLUMBIA LOCK NUT. The nut consists of an inner and an outer part, which when assembled form a unit. The inner nut, which is threaded to receive the bolt, is slotted throughout its length and is tapered from above downward to fit and correspond with the taper of the outer or binding nut. The device is a combination of three mechanical powers—although only in two parts—the wedge, the screw and the lever. It is a positive lock nut which will remain indefinitely where placed; it automatically fastens both bolt and nut absolutely.

—U. S. Metal & Manufacturing Company, New York, Chicago, Pittsburg.

LORAIN TRACK BOLTS. Manufactured with button heads and oval necks and provided with either square or hexagonal nuts. (See advertisement.)

—The Lorain Steel Company, Philadelphia, Pa.

NATIONAL LOCK WASHER. This is a positive spring nut lock for use on all kinds of work. Over 310,000,000 have been used in railroad track alone. It is made for all sizes of bolts. Its use requires but one nut, and that will remain positively locked. A nut lock that does fasten a nut, not dependent on spring holding power alone.

—The National Lock Washer Company, Newark, N. J.

SPIRAL NUT LOCK. This nut prevents the nut from screwing off the bolt. It is necessary for every bolt where it is important that the nut should stay in its proper position. It is made of special tempered steel wire of triangular shape, and the spiral is made to conform to the angle of the United States standard thread, so that it grips the bolt independently of the nut; this prevents the nut from unscrewing off the bolt. This nut is guaranteed to grip the bolt.

—Spiral Nut Lock Company, New York.

OILS

(See "Lubricants")

OILS, PAINT

SIPE'S JAPAN OIL. A self drying paint oil. Japan oil is not a substitute for linseed oil, but combines the good qualities of linseed oil with other products that add to the life of the paint. For binding and holding paints to either wood or metallic surfaces, it is claimed superior to linseed oil. On account of its elasticity and adhesive qualities, it will neither crack, blister nor peel off. Japan oil will stop and prevent rust if the surface is dry when coated. It forms a coating impervious to air and moisture.

—James B. Sipe & Company, Allegheny, Pa.

OIL AND WASTE SAVING MACHINES

OIL AND WASTE SAVING MACHINES. These machines are turbine engines with direct connected basket or waste receptacle in which the oily waste is placed to be reclaimed. The oil is separated from the waste by centrifugal force and the steam as the engine exhausts itself through the waste. The oil is then filtered, and the waste dried and used as new oil and waste. Operation requires thirty minutes and costs practically nothing as the engineer in charge of the power stations gives but a few minutes daily to the machine.

—Oil & Waste Saving Machine Company, Philadelphia, Pa.

OIL FILTERS

(See "Filters, Oil")

OVERHEAD EQUIPMENT

(See Line Material.)

PACKING

DUVAL METALLIC PACKING. This packing is for engines using superheated steam. It is equally good for packing steel or cast iron plungers working in water or oil, and for accumulators. It has been used extensively on heavy pressures, from 500 to 1,000 lbs. per sq. in. The packing consists of fine composition wire coated with anti-friction metal, plaited into square form. Sections of proper length to form rings are cut off with hacksaw or wood chisel and after binding ends with light wire to prevent fraying are soaked in graphite and oil and laid in the stuffing box, the joints being broken. Duval packing has lasted over seven years without renewal. It is not recommended on brass rods.

—Power Specialty Company, New York.

J-M PACKING. While the specialty of this company is asbestos packings, which include the well known Kearsarge and Vulcabeston materials, together with its latest production—Triplex sheet and Duplex hot water packing—it is prepared to meet the call for other packings, such as rubber, flax and cloth insertion goods. The company is always ready and willing to discuss packings for new conditions, its line of "specials" having often proved "a friend in need" to many engineers. (See advertisement.)

—H. W. Johns-Manville Company, New York.

METALLIC PACKING. This company's standard class No. 1 design of metallic packing for piston rods and valve stems of steam engines consists of two sets of packing arranged in tandem. By means of a ball and socket joint absolute flexibility is attained. This packing will give satisfaction if rod runs out of line. Friction and wear on rods are reduced to a minimum and rods are kept in perfect condition. Renewals needed only at long intervals and are easily made without disconnecting.

—The United States Metallic Packing Company, Philadelphia and Chicago.

MORRIS FIBROUS BABBITT STEAM PACKING. This packing fits any stuffing box regardless of size. It is as frictionless as oil and self lubricating. This packing will not score or bind the rod and can stand any steam pressure up to 200 lbs. without fusing. It does not have to be taken out, as a little refilling in case of a leak is all that is wanted.

—Elmer P. Morris Company, New York.

RAINBOW PACKING.

—Peerless Rubber Manufacturing Company, New York.

SUPERHEATED STEAM BRONZE GASKETS. These gaskets have been found to give excellent satisfaction in flanged joints of pipes carrying superheated steam. They are corrugated evenly with sharp ridges. The metal is well suited to high temperatures and has elastic properties tending to maintain tight joints.

—Power Specialty Company, New York.

PAINTS AND VARNISHES

(See also Insulating Compounds.)

ATLAS PAINTS. These embrace I. X. L. paints for wood and iron; Atlas primer, which takes the place of oil or paste-wood fillers, and Atlas surfacer, to take the place of lead and oil surfaces for passenger cars.

—Atlas Railway Supply Company, Chicago, Ill.

ELASTIC INSULATING VARNISH. Designed especially for use on all types of armatures, field magnet and transformer coils where maximum elasticity is required. Break down about 900 volts per mil. Bakes in eight to ten hours at 190° F.

—Standard Varnish Works, New York, Chicago, London—or International Varnish Co., Ltd., Toronto, Canada.

ELATEROID PRESERVATIVE COATING. The basic material of these preparations is obtained from natural deposits, and is a pure hydro-carbon treated by new processes controlled by this company. In its physical and chemical features it closely resembles rubber, so that in the form of coatings it possesses great elasticity, ductility and durability. It contains no destructive or disintegrating element, and may be applied to or combined with any material or substance without injury or detriment thereto. Elateroid is manufactured in all degrees of hardness, ductility, pliability, melting point and cold test, and in its physical features and actions is susceptible to almost infinite variations and regulation, whereby it is readily adaptable to a great variety of uses and purposes. It also possesses great features of insulation, and by its closeness of composition and great adhesion, forms an impervious coating for the preservation of anything to which it may be applied.

—The Hydro Carbon Manufacturing Company, Denver, Colo.

ELECTRO BLACK FINISHING VARNISH. A black air-drying finishing and insulating varnish for use in the repair shops of large and small electric railways for painting over fields and armatures of railway motors and repairing slight breaks in insulation. Air dries in half an hour, has good insulating properties, is absolutely waterproof and does not become brittle or crack.

—Standard Varnish Works—New York, Chicago, London—or International Varnish Co., Ltd., Toronto, Canada.

FLEXITE METAL PRESERVATIVE PAINTS. These paints are for protecting metal and other surfaces exposed to the weather, dampness, salt air, water and corrosive gases. They are made from inert pigments, and the vehicle contains pure refined linseed oil in combination with one of the most refractory materials known. This is a natural substance, and it alone has shown itself to be an exceptional resistant to the conditions mentioned. Linseed oil alone dries to an absorbent film comparable in a sense to a sponge; its micro-structure is entirely altered when used in conjunction with the material employed. The dried films in these paints present a compact, homogeneous mass, which ensures the exclusion of moisture and destructive gases. These paints impart a highly lustrous coating, and will retain their gloss under long exposure. A hard coat will form within twelve hours under ordinary conditions.

—The Standard Paint Company, New York.

GUTTA-PERCHA MICA STICKING VARNISH. Designed for use in making up flexible mica plate, etc. Air dries or may be baked at a low heat.

—Standard Varnish Works—New York, Chicago, London—or International Varnish Co., Ltd., Toronto, Canada.

(CONTINUED ON PAGE XXXIII.)

(INDEX TO ADVERTISERS, PAGES 15 AND 18)

PAINTS AND VARNISHES—Continued.

GUTTA-PERCHA BLACK FINISHING VARNISH. A black spirit varnish for use as a finishing coat on armatures and fields. Dries in the air in half an hour. Has good insulating properties and gives a glossy finish which will not fade. Is oil and water proof. Invaluable for use in brightening up fields and armatures of generators in central station lighting and power plants, because it can be applied to the fields and armatures of a dynamo and the machine may be started up in half an hour.
—STANDARD VARNISH WORKS—NEW YORK, CHICAGO, LONDON—OR INTERNATIONAL VARNISH CO., LTD., TORONTO, CANADA.

GUTTA-PERCHA COIL STICKING VARNISH. Designed especially for sticking varnished paper and cloth which is used for insulation on armature and field coils. Sets quickly and has excellent sticking qualities. Is not soluble in water and possesses good insulating properties.
—STANDARD VARNISH WORKS—NEW YORK, CHICAGO, LONDON—OR INTERNATIONAL VARNISH CO., LTD., TORONTO, CANADA.

GUTTA-PERCHA CLOTH VARNISH. An extremely elastic and durable varnish for coating cloth and paper for electrical work. Can be applied either by machine or by hand dipping. Break down 825 volts per mil.
—STANDARD VARNISH WORKS—NEW YORK, CHICAGO, LONDON—OR INTERNATIONAL VARNISH CO., LTD., TORONTO, CANADA.

GUTTA-PERCHA INSULATING VARNISH. A clear baking varnish used as a dipping varnish for armature coils, field coils, transformer coils, both air and oil cooked, magnet coils, etc. Break-down about 850 volts per mil. Requires from eight to twelve hours to dry under a temperature of 190 F., depending on depth of wire in coil.
—STANDARD VARNISH WORKS—NEW YORK, CHICAGO, LONDON—OR INTERNATIONAL VARNISH CO., LTD., TORONTO, CANADA.

GUTTA-PERCHA LIGHT FINISHING VARNISH. A spirit varnish designed for use on armatures and fields of rotary converters and generators when the windings are insulated in light varnish. It brightens up fields and armatures and greatly improves the appearance of all machines to which it is applied, besides reinsulating and providing an oil and weather proof coating. Dries in half an hour.
—STANDARD VARNISH WORKS—NEW YORK, CHICAGO, LONDON—OR INTERNATIONAL VARNISH CO., LTD. TORONTO, CANADA.

GUTTA-PERCHA QUICK DRYING VARNISH. A combined baking and air drying clear varnish of great elasticity for use on all classes of coil work where quick drying is required. Break down about 880 volts per mil. of thickness. Bakes in four to six hours at 190 F. Will air dry over night. Specially adapted for use by manufacturers who have limited baking facilities and for small electric railways and repair shops where baking ovens are not used.
—STANDARD VARNISH WORKS—NEW YORK, CHICAGO, LONDON—OR INTERNATIONAL VARNISH CO., LTD., TORONTO, CANADA.

HEAT RADIATING VARNISH. A varnish combining high insulation with superior heat conducting and radiating properties. Has high power of penetration and may be used as a dipping varnish for field, magnet spools and other windings. Reduces working temperature of windings through ability to conduct and radiate heat.
—STANDARD VARNISH WORKS—NEW YORK, CHICAGO, LONDON—OR INTERNATIONAL VARNISH CO., LTD., TORONTO, CANADA.

LUCAS PAINTS AND VARNISHES. These comprise a complete line of standard goods for the electric railway field as well as for general use. The company's coach and car colors, signal colors, station paints, enamels, car varnishes and Mirac varnish and paint remover are among the more prominent, but any of their products will be found equally satisfactory. This firm is one of the largest in the country, with a modern, well-equipped plant, whose output reaches every part of the world.
—JOHN LUCAS & COMPANY, NEW YORK, PHILADELPHIA, CHICAGO.

MACON LIGHT COLORED INSULATING VARNISH. A baking varnish possessing all requirements for perfect insulation. It is designed for use on armature coils, field coils, transformer coils, magnet coils, and wherever else a baking varnish should be used. It is a high insulator, very elastic and is not affected by the action of moisture or lubricating oils. It should be baked for eight or ten hours at a temperature of from175 deg. to 195 deg. (80 deg. to 90 deg. C.)
—MACON-EVANS VARNISH COMPANY, PITTSBURG, PA.

MIRAC VARNISH AND PAINT REMOVER. Almost instantly removes old varnish, shellac, enamel and paint from wood, iron and glass, leaving the surface clean and ready for finishing. Harmless to hands and not irritating to the eyes. It has no unpleasant odor. It is also an excellent brush cleanser; will not raise the grain or stain wood or injure hair or bristles of brushes. This material contains no ammonia, no alkali, water or acids, and is said to go much further and not evaporate like alcohol. Recommended for removing old paint, varnish, enamel, etc., from floors, furniture, front doors, store fronts, carriages, car blinds, inside shutters and exterior and interior wood, glass and iron work of all kinds. One gallon will remove from 250 sq. ft. to 300 sq. ft. of old finish.
—JOHN LUCAS & COMPANY, PHILADELPHIA, PA.

MORRIS INSULATING PAINT. Made for armatures, fields, switchboards, conduits, iron and wood poles, connections, mouldings, wires, cut-out boxes, lamp hoods, and all other kinds of electrical appliances where high insulation is desired. It contains no crude asphalts, tar, of other deleterious substances. It contains quick drying natural oils. It makes a lasting gloss equal to varnish; does not crack, blister or peel off; not affected by any extremes of climates, and loses none of its properties under 550 deg. to 600 deg. F. It is also a wood preservative. It will stand the action of any acids, alkalies, oils or salines, and is absolutely water repellant, hus preventing the absorption of oils and moisture and consequent lowering of insulation.
—ELMER P. MORRIS COMPANY, NEW YORK.

OHMLAC. A black insulating compound for dipping armatures and armature and field coils, possessing the remarkable property of being unaffected by continued high temperatures and consequently invaluable for the insulation of motors subject to heavy overloads. Contains no linseed oil and there is "no rotting" of the cotton covering of wires under continued high temperature. Quick drying, high insulation and great elasticity. (See advertisement.)
—EMIL CALMAN & COMPANY, NEW YORK.

SHERWIN-WILLIAMS SYSTEM OF CAR FINISHING. This consists of S-W primer and surfacer (foundation coats), S-W. standard car body (for color coats), and S-W. railway varnishes (roof or protecting coats), each made with special reference to its use with the other two. The logical result is a perfectly homogeneous and well-knit body of coats. This finishing insures maximum durability and a uniformly clear and smooth finish. Paints are also furnished for all parts of cars, buildings, poles, bridges, targets and machinery.
—THE SHERWIN-WILLIAMS COMPANY, CLEVELAND, OHIO.

S. P. C. ARMATURE AND FIELD COIL VARNISH. Made for armature and dynamo work. It gives a hard, glossy surface, and will not soften at a temperature up to 300 deg. It is absolutely moisture proof; a perfect insulator, and has elastic properties which will not allow it to crack or flake off.
—THE STANDARD PAINT COMPANY, NEW YORK.

S. P. C. FLEXIBLE IRON PAINT. A paint for bridges, water-tanks and all metal or woodwork exposed to the weather. For coating metal roofs and for the running gear of cars. It is weather-proof, elastic and resists acids and alkalies. It will not blister or peel.
—THE STANDARD PAINT COMPANY, NEW YORK.

STERLING PAINTS AND VARNISHES. Sterling black iron enamel and Sterling elastic iron finish black are especially adapted for use on iron and steel bridges, steel cars, buildings, roofs, signal towers, tanks, water and gas pipes, etc. Sterling black hull varnish is intended for the protection of metal work exposed to an unusual quantity of water, such as vessel hulls, pen stocks, etc. Sterling hot iron black is for use on flues, boiler fronts, smoke stacks, locomotive front ends, etc. The company's claim of merit for these materials is based upon the use of Sterling raw refined linseed oil in these paints. This oil is pure commercial raw linseed oil from which all those substances have been removed which cause linseed oil when spread on a surface to dry to a porous film. This linseed oil spread on a surface and dried is not porous. The pigments used in the above coatings are of the most durable nature.
—THE STERLING VARNISH COMPANY, PITTSBURG, PA.

THE STERLING VARNISH COMPANY, PITTSBURG, PA. In their recent treatise on "The Insulation of Electric Machines," (Whittaker & Company, 1905), Turner & Hobart say: "One of the earliest firms " (The Sterling Varnish Company), "to enter this field brought out Sterling varnish, which enjoys a wide use. It would appear that the materials now supplied under that name are considerable improvements upon the original varnish placed on the market." This space is too limited to furnish a list of the company's products, much less to indicate their individual application. The company maintains a well equipped laboratory and a corps of specialists who are continuously engaged on insulating problems for the benefit of its customers as well as its own. (See advertisement.)

SUPERIOR GRAPHITE PAINT. A protection for metal surfaces against rust. Basis is an inert amorphous graphite which, being ground to exceeding fineness, insures an absolute protection for the elastic oil coating. A notable feature is its power to absorb rust or moisture on the metal, thereby arresting corrosion, which is otherwise liable to start under the paint skin. It is adapted for electric railways, especially upon bridges, structural steel in buildings, corrugated iron, poles, stacks, trucks, etc. It is also used extensively upon brick, stone, wood and canvas.
—DETROIT GRAPHITE MANUFACTURING COMPANY, DETROIT, MICH.

VOLTALAC AIR-DRYING VARNISH. A black plastic varnish of extreme durability, especially adapted for use on street railway motor armatures and field coils. Sets to handle in half an hour and coils insulated with it air dry sufficiently to assemble in two to four hours. It may also be baked in one-half the time in case of hurried work. Is a neutral product and may be used as a first coat next to copper on windings of high tension machines, without danger of corrosion. Remains plastic and withstands heat for an indefinite period. Is absolutely waterproof. Break down about 900 volts per mil.
—STANDARD VARNISH WORKS—NEW YORK, CHICAGO, LONDON—OR INTERNATIONAL VARNISH CO., LTD., TORONTO, CANADA.

VOLTALAC ELASTIC VARNISH. A black baking varnish of high and uniform insulation. Break down averages from 1,000 to 1,100 volts per 1-1,000 in. of thickness. Requires nine to twelve hours to bake, at a temperature of 200°F. Is strong and elastic, yet yielding and plastic, thus enabling coils to be assembled in armatures with a minimum of labor and without danger of breaking the insulating film of varnish. Resists long continued heat without becoming brittle, withstands the action of water, moisture and lubricating oil. Has high power of penetration, thus ensuring best results from heat conduction and radiation.
—STANDARD VARNISH WORKS—NEW YORK, CHICAGO, LONDON—OR INTERNATIONAL VARNISH CO., LTD., TORONTO, CANADA.

PANELS, SEAT END

BRILL OPEN CAR SEAT-END PANELS. Metal round-corner seat-end panels for open cars give more entrance space, and as there are no sharp projecting corners to strike the knees against and catch in dresses, passengers may get in and out more safely and quickly than with the old style. They enable the conductor to move more freely and safely along the running-board, and give him more space to stand while collecting fares. The double curvature of the panels makes them very strong, so that they aid materially in stiffening the posts and supporting the seats. Curtain grooves are cast in the panels, allowing the curtains to be drawn to the floor. (Advertisements in last pages.)
—J. G. BRILL COMPANY, PHILADELPHIA, PA.
—AMERICAN CAR COMPANY, ST. LOUIS, MO.
—G. C. KUHLMAN CAR COMPANY, CLEVELAND, OHIO.
—JOHN STEPHENSON COMPANY, ELIZABETH, N. J.

PARK ATTRACTIONS

THE AEROSTAT. A safe and sane circle swing. Consists of a six-leg steel tower, gusset plate bridge construction, over which is telescoped a solid steel cantilever crown truss with six or more radiating arms. The crown truss rests upon 153 1-in. steel balls each held by a special ball retainer, traveling in its own path between two case hardened plates. The cars are suspended from the crown truss arms and the safety of the passengers is in no way dependent upon any part of the machinery. A thirty-six passenger swing requires 6½ hp. to operate. No brakes are used, yet by the use of the controlling device, the swing can be brought to a dead stop without a jar in thirty seconds. The structure is an ornament to any park, and when lighted presents a magnificent spectacle.
—FEDERAL CONSTRUCTION COMPANY, CHICAGO, ILL.

AMERICAN BOX BALL ALLEY. This is an automatic bowling alley well suited for parks, aside from

its value as an indoor entertainment. No helper is required to set pins and return balls, as the pins are set by a touch of a lever and the balls return by gravity. The game is scientific, as one pin is not depended on to knock down another. Easily installed and portable. Strongly built of oak, and handsomely finished in the natural color. Regular lengths, 30, 36, 42 and 48 ft. always kept in stock.
—American Box Ball Company, Indianapolis, Ind.

ARMITAGE-HERSCHELL MINIATURE RAILWAYS. The No. 1 miniature railway train made by this company draws twenty-four adults and is furnished with air brakes throughout; the No. 2 train is lighter and has air brakes only on the locomotive. These brakes are capable of stopping a loaded train at 15 m.p.h. in less than its own length. The locomotives usually employed for these trains develop 7.5 hp., at 15 miles per hour.
—Armitage-Herschell Company, North Tonawanda, N. Y.

ARMITAGE-HERSCHELL RIDING GALLERIES. The merry-go-rounds made by this company are produced in great variety of forms at costs ranging from a few hundreds to thousands of dollars, the more expensive styles having elaborate carvings, organs and other attractive accessories.
—Armitage-Herschell Company, North Tonawanda, N. Y.

AUTOMOBILE CYCLE SKATE. Among the improved skates made by this company, the automobile cycle skate deserves special mention. It has ball bearings, 5-in. rubber-tired wheels, metal parts of sheet steel and is finely nickel-plated. It appeals to both young and old, being adapted for use in skating rinks or on smooth sidewalks.
—Cycle Skate and Sporting Goods Company, New York.

AUTOMATIC GUM VENDING AND WEIGHING MACHINES. This company furnishes both the confection and weighing machines free of charge. In the case of the confection machine, the only obligation is to purchase and keep it filled with Huyler's chocolate and St. Nicholas gum, which is supplied by the company. In the case of the weighing scale, a liberal commission is allowed for the small space which it occupies. Both machines are entirely automatic, require no attention whatever, and may be placed nearly anywhere in parks and pleasure resorts, stations, waiting rooms, etc.
—The Automatic Vending Company, New York.

BAYONNE ELECTRIC LAUNCHES. Pleasure grounds fortunate enough to contain a lake or to be located on a waterway will find a good source of profit in the hiring of electric launches. This company has built a great many motor boats for pleasure purposes, and believes that only an electrically operated boat can afford the safety so essential where most of the passengers are children.
—The Electric Launch Company, Bayonne, N. J.

BETHLEHEM PARK BENCHES AND TABLES. This company is one of the largest manufacturers in the country of outdoor benches, cafe tables, iron work for parks, lawns, gardens, waiting rooms, etc. The settees or benches and tables are made so as to be shipped complete in knocked-down shape and can be set up and finished by an ordinary workman at little cost. When not otherwise specified, all woodwork is of ash, oil finish, and iron painted dull black.
—Bethlehem Foundry & Machine Company, South Bethlehem, Pa.

BIOGRAPH MOTION PICTURES. Originators of "The Horse Thief," "River Pirates," "Personal," "The Lost Child," "The Escaped Lunatic," "The Moonshiners," "The Chicken Thieves," "The Nihilists," and other great hits. This company furnishes its own and all other makes, and can offer either a complete service of machine, operator and films, or of films alone, and are also the sole manufacturers of the well-known penny-operated moving picture machine, the motoscope.
—American Mutoscope & Biograph Company, New York.

EDWARD C. BOYCE, NEW YORK. Designs, erects and operates amusement resorts and individual devices; furnishes plans and specifications and superintends erection; or, builds under contract. Mr. Boyce is prepared to organize amusement corporations; furnish all or a portion of the necessary capital; or build for the company and base his charges upon the cost of construction, either estimated or actual. This service includes expert advice and the benefit of exceptional resources in matters of purchase of material, machinery, renting concessions, institution of operating systems, advertising and general management. Many of the devices are patented and under his exclusive control. These are sold either outright or on royalty, granting exclusive territory. Mr. Boyce will submit a proposed arrangement with a suitable selection of devices, and give detailed estimates as to cost. Among Mr. Boyce's accomplishments are the erection of "The White City," Chicago; Dreamland, Coney Island, N. Y., and "The White City," New Haven, Conn.

BOYCE CANALS OF VENICE. This is considered one of the finest attractions in Dreamland, Coney Island. There are running through the interior of the building a quarter mile of canals which wind and encircle all of the most beautiful portions of this romantic city. Passengers are transported in gondolas by a swiftly moving current. The great plaza of St. Mark, the palace of the Doges, Rialto Bridge, Church of Santa Maria Della Sulute, palace in which Desdemona lived, Bridge of Sighs and the open sea leading into the Adriatic are some of the many picturesque features of a trip through this beautiful attraction.
—Edward C. Boyce, New York.

BOYCE FIGURE EIGHT ROLLER COASTER. As a five cent attraction, the figure eight or roller coaster has no equal in popularity and earning power. It is inexpensive in installation and its operating expenses are nominal. Can be planned to suit any shape of ground.
—Edward C. Boyce, New York.

BOYCE SCENIC RAILWAY. A trip on the scenic railway consists of a ride in cars through 2,500 ft. of bewilderment. The cars in starting move slowly down a slight incline, where a cable run by electricity pulls them up to the highest point—about 40 ft., from which they run by gravity to the starting point. The passengers find themselves being dashed along down sharp inclines and up again, around corners, through caves of darkness and tunnels containing beautiful scenery, and lighted by many colored electric lights, until the passenger finds himself again at the starting point, with even a greater desire to patronize this always popular and attractive amusement.
—Edward C. Boyce, New York.

BOYCE SHOOTING THE CHUTES. Few amusements of either modern or past times have enjoyed such widespread popularity as this well-known attraction. The fascination lies in a wild ride down the steep incline and the sensation of striking the water at full speed. Unlike the majority, this chute is equipped with a modern moving stairway which carries the passengers from the bottom to the waiting platform at the top.
—Edward C. Boyce, New York.

BOYCE "THE BUMPS." The bumps is a merry-maker for spectators and participants alike. It consists of a slippery hard wood incline with various depressions and elevations. It can be installed at a very moderate expense.
—Edward C. Boyce, New York.

BOYCE "THE GREAT COAL MINE." A visitor at the mine receives a ride of over one thousand five hundred feet in real coal cars. Starting on the street level a cable automatically picks up the cars and carries them up an incline, from the summit of which they run by gravity in a sinuous course through the mine, returning to the starting point. Descending into the mine, one sees all the typical sights of this great industry in full operation. It is extremely picturesque, intensely exciting and interesting.
—Edward C. Boyce, New York.

BOYLESS BOWLING ALLEY. This is a five-pin bowling alley made in standard lengths of 40 ft. Its great advantage lies in the fact that no pin-boys are needed, as the pins are reset by pulling a lever near the bowler and the balls return by gravity.
—Matthews-Fahl Manufacturing Company, St. Louis Mo.

CAGNEY MINIATURE RAILWAYS. This company has long been prominently identified in the construction of miniature railways. Its installation at last year's Louisiana Purchase Exposition proved one of the most profitable attractions. The locomotives and cars used are substantially built and are capable of being successfully operated on any length of straight or curved track.
—Miniature Railroad Company, (Cagney Brothers), New York.

CIRCLE SWING. This device consists of a central pole around which torpedo shaped boats are arranged to swing. These boats are made of steel plates. In general, the whole structure is substantially built and will remain in absolute equilibrium even if the load is all on one side.
—Edward C. Boyce, New York.

DOREMUS CIGAR AND CANDY VENDING MACHINES. An inexpensive, efficient and clean salesman, especially where it is not wise to carry a large stock. The machine is 8½ ins. long, 7 ins. wide by 13 ins. high, and is handsomely finished in oxidized copper or heavy nickel plate. The cigars are visible through plate glass and are obtainable only upon insertion of the proper coin. A valuable feature is the combination cigar cutter and match-box. A modification of this machine is adapted for selling candy and chewing gum.
—New York Vending Company, New York.

EAGLE LAWN SWINGS. Constructed entirely of high carbon steel, with the exception of the slats in the seats and platform, and can be easily and compactly folded. The chairs or seats can be quickly adjusted for any desired angle to suit the comfort of the occupants. The swing is built extra heavy for public use, and can be furnished in all cases with table or steel head rests.
—A. Buch's Sons & Company, Elizabethtown, Pa.

FEDERAL CONSTRUCTION COMPANY, CHICAGO. Designs and installs novel amusements in street railway parks. Among its popular devices are the Velvet Coaster, Aerostat, Katzenjammer Castle, Mystic Rill, water chutes, roller coasters and helter-skelters.

HERSCHELL-SPILLMAN ENGINES FOR LAUNCHES. This company furnishes gas and gasoline engines for auto and marine use in sizes from 10 to 60 hp., four-cylinder. These engines are well adapted for pleasure launches.
—Herschell-Spillman Company, North Tonawanda, N. Y.

HERSCHELL-SPILLMAN MERRY-GO-ROUNDS AND OCEAN WAVE GALLERIES. The products of this firm are so well known and so varied in style and character that it is unnecessary to attempt any detailed descriptions. The company has enjoyed a long experience in this field and is prepared to build any type of riding gallery suitable for the conditions given.
—Herschell-Spillman Company, North Tonawanda, N. Y.

THE INGERSOLL COMPANY, PITTSBURG, PA. This company is prepared to build parks for electric railway companies and install the most suitable and profitable attractions. The Ingersoll Luna Parks at Pittsburg and Cleveland earned $100,000 for the street railway companies in each of those cities this year. The company also builds for railway parks, or builds and operates "Figure 8" coasters, old mills, caroussels, scenic railways and all other amusements.

INGERSOLL ROLLER COASTER AND LAUGHING GALLERY. The "Figure 8" roller coaster has made the name of this company known far and wide. Ever since its introduction the roller coaster has proved a splendid attraction, with the result that no modern pleasure ground can be said to be complete without one. The Ingersoll laughing mirrors form another one of this company's money-makers.
—Ingersoll Construction Company, Pittsburg, Pa.

KATZENJAMMER CASTLE. Fourteen structures of this type were built this season and every one is reported to have proved profitable. Reports from several Eastern resorts show the Katzenjammer Castle to be earning more money than many amusements costing much more.
—Federal Construction Company, Chicago, Ill.

KINETOGRAPH MOVING PICTURE MACHINE. This machine can be installed anywhere at a nominal cost, no advance outlay being required. The company can furnish a kinetograph outfit, an operator and a weekly change of film, or can sell the machine and supply a weekly change of film upon an attractive rental basis. These machines can be operated by any park employe of average intelligence. This company is agent for machines and films made by the Edison Manufacturing Company, now used in many parks.
—The Kinetograph Company, New York.

KINGERY POPPING AND ROASTING MACHINES AND CREAM ACCESSORIES. This company manufactures peanut roasters, corn poppers, roasters and poppers combined, operated by steam, electric, spring and hand power. It also manufactures ice cream freezers, tubs, cans, cabinets, dishers, ice breakers, shavers, flavoring extracts, etc.
—Kingery Manufacturing Company, Cincinnati, O.

KINODROME MOVING PICTURE EXHIBITION. This exhibition has already been used in electric

railway parks with satisfactory results. The Kinodrome is the apparatus used by the Western Association of Vaudeville Managers in the leading vaudeville theatres in the Central and Western States. It is an economical and popular attraction.
—GEORGE K. SPOOR COMPANY, CHICAGO, ILL.

KLEINE MOTION PICTURES. These pictures form a most popular and economical amusement for summer parks. The catalogue No. 2D published by the company contains an extended description of a great many interesting subjects besides detailed references to the apparatus used in connection therewith.
—KLEINE OPTICAL COMPANY, CHICAGO, ILL.

MELVILLE'S THEATRICAL BOOKING AGENCY. Electric railway companies owning parks have found it profitable to place the business of furnishing theatrical attractions in the hands of an experienced booking agent who has at command a wide range of theatrical talent. Mr. Melville is very prominent in this field as is shown by the fact that over fifty parks were in his circuit last year, enjoying the best summer attractions at minimum expense.
—FRANK MELVILLE, NEW YORK.

MILES MOVING PICTURES AND SONG SLIDES. The location of this company's New York office, together with its London and Paris connections, and San Francisco studio, places it in close touch with the largest manufacturers and best novelties in this field. Moving pictures to be permanently profitable must not only cover novel situations, but also be changed from time to time so that the public will not tire of them. The organization by this company of a moving picture circuit meets this demand very effectively.
—MILES BROTHERS, NEW YORK AND SAN FRANCISCO.

MILLS SLOT MACHINES. To enumerate the slot machines made by this company would mean to cover practically everything that has been found popular in this line. An idea of the company's manufactures may be obtained, however, by stating that these machines include the following: Illustrated song machines, auto-stereoscopes, phonographs, bag punchers, weighing machines, hat blowers and Cupid post office. The company is prepared to equip complete arcades.
—MILLS NOVELTY COMPANY, CHICAGO, ILL.

MORRIS FIGURE 8 TOBOGGANS AND MERRY-GO-ROUNDS. This builder has enjoyed long experience in the design and construction of up-to-date amusement contrivances. Among these are "Figure 8" toboggans and merry-go-rounds which he has built for many picnic grounds throughout the United States.
—E. JOY MORRIS, PHILADELPHIA, PA.

MULLINS STEEL BOATS. The obvious advantage of a non-sinkable boat is embodied in the steel boats made by this company. Thousands of this company's stamped steel boats are in use wherever boating is in favor because of their lightness, durability and safety.
—THE W. H. MULLINS COMPANY, SALEM, OHIO.

MUTOSCOPE. This is a standard slot machine showing moving pictures. The Mutoscope is exceedingly simple of operation and requires no expert attendance. All parts are interchangeable; it is mounted in a handsome iron cabinet. It has the safest device known for the care of money, and is supplied with register attachment when desired. The average equipment for a summer park is thirty machines, which will readily take in a dollar per day per machine.
—AMERICAN MUTOSCOPE AND BIOGRAPH COMPANY, NEW YORK.

NAUGHTON'S HOUSE OF TROUBLE AND LAUGHING GALLERIES. The specialties of this company as indicated by the above title are the "House of Trouble" and metal laughing galleries. Construction plans are sold by the company to enable park managers to install the necessary structures at minimum expense.
—J. M. NAUGHTON AMUSEMENT CONSTRUCTION COMPANY, COLUMBUS, OHIO.

THE PHILADELPHIA TOBOGGAN COMPANY, PHILADELPHIA, PA. This company has installed a large number of forest coasters, toboggan slides and riding galleries in prominent amusement resorts throughout the country. Its carrousels are exceptionally popular on account of the well-carved figures and artistic decorations furnished.

QUAKER CITY TARGETS. Shooting galleries are an ever-popular attraction in picnic parks, but they can be made even more so by equipping them with attractive targets. This company has made a specialty of this work and can furnish all kinds of amusing subjects, such as Punch and Judy, prize fighters, running rabbits, flying birds, etc.
—QUAKER CITY ARMS & TARGET WORKS, PHILADELPHIA, PA.

TRAVER CIRCLE SWING FLYING MACHINE. This popular device is made up of a central steel shaft, to the hub of which projecting arms are attached. Cables for carrying small cars are suspended from these arms. The entire structure is revolved by an electric motor within the tower, the acceleration being so rapid that in less than a minute the passengers enjoy the exhilarating sensation of sailing through the air at high speed but with absolute safety.
—TRAVER CIRCLE SWING COMPANY, NEW YORK.

UNION ROLLER SKATES. This company has been making roller skates ever since their introduction and is prepared to furnish them for park skating rinks in any desired quantity. The skates are made either in plain or ball-bearing models, but the latter are preferable for rink use as they run so easily.
—UNION HARDWARE COMPANY, TORRINGTON, CONN.

VELVET COASTER. This is a departure in pleasure railways. It has all the sensations of a scenic railway, without any noise or danger. No cast iron is used in the construction of the cars. All running parts are of phosphor bronze and hammered steel, cars are of handsome design upholstered in best wool plush. The Velvet Coaster has been pronounced by many who have ridden it as the most delightful ride ever invented. It is absolutely noiseless and runs as smooth as a cutter on new snow.
—FEDERAL CONSTRUCTION COMPANY, CHICAGO, ILL.

WINSLOW ROLLER SKATES. The renewed popularity of roller skating should prove a valuable source of income in parks equipped with a well-built skating rink. This company makes a very extensive line of skates both plain and ball bearing, with stationary and adjustable foot-plates. A popular style for rink use is the "Vineyard," No. 13, which has ball bearing web steel rolls.
—THE SAMUEL WINSLOW SKATE MANUFACTURING COMPANY, WORCESTER, MASS.

PAVING MATERIALS

ARTHUR'S "HUMP" RAIL BLOCK. This company manufactures rail blocks of all shapes for all kinds of track, and has for sale large quantities of paving blocks and bricks.
—MACK MANUFACTURING COMPANY, PHILADELPHIA, PA.

MARGINAL PROTECTING STRIPS. Toothed strips of cast iron for laying on inside edges of street railway track rails to prevent injury to asphalt pavement from movement of rails; strips are toothed to interlock with pavement and provided with toe checks to prevent slipping of horses.
—AMERICAN BRAKE SHOE & FOUNDRY COMPANY, MAHWAH, N. J.

U. S. WOOD BLOCKS. These blocks are of all-heart long leaf pine treated throughout with 22 lbs. of preservative mixture to the cubic foot instead of 10 or 12 lbs., as is the general practice. Especially suitable for street railroad work, because they are not injured like asphalt by oil drippings from cars, are not damaged by vibration of rails and are very easily removed for repairs to track. Will outwear granite block. Smooth, noiseless and sanitary. Booklets furnished on application.
—U. S. WOOD PRESERVING COMPANY, NEW YORK.

PHOSPHOR BRONZE

(See "Alloys")

PINIONS

(See "Gears and Pinions")

PIPE COVERINGS

(See "Coverings, Pipe")

PIPE FITTINGS

"BALLWOOD" WELDED PIPE FLANGES. This flange consists of a forged flange or collar placed on the end of a piece of wrought pipe, and the pipe and flange welded together. Then flanges are faced, back and edge turned off, and bolt holes drilled. By this method the flange is made an integral part of the pipe. Leaks between flange and pipe are thus eliminated. This joint is ideal for high pressures, and for air and gas. The flanges can be furnished on special lengths of pipe to blue print, and with any style of faces and of any thickness and diameter. Pipe bent to special shapes and radii also furnished with this type of flange.
—THE BALL & WOOD COMPANY, NEW YORK.

CRANE PIPE FITTINGS.
—CRANE COMPANY, CHICAGO.

WAINWRIGHT EXPANSION JOINTS. A deeply corrugated copper tube which yields readily to compression. An expansion joint which never leaks. Used for vacuum, exhaust and high pressure lines.
—ALBERGER CONDENSER COMPANY, NEW YORK.

WALMANCO PIPE JOINT. This joint does not weep under the highest pressures. It has no threads or rivets; the flanges swivel.
—THE WALWORTH MANUFACTURING COMPANY, BOSTON AND NEW YORK.

PLANERS

(See Machine Tools and Woodworking Machinery.)

PLOWS, SNOW

(See Snow Plows and Sweepers.)

PNEUMATIC TOOLS

CHICAGO PNEUMATIC TOOLS. Pneumatic tools and appliances, of the Boyer, "Little Giant" and Keller types are used extensively in connection with street railway work and are of the latest and best types yet devised. They are extensively used throughout the civilized world. They are powerful, durable and efficient. Use air economically. They have so many unique features space will not permit enumerating them. (See advertisement.)
—CHICAGO PNEUMATIC TOOL COMPANY, CHICAGO, ILL.

POLES, TIES AND LUMBER

ABELES & TAUSSIG, ST. LOUIS, MO. Distributors of cross ties, switch ties, crossing plank, bridge and car timbers, white oak and cypress piling, cedar and cypress poles, and everything in heavy timbers for steam and electric railways or industrial plants. White oak 5 x 7 x 7 sawed ties carried in stock. The company owns 40,000 acres of virgin white oak timber, controls the output of good oak mills, and can furnish anything in its line. Heavy lumber and timbers a specialty.

THE F. BISSELL COMPANY, TOLEDO, O. Dealers in Michigan and Idaho cedar poles.

CHURCHILL CEDAR COMPANY, HERON, MONT. Producers and dealers in western cedar poles, posts, ties and piling.

JOHN H. FOWLER & COMPANY, CHICAGO, ILL. This company is prepared to furnish poles, ties, posts and piling in any desired quantity.

FRANCIS BEIDLER & COMPANY, CHICAGO, ILL. Specialists in the production and sale of live peeled white cedar poles.

GLENN-KLINE LUMBER COMPANY, PITTSBURG, PA. Chestnut, oak or cedar are used for the poles, ties, piling and posts made by this company.

GRAY TIE COMPANY, EVANSVILLE, IND. Manufacturer of oak cross ties for steam and electric railways.

LINDSLEY BROS. COMPANY, CHICAGO, ILL. The officers of the company are: President, G. L. Lindsley; Vice-President, C. P. Lindsley; Secretary and Treasurer, E. A. Lindsley. Wholesalers of cedar poles, cedar posts, cedar and oak ties. Also representing The Lindsley Bros. Company, Spokane, Wash., the officers of which are: President, C. P. Lindsley; vice-president, G. L. Lindsley; secretary and treasurer, E. A. Lindsley. Wholesale dealers in Western cedar poles, ties and piling; also fir piling.

H. H. MAUS & COMPANY, PHILADELPHIA, PA. Producers of ties, poles, cross-arms, brackets and pins for use in electric installations.

THE MORSE CEDAR COMPANY, SAGINAW, MICH. Dealers in cedar poles, ties, posts, flag poles, station yard posts and paving blocks.

T. J. MOSS TIE COMPANY, ST. LOUIS, MO. This firm carries on a large business in railway lumber, such as white oak, red oak, cypress and chestnut railroad ties, bridge ties, switch ties and piling.

WILLIAM MUELLER COMPANY, CHICAGO, ILL. Producers and dealers in cedar ties, posts and poles.

D. W. PHELAN, NEW YORK. Dealer in wooden cross-arms, pins and braces; octagonal or round yellow pine poles, chestnut or southern cedar poles, and yellow pine, oak or chestnut ties.

RABER & WATSON, CHICAGO, ILL. Dealers in Michigan cedar poles and posts, and ties of cedar, oak or chestnut.

SOUTHERN LONG LEAF PINE OCTAGONAL POLES. These poles are manufactured from long leaf yellow pine, sawed eight equal sides; base measurement from 8 ins. to 20 ins., with gradual taper, in any length from 20 feet to 65 feet. Painted, butts treated, tops coned.
—SOUTHERN EXCHANGE COMPANY, NEW YORK.

SOUTHERN WHITE CEDAR POLES. These poles are furnished peeled of the bark, knots closely shaved, topped and butted with a saw. They have a large base measurement, grow very straight, with a gradual taper, and are entirely free from butt rot.
—SOUTHERN EXCHANGE COMPANY, NEW YORK

STANDARD TIE COMPANY, DETROIT, MICH. This company deals entirely in oak, cedar cypress, chestnut and pine railway ties, telegraph poles, posts, shingles and switch ties. The main offices are at Detroit, but there are branches in New York, N. Y.; Paducah, Ky.; Au Train, Mich.; Duluth, Minn.; Evart, Mich., and Chicago, Ill.

THE VALENTINE-CLARK COMPANY, CHICAGO, ILL. Cedar as well as steel poles are supplied by this company in any desired quantity for traction, light and other power purposes.

C. H. WORCESTER COMPANY, CHICAGO, ILL. This firm is a large producer and wholesaler in Michigan white cedar for telegraph and railway poles, piling, fence posts, railroad ties, shingles, etc. The company has worked out an excellent code as a means of enabling buyers to send telegraphic orders at minimum cost.

POLES, TROLLEY

COLUMBIA TROLLEY POLES AND WHEELS. The trolley poles are made of steel tubing and as light in weight as is consistent with strength. They also have almost a spring temper and therefore do not bend easily. The wheels are made of phorphor bronze, and some of them are recorded as having made eight thousand miles.
—COLUMBIA MACHINE WORKS AND MALLEABLE IRON COMPANY, BROOKLYN, N. Y.

RECORDING FARE REGISTER COMPANY'S TROLLEY POLES. Corrugated, seamless, taper drawn steel poles. The principal feature of advantage is great strength combined with little weight, a 12-ft. pole weighing only 16 lbs. Also poles of standard types.
—THE RECORDING FARE REGISTER COMPANY, NEW HAVEN, CONN.

SHELBY TROLLEY POLES. Made from cold-drawn seamless tubing. Each pole is tested by suspending 12 ft. from butt end, a weight of 40 lbs., which must not produce a deflection in pole greater than 12 in. After removal of weight, if pole does not return to its original shape, it is rejected.
—THE GARFORD COMPANY, ELYRIA, OHIO.

POLES, METAL (STREET)

AMERICAN METAL POLES. Metal poles for electric railway service are furnished by this company.
AMERICAN BRIDGE COMPANY OF NEW YORK, NEW YORK.

CREAGHEAD POLES AND POLE FITTINGS. A complete line of fittings for iron or wooden poles designed to meet the requirements on either telephone, electric light, railway or high tension power transmission work, consisting of the following principal items: Malleable iron cross arms and insulator pins; pole tops, pole collars, pole bases; ornamental arc lamp poles and brackets; malleable iron high tension insulator pins, brackets and break arms. The high tension insulator pins are made of malleable iron and steel with threaded wooden thimble for insulator or with top to cement into insulators. All sizes for insulators from 500 to 50,000 volts.
—THE CREAGHEAD ENGINEERING COMPANY, CINCINNATI, OHIO.

VOYNOW RE-INFORCING AND PROTECTIVE SLEEVE FOR METAL POLES. A simple, common-sense, and very effective means for overcoming the weakened condition of metal poles caused by corrosion at the ground level. It doubles the strength and prevents such corrosion when applied to new poles. Such corrosion of poles has only lately been seriously recognized; investigation indicates that practically all metal poles which have been in use for ten years or more are fast approaching, in their present condition, the end of their usefulness. The Voynow sleeve, at a small cost, makes the pole as good as new without removing it from service. (Pole equipped with this sleeve illustrated in advertisement.)
—WILLIAM D. GHERKY, PHILADELPHIA, PA

WIRE-LOCKED SWEDGED JOINT POLES. These iron and steel tubular poles have special wire-locked swedged joints. Pole joints so made they cannot be telescoped by overloading by the drop test, or in any other way. They caliper the same all over the joint, which is as smooth on the outside as the tubes of which the pole is composed, showing that the swedging is perfect. As the metal of the outer tubes is laid down on the inner tube it is upset and thickened the whole length of the joint, and not stretched out and thinned, as in the ordinary manner of swedging under the hammer. The edge of the outer tube at all joints is chamfered, so that water cannot rust and corrode the pole at these points.
—ELECTRIC RAILWAY EQUIPMENT COMPANY, CINCINNATI, OHIO.

POLISHES, METAL

U. S. METAL POLISH. This material is well adapted for easily and effectively polishing all kinds of metal car trimmings.
—GEO. W. HOFFMAN, INDIANAPOLIS, IND.

PRESSES, HYDRAULIC WHEEL

(See Machine Tools.)

PULLEYS, NON-METAL

ROCKWOOD PAPER PULLEYS. The chief merits of paper pulleys are stated to be as follows: Improved belt adhesion over iron and wood pulleys, economy resulting from absence of belt slipping and reduction in wear of shafting; superior strength and durability resulting from absence of shrinkage strains; no belt tightener required; perfect balance due to uniform density; better appearance, and cheaper and safer to transport as they are non-breakable and light.
—THE ROCKWOOD MANUFACTURING COMPANY, INDIANAPOLIS, IND.

XYLOTITE PULLEYS AND FRICTIONS. Made of a tough, fibrous material to which a belt will cling. No slipping as with iron, wood or steel. The solid pulleys are especially adapted for dynamos and motors and are made in any size from two to sixty ins. in dia. with any width of face. The split pulleys have no equal for general shop use. The wear and tear on belts, shafting and hangers is reduced to a minimum, as all the necessary power can be transmitted with a slack belt. The frictions give a uniform drive without slippage and stand the most severe service. (See illustration in advertisement.)
—THE XYLOTITE PRODUCT COMPANY, CINCINNATI, OHIO.

PRESSURE REGULATORS

FOSTER PRESSURE REGULATORS, CLASS W. The "Class W" pressure regulator is a "standard" device for obtaining a constant, uniform delivery pressure of steam, water, gas or air, irrespective of variations in the initial pressure or volume of delivery. The special features claimed for this valve are a compensating spring movement, insuring positive delivery; no small parts liable to clog, or pistons to stick; simple construction; easily adjusted; and reliable. Made screwed or flanged, for standard or extra heavy working pressures, in sizes ½ in. to 20 ins.
—FOSTER ENGINEERING COMPANY, NEWARK, N. J.

FOSTER LOW PRESSURE REGULATORS, "CLASS Q," "CLASS QV" AND "CLASS Q H" VALVES. Designed expressly for steam heating service, especially for vacuum systems. Will deliver as low as atmosphere but are not intended for service on steam exceeding 15 lbs. or on air above 25 lbs. In the "QH Class," the outlet connection is double the size of inlet, to permit use of larger distributing pipes on reduced pressure.
—FOSTER ENGINEERING COMPANY, NEWARK, N. J.

FOSTER AUXILIARY PRESSURE REGULATORS. Reduce the initial pressure and maintain a constant, uniform delivery of steam, water or air. The "Class G" regulator can be adjusted to deliver from zero to within a small fraction of the initial pressure or will close off and hold tight where no steam, etc., is required. Operates horizontally, vertically, inverted or at any angle; made in composition only, in sizes half inch to ten inches. Specially designed for very exacting work and recommended where price is secondary consideration.
—FOSTER ENGINEERING COMPANY, NEWARK, N. J.

PUMPS

(See also Condensers.)

ALBERGER TWO-STAGE DRY VACUUM PUMPS. The result of experience in building condensing machinery for producing the high vacuums required in connection with steam turbines, vacuum pans, etc. With a two-stage pump 29 in. vacuum is maintained when the temperature of the water will permit. Air cylinders fitted with positive type equalizing suction valve which cuts out the voluntary discharge valve from vacuum at end of stroke, thereby causing easy seating and quiet running. Steam cylinders of smaller pumps fitted with plain slide valve gear, of larger pumps with Corliss gear.
—ALBERGER CONDENSER COMPANY, NEW YORK.

ALLIS-CHALMERS SINGLE-STAGE CENTRIFUGAL PUMP. Fluids are elevated by means of the velocity imparted to them in passing through a rotating impeller. Impellers are made with curved vanes enclosed on either side and the material used is cast iron, bronze or acid resisting metal. Best adapted to low heads and large capacities, such as low service pumping in municipal water supply, sewerage and draining, pumping and irrigation. Impellers are arranged to take suction on one or both sides; the double suction impeller being in hydraulic balance requires no thrust bearing. All sizes have removable flanged covers permitting removal of impeller.
—ALLIS-CHALMERS COMPANY, MILWAUKEE, WIS.

ALLIS-CHALMERS CENTRIFUGAL PUMPS, MULTI-STAGE. Same general construction as single-stage described herein. Casings made of cast iron in one piece; only the larger pieces being split. Including the single-stage pump, the capacities of a centrifugal pump range from 600 gal. to 150,000 gal. per minute. Designed for heads from 500 to 2,500 feet. Driven by direct connection, gearing, belting or ropes. Multi-stage pumps specially adapted to high heads with moderate and small capacities, where low first cost or compactness is of more importance than high economy under continuous operation, and are used for fire protecting service, etc.
—ALLIS-CHALMERS COMPANY, MILWAUKEE, WIS.

W. H. BLAKE PUMPS. Absolute certainty of action is insured in these pumps, for the valve mechanism is actuated solely by direct boiler pressure, and is not dependent upon an adjustable arrangement of levers and rods connected to the piston. With the latter arrangement there are certain points in the stroke where the valves are not directly controlled but momentum is relied upon to reverse the valve gear. With the special steam actuated valve motion a full, even stroke is maintained under all conditions of duty. The waste room of an uncompleted stroke is reduced to the least possible amount for proper cushioning. These pumps are composition fitted throughout, both the water and air cylinders are lined and a Tobin bronze piston rod is used. They equal in economy the best engine construction.
—W. H. BLAKE STEAM PUMP COMPANY, BOSTON, MASS.

CONOVER COMBINED AIR AND CIRCULATING PUMP. The air pump is large enough to do its work when the circulating pump is running at its lowest speed. If desired to increase the speed of the circulating pump, the air pump takes less water at each stroke on account of running faster, that is, reduces the mean effective pressure in direct proportion to the speed. By simply running the apparatus at the proper speed for the circulating pump, the air pump will take care of the air automatically.
—WATSON MACHINE COMPANY, PATERSON, N. J.

DEMING PUMPS. The pumping machinery of this type is adapted for operation by any power. Styles manufactured embrace single and double-acting triplex pumps for various services, power deep well working heads, artesian well cylinders, as well as rotary and centrifugal pumps.
—THE DEMING COMPANY, SALEM, OHIO.

GENERAL ELECTRIC PUMPING SETS. Are supplied in both piston and turbine types. The direct current current motors on piston pumps are wound for low speed so that they can be belted without interposition of noisy gearing. Induction motors can also be used to drive this type of pump. The turbine pump is direct connnected to the motor, thus making a neat, self contained apparatus. Alternating current equipments can also be supplied. When used in connection with storage tanks, the General Electric

Company is prepared to furnish an automatic device for starting and stopping motors.
—GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

STEAM PUMPS.
—HENRY R. WORTHINGTON, NEW YORK.
—THE GEORGE F. BLAKE MANUFACTURING COMPANY, NEW YORK.
—KNOWLES STEAM PUMP WORKS, NEW YORK.
—DEANE STEAM PUMP COMPANY (OF HOLYOKE), NEW YORK.
—SNOW STEAM PUMP COMPANY, NEW YORK.
—LAIDLAW-DUNN-GORDON COMPANY, NEW YORK.

SMITH-VAILE BOILER FEED PUMPS. These are duplex pumps provided with removable water cylinders and adjustable packed water plungers, permitting compensation for wear. At a small additional cost brass-lined water cylinders are furnished, with brass or brass covered piston rods and composition plungers. The water valves are made of rubber, composition rubber or brass., as the service requires. For pressures below 125 lbs. internally packed pumps may be used, but for pressure above that the outside packed plunger type is recommended.
—PLATT IRON WORKS COMPANY, DAYTON, OHIO.

SMITH-VAILE SINGLE-ACTING TRIPLEX PUMPS. When power from shafting or electric motors is conveniently available, these pumps will show a great saving in cost of operation over direct-acting steam pumps. When used for boiler feeding an automatic by-pass may be applied to regulate the supply of water. The plungers are outside packed, rendering leakage at once visible and easily remedied.
—PLATT IRON WORKS COMPANY, DAYTON, OHIO.

WHEELER PUMPS. Pumps for moving water and producing a vacuum in connection with condensing systems are of many types and kinds. Different manufacturers have brought out special lines of pumps to suit different requirements. In connection with its condenser practice, this company has had a long experience with water pumps, of both the plunger and centrifugal types, and for vacuum purposes. A line of improved vacuum pumps has also been produced. These are manufactured in many sizes, either for steam-driven or motor-driven units, and careful attention is given to adapting the kind best suited for the work proposed
—WHEELER CONDENSER & ENGINEERING COMPANY, NEW YORK.

PUMP GOVERNORS

FOSTER PUMP GOVERNORS. This piston actuated pump governor is controlled wholly by the discharge pressure from the pump. The water acting on a piston tends to close the steam valve against the tension of a spring. The points claimed for this governor are durability, close and reliable regulation. Made in sizes from ½ in. to 5 ins. Sizes up to and including 2 ins. are made wholly of steam metal, larger sizes have iron bodies and composition interiors. Renewable seats.
—FOSTER ENGINEERING COMPANY, NEWARK, N. J.

WILLIAMS PUMP GOVERNOR. In the building of this governor absolute simplicity was the aim, consequently there is an entire absence of weights, cups or pistons. The spring used is tempered to permit wide ranges of tension without loss of resiliency. The adjustment is simple; to resist steam pressure and raise water pressure two nuts are taken up under the spring rider and to obtain the opposite condition the operation is reversed.
—THE WILLIAMS GAUGE COMPANY, PITTSBURG, PA.

PUNCHES, TICKET

AMERICAN TICKET PUNCHES. The styles of punches made by this company embrace a large variety for practically every case where punches are needed. The conductors' ticket punch made by this company is called the "Hoole" and enjoys wide use on American railway systems.
—AMERICAN RAILWAY SUPPLY COMPANY, NEW YORK.

MEYERS' TICKET PUNCHES. In offering this punch to railways, the manufacturer does so with the conviction that when its various practical advantages are once known it will become the favorite punch in use. The best materials are used in this punch; but no matter how good a spring may be, the chances are that it will break some time. This punch solves the problem. The spring can be removed or replaced by a new one, by merely springing it into place. No rivets, screws or other devices for holding spring in place. It is only necessary to pass the short end through the eye, then insert in small hole, and spring the other end in place.
—THE FRED. J. MEYERS MANUFACTURING COMPANY, HAMILTON, OHIO.

SAYRE PUNCHES. The styles numbered 420 to 438 are the "Open Sight" class that are especially adapted for street railways. They are all steel tools. The manufacturers have a list of 1,065 different dies. The "Duplex" punch is meeting with great success where commutation tickets are used. It punches a die in any part of the ticket, or cuts a piece from the edge. The Reservoir punch is claimed the strongest and neatest in the market. All of these tools are made of the finest material and best workmanship.
—L. A. SAYRE & COMPANY, NEWARK, N. J.

TICKET PUNCHES. Twenty-two styles made with 1000 different designs of dies.
—THE RECORDING FARE REGISTER COMPANY, NEW HAVEN, CONN.

WOODMAN PUNCHES. These punches are made in a wide variety of forms and dies for conductors' work and all other purposes where a convenient cancelling device is needed. They are made of cast steel for more than 500 dies.
—THE R. WOODMAN MANUFACTURING & SUPPLY COMPANY, BOSTON, MASS.

PURIFIERS, FEED WATER

(See "Heaters and Purifiers")

PUSHERS, CAR

THE EASY CAR PUSHER. This device consists of a steel bar, a malleable iron shoe, a tool steel bit and a fine steel spring. The total weight is 20 lbs. and the length 5½ ft. The heel has lugs extending downward on both sides of the rail so as to hold it firmly in position and prevent its slipping sideways. The triangular bit or steel cuts into the rail when pressure is applied and prevents slipping backward, even though the rail is icy, greasy or wet. This bit can be inverted. Each one has three sharpened edges. When the pressure is released, the steel spring lifts the steel bit from the rail, thus preventing it from being dulled by sliding over the rail when following the wheel.
—THE R. WOODMAN MANUFACTURING & SUPPLY COMPANY, BOSTON, MASS.

RACKS, BASKET

"REX" BASKET RACKS. This company has patterns for manufacturing one hundred and ninety-eight different styles of racks, all made with a view of being ornamental as well as strong and durable to withstand the uses to which they are subjected. Its recent efforts in making a continuous rack, which style is now very much used, have resulted in one known as the "Rex" rack. This is so constructed that it can be secured in place and each section independent of any other section can be removed without disturbing the brackets or connecting rods, which feature commends itself very strongly when replacing broken sections, or when desiring to refinish same. This rack is made with either bronze rod or wire cord bottoms.
—THE DAYTON MANUFACTURING COMPANY, DAYTON, O.

RAILS

(See "Trackwork")

RAIL BENDERS

(See "Benders, Rail")

RAIL BONDS

(See "Bonds, Rail")

RAIL JOINTS

(See "Joints, Rail")

RAIL WELDING

(See Joints, Rail.)

RATTAN

"AMERICAN" SWEEPER RATTAN. This is a natural growth rattan of suitable diameters, furnished in natural long straight bundles of about 67 lbs.; also cut to any desired length and put up in bundles of about 50 lbs. each. Owing to the severe usage which the sweeper rattan receives, the best quality only should be used, so as to procure the desired service. Practical experience has evidenced that cheap rattan is utterly unfit for sweeper purposes. This company makes a specialty of furnishing a high grade select quality for sweeper purposes.
—AMERICAN RATTAN & REED MANUFACTURING COMPANY, BROOKLYN, N. Y.

BRILL RATTAN FOR SWEEPERS. An ample supply of rattan in all lengths is kept in stock ready for prompt shipment. Complete sets of segments for Brill brooms, or single segments, made and filled at short notice.
—J. G. BRILL COMPANY, PHILADELPHIA, PA.
—AMERICAN CAR COMPANY, ST. LOUIS, MO.
—G. C. KUHLMAN CAR COMPANY, CLEVELAND, OHIO.
—JOHN STEPHENSON COMPANY, ELIZABETH, N. J.

BRILL WOVEN RATTAN FOR CAR SEATS. These companies manufacture lined and unlined woven rattan in all widths and lengths. Their improved processes insure a closely woven and durable seating material. Only the best selected hard cane is used.
—J. G. BRILL COMPANY, PHILADELPHIA, PA.
—AMERICAN CAR COMPANY, ST. LOUIS, MO.
—G. C. KUHLMAN CAR COMPANY, CLEVELAND, O.
—JOHN STEPHENSON COMPANY, ELIZABETH, N. J.

HALE & KILBURN RATTAN COVERING. A clean, sanitary and durable seat covering for upholstered car seats. This material consists of high grade enameled rattan, reinforced with heavy canvas lining, cemented to the underside of the rattan by the Hale & Kilburn special waterproof cement. This popular material was the invention of this company, and the manuacturers and headquarters for its supply. The twill weave hard enameled rattan is the most generally used and best adapted for electric railway service, the silicate surface having a tendency to shed the dirt rather than absorb it, as in the case of soft chair cane, sometimes used.
—THE HALE & KILBURN MANUFACTURING COMPANY, PHILADELPHIA, PA.

MORRIS RATTAN FOR SWEEPERS. This brand of sweeper rattan is imported direct from India.
—ELMER P. MORRIS COMPANY, NEW YORK.

REGISTERS AND REGISTER FITTINGS

INTERNATIONAL REGISTERS. Distinctive features are: Seamless drawn case fitting bed plate rim and locked by a signature seal, preventing access to the mechanism without destroying the seal. Red blind covering trip figures during both registration and cancellation, thus clearly showing incomplete operations. Totalizer self contained and riveted up, so reading cannot be changed when register is open. Separate bell and mechanism chambers, one open to let sound out, the other closed to keep dust out. Secure and convenient fastening of register to back, preventing accidents and facilitating handling. Interchangeable parts that must pass limit gages before assembling, thus greatly facilitating repair. Parts made of cold rolled steel, hardened where necessary, resulting in unusual durability. (See advertisement.)
—THE INTERNATIONAL REGISTER COMPANY, CHICAGO, ILL.

INTERNATIONAL AND NEW HAVEN REGISTER FITTINGS. Cord and rod fittings for register operation made in a great variety of styles and shapes, of a very strong and durable bronze, having a larger percentage of copper and tin than is usually put into car fittings, and finished, polished or dipped, as desired. The cord fittings include the usual pulleys, guides, anchors, etc., and the rod fittings are divided into three classes: New Haven, designed for use with the flat sided round steel rod; International Round, for the ordinary round rods, and International Square, for square steel rods. The first two classes are interchangeable but the last can be used only on the square rods, and is the most substantial of the three, though costing a little more. (See advertisement.)
—THE INTERNATIONAL REGISTER COMPANY CHICAGO, ILL.

MORRIS REGISTER FITTINGS. Castings and fittings made for fare registers.
—ELMER P. MORRIS COMPANY, NEW YORK.

NEW HAVEN REGISTERS. Made in many types, single, double, triple and either round or square. The square types have ornamental solid bronze cases and the round types spun brass cases, both finished in antique copper. All have aluminum face dials, ten sided lithographed trip wheels, and simple, durable mechanism similar in design in the various types. Trip counters show number of trips made. A conspicuous red shutter covers the trip figures during registration and calls attention to

any failure to complete the operation. Trip figures read to 999. Operation is by either cords or rods from the same back from one or both sides of the car. (See advertisement.)
—THE INTERNATIONAL REGISTER COMPANY, CHICAGO, ILL.

OHMER FARE REGISTERS. These registers are made for registering and indicating separately, different classes of fares as collected, and printing a record of each class at the end of each half trip or trip (just as desired) together with the register number, trip number, day and date, and the badge number of the conductor. Four new types of two-fare recording registers have just been completed. They are especially strong machines, easy to operate, and have many new features.
—OHMER FARE REGISTER COMPANY, DAYTON, OHIO.

RECORDING FARE REGISTERS AND REGISTER FITTINGS. Recording registers made in three styles and with practically unlimited recording capacity. Automatically records the direction of the trip, the number of trips made during the day, the number of the register, and the number of fares registered on each half trip. This machine prints a reading of the face of the register so the register can be checked instantly with the conductor's report, absolutely without any calculations. Plain register, same general design as the recording registers, but without the recording feature. Fittings for round or square rods.
—THE RECORDING FARE REGISTER COMPANY, NEW HAVEN, CONN.

RIDLON REGISTER FITTINGS AND CAR TRIMMINGS. This company manufactures a full line of standard register fittings, carrying the same in stock. Special fittings or trimmings made from specifications drawings or models.
—FRANK RIDLON COMPANY, BOSTON, MASS.

SECURITY RECORDING FARE REGISTERS. These registers take out of the hands of employees the making of a single register record, and besides saving this expense an absolute report is obtained of every fare rung up, without requiring further verification. The machines, while operated exactly like an ordinary register, print a full statement of the fares rung up, the number of the conductor who rang them, the number of the register, the half-trip records and the number of fares for which each conductor who was on the car is responsible. Every register is so arranged that the motorman and inspector can register their presence on the car. Not a single fare can be registered on this register without the identity of the man ringing it being given.
—SECURITY REGISTER COMPANY, ST. LOUIS.
—GILES S. ALLISON, NEW YORK.

STERLING FARE REGISTERS. The single registers made by this company, are Nos. 1, 3, 5, 7; the double registers, Nos. 2, 4, 6; and the printing registers, Nos. 8, 9, 10, 11. Portable registers and register fittings, including patent detachable handles, are also made. Sterling registers embody the greatest ingenuity, simplicity, accuracy and durability, with latest and original improvements.
—STERLING-MEAKER COMPANY, NEWARK, N. J.

WOODMAN HAND TALLY REGISTER. This is a hand register held by passing one of the fingers through a ring on the back and operated by depressing a pusher with the thumb. These little registers are positive in their action, and can be set to zero at will. They are simple in construction, can be carried in the pocket, are about the size of an ordinary watch, and weigh about 4 oz. They are used by railroad men for checking or tallying ties, telegraph poles and passengers, all kinds of freight, etc. In fact they can be used for any purpose where a correct count is desired.
—THE R. WOODMAN MANUFACTURING & SUPPLY COMPANY, BOSTON, MASS.

REGULATORS, CONTROLLER

(See "Controller Regulators")

REPAIR WORK

(See also Armature and Field Coils.)

CHATTANOOGA ARMATURE WORKS, CHATTANOOGA, TENN. These Works repair anything from an old brush arc to a modern turbine generator. Can handle anything up to six tons in their shop, and have competent and expert men to send out on larger work. Also build switchboards in accordance with the Underwriters' requirements.

CLEVELAND ARMATURE WORKS, CLEVELAND, OHIO. At these works everything in connection with an electric motor, dynamos or generator is repaired, armatures rewound, reshafted, coles rebuilt, new shafts, end plates and collars for armatures furnished, armature coils of all kinds made, commutators new, refilled and assembled. Field work a specialty.

COLUMBIA MACHINE WORKS AND MALLEABLE IRON COMPANY, Brooklyn, N. Y. Manufacturer of armature coils, field coils, journal bearings, bells, gongs, brakes, castings, commutators, trolley poles and wheels, also carry on hand all kinds of electric railway repair work.

CHAS. E. DUSTIN COMPANY, NEW YORK. See item under Second Hand Equipment.

FORD ELECTRIC & MANUFACTURING COMPANY, ST. LOUIS MO. This company has installed coil winding and other machinery of a kind enabling it to carry out the best class of rewinding and other repair work. It also has facilities for handling heavy machinery.

DITTRICK & JORDAN ELECTRIC COMPANY, CLEVELAND, OHIO. This company specializes in the manufacture of armature coils and field coils; it also rewinds armatures, reshafts commutators, repairs commutators and does all sorts of electrical repair work. The company has recently increased its facilities and is in shape to send experienced men to distant points to repair large machines, if desired.

JORDAN BROS., NEW YORK. This firm does general electrical and mechanical work, including dynamos, motor and lamp repairs, and keeps a large stock of electrical supplies on hand such as carbon and wire brushes. Among its specialties described in the dictionary are the commutator truing device and signal system. A large stock is kept of new and second hand dynamos and motors.

MORRIS REPAIR WORK. All classes of electrical repair work handled by this company.
—ELMER P. MORRIS COMPANY, NEW YORK.

REPAIR WORK. These companies have patterns and facilities for duplicating parts of all cars and trucks of their manufacture at short notice. It is only necessary to have the name of the original purchaser, date of purchase and name of part, to enable the companies to supply it without further information, For parts of cars or trucks of other makes, a sketch, blueprint or sample of the part will be necessary. Everything is made that cars and trucks are built with, from the smallest piece to an entire roof, a journal box lid to a side-frame.
—J. G. BRILL COMPANY, PHILADELPHIA, PA.
—AMERICAN CAR COMPANY, ST. LOUIS, MO.
—G. C. KUHLMAN CAR COMPANY, CLEVELAND, OHIO.
—JOHN STEPHENSON COMPANY, ELIZABETH, N. J.

FRANK RIDLON COMPANY, BOSTON, MASS. This company has a large and well equipped repair shop with facilities for handling all classes of electric machinery from the largest generators to the smallest motors. Armatures and fields rewound, and commutators refilled.

ROSSITER-MacGOVERN REPAIR WORK. In addition to making all classes of armature and field coils, commutators, etc., this company also has the best facilities for carrying out repair work of every description.
—ROSSITER, MACGOVERN & COMPANY, BOSTON, NEW YORK, ST. LOUIS.

VAN DORN-ELLIOTT REPAIR WORK. This company has a thoroughly equipped repair shop for handling repair work. Its armature repairing department is equipped to rewind, repair, reshaft and rebuild armatures, from the smallest to the largest. The commutator department is equipped with the latest devices for refilling and repairing commutators quickly and satisfactorily. (See advertisement in this issue.)
—THE VAN DORN-ELLIOTT ELECTRIC COMPANY, CLEVELAND, OHIO.

WOOD REPAIR WORK. This company makes a specialty of high-class repair work for electric railway work, such as rewinding armature and field coils, repairing commutators, etc.
—CHARLES N. WOOD ELECTRIC COMPANY, BOSTON, MASS.

REPLACERS, CAR

BUDA CAR REPLACERS. These replacers are made in two sizes for rail 100 lbs. and under and 60 lbs. and under. Are arranged for easy and gradual ascent doing away with injury to equipment. No abrupt arches on ends of replacers. Deflection to rail absolutely certain. A groove to receive flange of wheel allows tread to engage replacer, avoiding damage to flange, and the sloughing of replacers.
—BUDA FOUNDRY & MANUFACTURING COMPANY, CHICAGO, ILL.

KALAMAZOO LOCOMOTIVE AND CAR REPLACERS. Made from 9-16 in. pressed steel and guaranteed to re-rail the heaviest locomotives. Easily handled by one man. The No. 1 replacer, weighing 160 lbs. per pair, is for 6 in. rail; the No. 2 replacer, weighing 150 lbs. per pair, is for rail from 4½ to 5½ ins. high, and the No. 3 replacer, weighing 50 lbs. per pair, is for any rail under 4½ ins. high.
—KALAMAZOO RAILWAY SUPPLY COMPANY, KALAMAZOO, MICH.

SNOW CAR REPLACERS. These replacers require no clamps, and frogs will not turn over or push away from rails. They clear brake hangers, brake levers and sand pipes, and can be placed parallel or at angle to rails, according to position of derailed trucks, and they will not break wheel flanges. They are reversed by simply moving the tongue in one frog, and being wedge-shaped they can be placed well underneath the derailed wheels. Size No. 1 A, made of basic open hearth steel, weighing 235 lbs. per pair, is for wreck cars and 90 to 100 lb. rails; No. 1, the standard replacer, weighing 210 lbs. per pair, is for general use with heavy engines and cars; No. 2, same exactly as No. 1, but made of air furnace malleable iron instead of steel, weighing 160 lbs. per pair, and suitable for light engines, caboose equipment, etc.; No. 3, made of air furnace malleable iron, weighing 120 lbs. per pair, for traction companies.
—WENDELL & MACDUFFIE, NEW YORK.

VICTOR CAST STEEL CAR REPLACER. Made in various types to suit different service conditions. No. 1, weighing 110 lbs. per set, for elevated railroads and where grade rails are used; No. 2, weighing 185 lbs. per set, for standard steam railroads and for use on 100 lb. rails and under; No. 3, weighing 38 lbs. per set, for paved streets and conduit lines; No. 4, weighing 136 lbs. per set, for electric and steam railways using rails 5 ins. high or under.
—U. S. METAL AND MANUFACTURING COMPANY, NEW YORK, CHICAGO, PITTSBURG.

RESISTANCES, WIRE AND TUBE

GENERAL ELECTRIC RAILWAY RESISTANCES. In general these are of two types: "C G" and "T." Type "C G" rheostats are made up of 18 to 24 cast iron grids assembled on insulating rods between end frames which are provided with feet. All insulation used is of mica and creeping surfaces are made as wide as possible. Cast grid rheostats are used in the main or motor circuit. Type "T" rheostats are made of resistance tubes supported between end frames. The tubes are composed of galvanized steel insulated with mica upon which a non-corrosive resistance is wound. There are no soldered joints, all connections being clamped. The wound tubes are treated with an enamel varnish. Covers completely encasing the tubes are provided where required. These rheostats are used in the control circuit of the train control system.
—GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

SIMPLEX CAST GRID RESISTANCES. These resistances are mounted so as to form rigid and thoroughly insulated units for street railway or power purposes.
—SIMPLEX ELECTRIC HEATING COMPANY, CAMBRIDGEPORT, MASS.

SIMPLEX ENAMELED METAL TUBES. These tubes are made for headlights, electro-magnets, and all uses requiring a high resistance in a small, compact and durable form. These units are made by imbedding resistance in enamel fused to cast iron or drawn steel tubes.
—SIMPLEX ELECTRIC HEATING COMPANY, CAMBRIDGEPORT, MASS.

SPIRAL RESISTANCES. These are made up of a series of spiral units. The elasticity of the spirals imparts great strength to the metal and makes the resistance very durable. Perfect ventilation is also effected by this type. The current passing around the convolutions of the spirals produces an inductive effect in the resistance which checks sudden rushes of current at any time when the motorman steps up too fast on his controller. Standards have been adopted for the motors now generally used. These rheostats have stood some severe tests and have proved their worth.
—TRACTION EQUIPMENT COMPANY, BROOKLYN, N. Y.

WESTINGHOUSE RAILWAY RESISTANCES. For street railway equipments this company offers two types of resistance, the ventilated cell type of diverter adapted for use where large ohmic resistance and small capacity are required, and the grid type for low ohmic resistance and large capacity. Good contact is made between adjacent grids, insuring the absence of heating due to poor connections. A broken grid may easily be removed from the frame or connections made, all connecting terminals being in view and conveniently located.
—WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, PITTSBURG, PA.

RESEATING MACHINES

(See also Boiler Cleaners, Mechanical.)

LAGONDA RESEATING MACHINE. This is a device for cleaning header faces, nuts and caps of water tube boilers. It does the work in much less time than it can possibly be done by hand, and is more reliable, as when these parts have been cleaned with the machine, it is perfectly done, and taking down and recleaning is never necessary. It can be driven either by water or electric motor.
—THE LAGONDA MANUFACTURING COMPANY, SPRINGFIELD, OHIO.

RETRIEVERS, TROLLEY

(See "Catchers and Retrievers, Trolley")

ROOFING

J-M ASBESTOS ROOFING. Composed of asbestos felts and water-proofing compounds, put together in alternate laminations and compressed into one flexible sheet, all ready to apply. Present to both the sheathing boards and the weather a pure white fire-resistant asbestos sheet insuring protection against sulphur, acids and gases. Meets all the peculiar conditions to which power houses and similar structures are subject. Are adapted to buildings of all descriptions, both flat and steep. Is an excellent insulator, reducing the temperature materially in buildings on which it is used. (See advertisement.)
—H. W. JOHNS-MANVILLE COMPANY, NEW YORK.

RUBEROID CAR ROOFING. Made of felt with Ruberoid compound. The toughest and most elastic car roofing on the market. Will not break or tear from racking of cars in motion. Ruberoid compound makes it absolutely water-proof and temperature-proof. It contains no tar, is always pliable. It is put up in rolls 60 ins. wide, each roll containing sufficient material to cover a car roof; is easy to apply, clean to handle and is without odor. It does not require tar or pitch at seams.
—THE STANDARD PAINT COMPANY, NEW YORK.

SAND BOXES

(Including Pneumatic Sanders.)

BRILL "DUMPIT" SAND-BOX. The unique feature of this box is a double hopper which successfully prevents moisture, that creeps up the hose, from getting into the sand box. It is impossible to keep the sand-wick from forming in the hose, but it is possible to prevent the wick from having any connection with the sand in the box —that is the principle on which the "Dumpit" is designed. The flow is continuous, the operation by foot-pedal or hand-lever is easy, and the construction simple and compact.
—J. G. BRILL COMPANY, PHILADELPHIA, PA.
—AMERICAN CAR COMPANY, ST. LOUIS, MO.
—G. C. KUHLMAN CAR COMPANY, CLEVELAND, OHIO.
—JOHN STEPHENSON COMPANY, ELIZABETH, N. J.

COMMON SENSE SAND BOX. The construction of this sand box is such that it will never rust together, no matter how long the car may be in a damp place, because the valve slides on two narrow steel runners, and the bottom of the casting does not touch the slide and is therefore always ready to work. It is claimed that this is the only box that has worked twelve years without any refusal or repairs. (For illustration see advertisement.)
—DEWITT SAND BOX COMPANY, TROY, N. Y.

HAM SANDBOX, No. 10. This sandbox differs in operation from other sanders, inasmuch as it is not fastened to the floor of the car, but is suspended to permit the entire sandbox to swing. The forward motion is suddenly arrested, thus forcing the sand from the hopper, no matter what the condition of the sand may be—wet or dry. No matter how hard the sand may become packed or caked in the box, the operation is such that the sand is broken up and forced from the box.
—HAM SAND BOX COMPANY, TROY, N. Y.

HAMMOND SANDER. A sanding machine operated either by foot or by hand. It consists of a screw conveyor operated by a lever and for each movement of the lever the screw turns a certain part of a revolution, thereby forcing the sand out of the hopper, whether wet or dry. The sand does not need to be dried or put through a screen before using. The machine is built to sand both rails simultaneously. It is durably constructed, has few parts to get out of order and is easily applied and operated.
—TRACTION EQUIPMENT COMPANY, BROOKLYN, N. Y.

KILBOURNE TRACK SANDER. This sander is now manufactured by this company in malleable iron throughout, thereby reducing to a minimum the chances for breakage. The spout is made from a spiral steel spring and the same spout may be used either on single or double truck cars. The sander will handle anything from fine sand to gravel or crushed stone, either wet or dry, and in just the amount required.
—FRANK RIDLON COMPANY, BOSTON, MASS.

NICHOLS-LINTERN AIR SANDERS. This sander consists of a supplementary valve, operated in unison with the engineer's air-brake valve, and a sand trap of special design. It doubles the efficiency of the air brakes. It prevents skidding, does not waste sand, is always under instantaneous control, makes possible fast schedule time where frequent stops are necessary, and is an invaluable aid in starting and hill climbing. (See pages 627 to 636, Bulletin No. 1; see also advertisement.)
—THE OHIO BRASS COMPANY, MANSFIELD, OHIO.

PNEUMATIC SANDERS. The track sander made by this company is designed for operation by compressed air.
—JEWETT CAR COMPANY, NEWARK, O.

PNEUMATIC TRACK SANDERS. This sander insures the placing of a small quantity of sand instantaneously exactly where needed at point of contact of wheel and rail, of the greatest value in emergencies, as by one movement of motorman's hand sander is started and remains in operation without further attention until shut off, the warning port in the valve giving constant notice that sander is working so that it cannot be forgotten and all sand run out of box.
—AMERICAN LOCOMOTIVE SANDER COMPANY, PHILADELPHIA AND CHICAGO.

ST. LOUIS SAND BOXES. No. 1 has galvanized iron hopper, with ball and socket valve and agitator combined, operated by bell crank connecting rod, with either pedal or lever. No. 21 is the same as No. 1, with these exceptions: Instead of ball and socket valve and agitator, a slide valve is used. No. 3 has cast iron hopper and is absolutely water proof. Rotary agitator prevents sand from packing, and prevents clogging. Can be operated with bell crank and pedal attachment, or by lever inside of dash. It is absolutely positive in its operation. Tube leading to rail can be set in practically any position desired, one of the strong points in favor of No. 3.
—ST. LOUIS CAR COMPANY, ST. LOUIS, MO.

STERLING SAND BOX. This box emits sand, coarse or fine, vertically by gravity, through large or small aperture, as desired. Sand kept always in flowing condition. Perfect design, great strength of parts, absolute certainty of operation. It is now in use on thousands of cars.
—STERLING-MEAKER COMPANY, NEWARK, N. J.

SASH FIXTURES

(See also Curtains.)

NATIONAL SASH BALANCE. This device as its name implies, balances the weight of sash. It is a spring roller held in brackets at the highest part of the sash slide. This roller is held to the sash by two belts, one at each end of roller. These belts are connected with roller by brass straps locked in groove of roller, and the lower ends connected to sash by hooks secured to the belting by brass straps. These hooks fit into eyes whhich screw into top of sash, thus making it easy to take out sash when necessary. The screw eyes can also be raised or lowered one or more turns to equalize belt on each side. This device operating with the National Sash Lock, automatically locks windows at any height.
—THE NATIONAL LOCK WASHER COMPANY, NEWARK, N. J.

NATIONAL SASH LOCK. This will positively lock sash at any height, and prevents rattle when sash is made loose enough to be easily raised or lowered. It is operated by simply compressing and releasing levers. The window cannot possibly fall as the jar, instead of loosening it, more securely locks it. By a novel arrangement of levers, if bottom lever is lifted, top lever unlocks itself, but if top lever is pulled down it will not unlock bottom lever, so that to lower window, bottom lever must be used. If the spring by any chance should break, the bottom lever is free and will hold window by gravity.
—THE NATIONAL LOCK WASHER COMPANY, NEWARK, N. J.

SAWS, RAIL

Q AND C PORTABLE RAIL SAW. Furnishes the best and most economical means for cutting rails in track work for they cut clean, thus saving both ends of the rails which is not possible with any other means for cutting in use. It affords a great saving in track labor and saves its cost in less than a year. This saw is made in two styles of two sizes each, and has a capacity for cutting up to 9 ins. girder rail and at an angle up to 45 degs. Furnished complete with saw grinder, two saw blades and the necessary wrenches.
—RAILWAY APPLIANCES COMPANY, CHICAGO AND NEW YORK.

SCRAPERS, TRACK

(See "Cleaners, Track")

SEATING MATERIALS

(See "Curtains and Curtain Materials")

SEATS, CAR

BRILL CAR SEATS. This company manufactures seats of every form for closed, open and convertible cars. The step-over seats, besides having a simple mechanism, few parts and easy operation, are the most comfortable, durable and sightly. The rattan is smoother and more closely woven by an improved process. Frames, springs, padding, covering and all parts are the best in construction, material and workmanship—the proof of which is the enormous increase of business necessitating a recent addition to the department of 12,500 sq. ft., not counting galleries, all used for manufacturing.
—J. G. BRILL COMPANY, PHILADELPHIA, PA.
—AMERICAN CAR COMPANY, ST. LOUIS, MO.
—G. C. KUHLMAN CAR COMPANY, CLEVELAND, OHIO.
—JOHN STEPHENSON COMPANY, ELIZABETH, N. J.

HALE & KILBURN CAR SEATS. All the most modern types of walkover and reversible car seats, in rattan and other coverings, adapted to suit construction of side of car, and giving greatest seating room for actual space occupied; also securing greatest strength, while affording highest degree of comfort to occupant, by providing cushions and backs with steel top reinforced spring construction, the most perfect shapes and angles of cushion and back, together with automatic foot rest, corner grab handle, etc. Designer and sole maker of all-steel car seating of fire-proofed construction. Every description of stationary and longitudinal seating for cars and every other form of passenger vehicle.
—THE HALE & KILBURN MANUFACTURING COMPANY, PHILADELPHIA, PA.

HEYWOOD BROTHERS & WAKEFIELD CAR SEATS. The particular feature which distinguishes these seats from others is the simplicity of the Wheeler mechanism of the walkover type, which automatically tilts and moves the cushion forward with the reversal of the back. This mechanism is also made with automatic foot rest which tilts with the reversal of the back. This seat has very few parts. The rocker which carries the seat cushion is operated by cams and there are no ratchets, cogs, or other complicated mechanism to bind and cause breakage. The spring cushions are made with practically indestructible flexible steel tops. Besides the Wheeler reversible seat the company manufactures the turnover and double revolving types, as well as longitudinal spring seating, non-reversible, cross seats, motormen's seats, reed parlor car chairs and reclining car seats.
—HEYWOOD BROTHERS & WAKEFIELD COMPANY, WAKEFIELD, MASS.

ST. LOUIS SEATS. These seats are designed to meet the exacting conditions of city and interurban service. The very best twill weave rattan, canvas lined, is used on the cushions, furnished with spring or stiff edge, as may be desired. Seats in plush, leather, etc. The operating mechanism is made of the very best malleable iron, carefully fitted, and combines great strength with ease of operation. The cost of maintenance is slight. The rattan is woven and castings made in the company's shops.
—ST. LOUIS CAR COMPANY, ST. LOUIS, MO.

SEPARATORS, OIL AND STEAM

COCHRANE OIL SEPARATORS. These appliances which are already protecting over 4,000,000 hp. of boilers from oil, are very efficient for removing oil from exhaust steam and rendering the condensation of the steam suitable

for use in boilers. These oil separators are used in street railway power plants on the exhaust line leading to closed feed water heaters, though in many cases it has been found more economical to discard the closed heaters and install Cochrane Open Heaters. (See advertisement.) The Cochrane Vacuum Oil Separators are designed for removing oil from exhaust steam under a vacuum and are placed between the engine and condenser.
—HARRISON SAFETY BOILER WORKS, PHILADELPHIA, PA.

COCHRANE STEAM SEPARATORS. These separators, besides protecting engines from large flushes of water, are most efficient in removing smaller quantities of water or moisture from the steam, thus insuring dry steam for the engines, with the consequent advantages of steam economy, better cylinder lubrication and economy of lubricating oil. The Cochrane Receiver Separators are particularly adapted for service at the end of long or exposed lines of piping. In addition to having the same efficiency as the ordinary Cochrane Steam Separators in removing large or small quantities of water from steam, they are provided with extra large wells which act as receivers for storing steam under full boiler pressure, close to the engine, upon which the engine may draw instantly when the load is suddenly increased. They are very effective in preventing hammering and vibration in the piping.
—HARRISON SAFETY BOILER WORKS, PHILADELPHIA, PA.

MURRAY STEAM SEPARATORS. These steam separators are of two types—of steel boiler plate construction and cast iron. They are effective, durable and economical and prevent accidents due to charges of water in the engine cylinders.
—THE MURRAY IRON WORKS COMPANY, BURLINGTON, IA.

STRATTON STEAM SEPARATOR. This separator delivers dry steam to engines even under unfavorable conditions. It permits the use of long lines of pipe, as it will remove all condensation that may take place. It permits the forcing of boilers to their limit, and yet eliminates all entrained water which such practice would ordinarily produce. It is able to handle large amounts of water, arresting it, and thereby preventing possible engine wrecks.
—GOUBERT MANUFACTURING COMPANY, NEW YORK.

SETTEES AND BENCHES

BETHLEHEM PARK SETTEES AND BENCHES. Outdoor benches, cafe tables, iron work for parks, lawns, gardens, waiting rooms, etc. The settees or benches and tables are made to be shipped complete, in knocked-down shape, and can be easily set up and finished.
—BETHLEHEM FOUNDRY & MACHINE COMPANY, SOUTH BETHLEHEM, PA.

SHIELDS, THIRD-RAIL

BUCKEYE THIRD-RAIL SHIELD. This shield insures perfect safety to persons or stock and forms an absolute protection from sleet and snow. It is furnished with an enclosed rack for carrying feed, telephone or signal wires. The top of this shield is also removable at any point along the line.
—BUCKEYE THIRD-RAIL SHIELD COMPANY, COLUMBUS, OHIO.

SHOES, BRAKE

(See "Brake Shoes")

SHOVELS, POWER

VULCAN STEAM AND ELECTRIC SHOVELS. These shovels are built in ten standard sizes. Volumes of material ranging from 300 cu. yds. up, can be handled, according to the size of shovel. This construction consists of an all steel car, built to withstand severe strains, upon which are mounted improved engines and correctly proportioned machinery of the best mechanical construction. Ample power is provided for successful operation.
—THE VULCAN IRON WORKS COMPANY, TOLEDO, OHIO.

SHUTTERS, STEEL ROLLING

(See "Doors, Steel Rolling")

SIGNAL SYSTEMS

BLAKE SIGNAL SYSTEM. A railway semaphore signal for use in connection with telephones. Enables a dispatcher to set a semaphore arm and red light at any telephone point, thus, signifying to an approaching car that the dispatcher desires to communicate with the car crew. Requires but a single bare iron line wire for each 15 signals. The signals are perfect in mechanical and electrical detail. The mechanism is simple, the action positive, and there is a positive "answer back" to central office when semaphore arm and red light are set.
—BLAKE SIGNAL & MANUFACTURING COMPANY, BOSTON, MASS.

EUREKA AUTOMATIC ELECTRIC SIGNALS. Two systems of Eureka signals are manufactured, both adapted to the several types of electric railways, and constructed to operate from the track or by overhead contact-makers. Both systems may employ lamps or semaphores The two-wire system counts cars The single-wire system is the acme of simplicity Both systems are modified to ring bells on bridges and at road crossings, as well as to operate semaphores, normally at danger to show danger or safety of steam tracks crossed at grade All Eureka apparatus is designed and constructed for long, continuous, heavy service, the controllers being models of mechanical excellence
—EUREKA AUTOMATIC ELECTRIC SIGNAL COMPANY, LANSFORD, PA.

JORDAN AUTOMATIC SIGNAL. Contains only three moving parts the actuating magnet plunger, the color target for changing the light colors and the semaphore target and its shaft. A cast iron box is provided, the upper part containing the signal lights and the lamps in the protection circuit, together with a relay in connection with them. The lower part of the box contains two actuating magnets of the solenoid type A single core is acted on by these magnets, the clear magnet pulling the core to the right and the danger magnet to the left. Gears on the core cause the proper working of the semaphore and targets. Adapted to third rail, overhead or underground systems.
—JORDAN AUTOMATIC ELECTRIC SIGNAL COMPANY, NEW YORK.

KINSMAN BLOCK SYSTEM. A system for preventing one train entering the block of another by automatically cutting off the power and applying the air brakes when a danger signal is disobeyed. Each track section forms part of a continuous electrical circuit. The presence of a train, or other obstruction producing a similar effect, results in disrupting the circuit controlling the apparatus in the next section, thereby operating emergency braking devices on the following train. This is obtained by the action of an increased current upon the train apparatus when the track conditions of the intermediate section become abnormal. This system is employed in the New York Subway.
—KINSMAN ELECTRIC & RAILWAY SUPPLY COMPANY, NEW YORK.

UNITED STATES BLOCK SIGNAL SYSTEM. At each end of a block are placed a signal box and automatic trolley switch, the former being about 100 ft. beyond the switch so as to be easily seen by the motorman as his car passes under switch. A car about to enter a block passes under the trolley switch, lighting a white signal in the box in front and red signal at the distant end of block. These signals are extinguished when the car operates switch on leaving the block. Red signal shows approaching car, white signal receding one. Block is clear only when signal box shows white as car passes under switch. This system does not depend upon the continuity of the lamp circuit, for if lamps burn out after being lighted, it would be impossible to get a "clear" signal. Semaphores may be used in connection with the lights.
—UNITED STATES ELECTRIC SIGNAL COMPANY, WEST NEWTON, MASS.

UNITED STATES REAR-END PROTECTION SIGNALS. To lessen the danger of rear end collisions upon sharp, hidden curves and steep hills, this company has designed a signal that operates for cars going in one direction only. It uses but one line wire and requires each car to clear the signal in its rear before leaving the block' It can be furnished with or without semaphores, the same as the company's regular block system.
—UNITED STATES ELECTRIC SIGNAL COMPANY, WEST NEWTON, MASS.

UNITED STATES TERMINAL AND CROSSING SIGNALS. The terminal signal announces the approach of a car and can be set to act at any desired distance. The highway crossing signal is equipped with an 8 in. gong, which gives an audible, as well as visible, signal that a car is approaching the crossing. The gong and signal usually are set to give the alarm when the car reaches a point about 1,500 ft. from the crossing.
—UNITED STATES ELECTRIC SIGNAL COMPANY, WEST NEWTON, MASS.

SIGNS, CAR AND TRACK

BUDA TRACK SIGNS. These are nowadays considered a permanent part of the right of way, and more substantially constructed than formerly. Cast iron face with raised letters is growing in use. Made to go with wood and steel posts and with concrete bases. Numerous styles.
—BUDA FOUNDRY & MANUFACTURING COMPANY, CHICAGO, ILL

THE CREAGHEAD ILLUMINATED CAR SIGN (INDICATING). Any number of route changes may be carried in the sign, on a continuous sign curtain, the same being reversible through the operating mechanism of a spring roller at the top of the frame, and a plain roller at the bottom. Additional routes can be added to both the sign and indicator, without taking them off the car, as both can be readily taken apart and readjusted. In connection with the sign there is an indicator accurately indicating the changes on the sign on the hood of the car and enabling any changes of route to be made while the car is in motion or stationary, without cementing to the roof of the car or resorting to any other tedious means. The spring winding device obviates any necessity to take the frame apart to tighten the spring if it should become lax through use. Attention is particularly directed to the feature enabling one to switch cars to any route at a moment's notice.
—THE CREAGHEAD ENGINEERING COMPANY, CINCINNATI, OHIO.

HENDERSON CAR SIGN ILLUMINATOR.
—UNITED STATES ELECTRIC SIGNAL COMPANY, WEST NEWTON, MASS.

MILLEN ILLUMINATED CAR SIGN. This sign is used on the lines of the New York City Railway Company and other important systems.
—COLUMBIA MACHINE WORKS AND MALLEABLE COMPANY, BROOKLYN, N. Y.

MORRIS CAR SIGNS. This company is a manufacturer of enameled signs for street and interurban cars.
—ELMER P. MORRIS COMPANY, NEW YORK.

THE ONE LIGHT SIGN. The frames are made of metal. The names are cut out of zinc, painted black and placed in front of white glass. They can also be furnished on colored glass with etched white letters. Either way a very distinct letter is shown during the day and at night the sign is illuminated by 1-16 cp. incandescent lamp producing a uniform and very strong light. If colored markers are required they can be furnished with the sign and both illuminated at night. In this case 2-16 cp. lamps are used. For any electric railways using fixed signs or making few changes in them they are very desirable.
—TRACTION EQUIPMENT COMPANY, BROOKLYN, N. Y.

SLEET CUTTERS

PORTER & BERG'S "O. K." SLEET CUTTER. This device is made of malleable iron, angle shape, with a soft copper contact lug inserted in the end of the upper arm. The lower arm is furnished with nut and washer to hold the sleet cutter firmly in place between the harp and the under side of the wheel. This construction makes the device a part of the harp for all practical purposes, and yet enables the motorman to attach or detach it in an instant. This sleet cutter has been giving universal satisfaction for the past five years and is extensively adopted as the standard device for removing sleet from the trolley wire. (See Catalogue No. 2.)
—PORTER & BERG, CHICAGO, ILL.

SMOKE STACKS

(See "Chimneys")

SLEEVES FOR POLES

(See Poles, Metal.)

SLEEVING

(See Tapes and Cloths.)

SOAPS

(See "Cleaning Powders and Washes")

SOLDER

BRADY SOLDER. This company manufactures the following grades of solder for electric railways: Warranted ½ and ½; strictly ½ and ½; commercial ½ and ½; No. 1 refined; wiping solder; and wire solder of every gage.
—BRADY BRASS COMPANY, NEW YORK.

HALF-ROUND BAR SOLDER. This special form of bar is the most economical form of solder that can be used on small joints, such as armature leads, etc. It is cast in 5-16 in. half round bars about 15 in. long, weighing about ¼ lb. each, and made up in three grades.
—LUMEN BEARING COMPANY, BUFFALO, N. Y.

(CONTINUED ON PAGE XLI.)

SNOW PLOWS AND SWEEPERS

BRILL SNOW-PLOWS. These nose and shear plows have ⅜ in. steel plow-plates, curved at upper and lower edges and strongly backed. The plows are raised and lowered by means of chains and worm gear operated by horizontal hand-wheels. The posts on which the plows are adjusted are composed of T-rails and are braced by 3 in. by 3½ in. iron bars, which extend along each side from post to post and give enormous resisting power. For interurban service the companies build a double-truck baggage car equipped with removable plows, and design plows to meet conditions of all kinds. (Advertisements in last pages.)
—J. G. Brill Company, Philadelphia, Pa.
—American Car Company, St. Louis, Mo.
—G. C. Kuhlman Car Company, Cleveland, Ohio.
—John Stephenson Company, Elizabeth, N. J.

BRILL STANDARD SNOW SWEEPER. Short brooms are used with this sweeper as they can be set at an angle necessary to throw the snow clear of the rails. They also work and wear more evenly than long brooms, are easier to handle, and are capable of independent adjustment to conform to the curvature of the pavement. With one end set a little lower than the other, the rattan digs into the hollow of the rails and cleans them out thoroughly. Three motors are used, two for propulsion and one for the brooms. The sweeper is powerfully constructed in every particular and intended for heavy service. (Advertisements in last pages.)
—J. G. Brill Company, Philadelphia, Pa.
—American Car Company, St. Louis, Mo.
—G. C. Kuhlman Car Company, Cleveland, Ohio.
—John Stephenson Company, Elizabeth, N. J.

CAMPBELL SNOW BROOM. This broom is made in two sections, of any length, and can be applied or removed from the shaft of a car in a few minutes by simply screwing or unscrewing some neatly fitted bolts. Malleable iron adjustable heads make this broom practically indestructible, as the heads will not break or wear out.
—The Consolidated Car Fender Company, New York.

DORNER SNOW SWEEPERS. These sweepers are in use on a number of electric railways; the brooms are operated by motor independent of car. Brooms each end, cars built to suit road, single or double trucks.
—The Dorner Manufacturing Company, Chicago, Ill.

RUGGLES ELECTRIC ROTARY SNOW PLOW. Designed for the severest service. Constructed like rotaries used on steam railroads but adapted for operation by electric motors, and will move in either direction. The snow is removed from track by revolving steel blades operated from a motor-driven fan shaft running through the cab. The snow-removing blades are protected by steel scoops. Snow is received on the revolving blades and expelled laterally through chutes. The plow also has scrapers and ice diggers.
—The Peckham Manufacturing Company, Kingston, N. Y.

SPEED INDICATORS

WOODMAN-HUDSON SPEED INDICATORS. These indicators are adapted to pointed or hollow centers, and have a raised sight on dial so as to count by touch which is of great importance, especially in dark places, as it is only necessary to look at the watch and count the number of revolutions the dial makes, which, with the fractions, will be the exact speed of the machine. It is accurate, reliable, of convenient size, neatly finished, and suited to carry in the pocket. The spindle is made of best tool steel. The double speed indicator indicates up to 5,000 revolutions, either right or left hand. The index point can be adjusted to zero with the finger. An extra hardened point, 6 ins. long, can be furnished for dynamos.
—The R. Woodman Manufacturing & Supply Company, Boston, Mass.

SPLICING SLEEVES

(See "Clamps and Connectors for Wires and Cables")

SPRINKLERS, FIRE

(See "Fire Extinguishers")

SPRINKLERS, TRACK AND ROAD

BRILL CENTRIFUGAL SPRINKLER. A centrifugal pump operated by a direct-connected motor, both on platform at one end of car, supplies pressure for distributing water uniformly for fifty feet on each side of track. Same pump will fill tank from lake or stream fifteen feet below track, or tank may be filled in usual manner. The shaft of the centrifugal pump is the only wearing surface. No check or inlet valves. No crank shafts nor pistons to become heated. No need for expensively riveted tanks to withstand air pressure. Amount and direction of water always under perfect control by a patented sprinkling head.
—J. G. Brill Company, Philadelphia, Pa.
—American Car Company, St. Louis, Mo.
—G. C. Kuhlman Car Company, Cleveland, Ohio.
—John Stephenson Company, Elizabeth, N, J.

BRILL GRAVITY SPRINKLER. This apparatus is suitable wherever it is unnecessary to sprinkle more than twelve feet on either side of track. The standard sizes of tanks are as follows: 6½ x 10 ft. — 2,480 gals.; 6½ x 13 ft. — 3,225 gals.; 5½ x 24 ft. — 4,000 gals. Under ordinary conditions, a 2,480-gal. tank will sprinkle four to six miles of roadway. The sides of the tank are composed of ⅛-in. and the ends of 5-16 in. steel. The ends are strengthened with inner stays and swash plates prevent surging of water. The sprinklers are built with enclosed tanks, if desired, and the appearance made similar to an ordinary car.
—J. G. Brill Company, Philadelphia, Pa.
—American Car Company, St. Louis, Mo.
—G. C. Kuhlman Car Company, Cleveland, Ohio.
—John Stephenson Company, Elizabeth, N. J.

SPRINGS, CAR AND TRUCK

BRILL SPRINGS. These companies make every kind of spring used on electric and steam railways, from the diminutive box-lid coil to the heaviest locomotive driving spring. The grade of steel used is that known as the Pennsylvania Railroad Standard Analysis and Test. The companies' enlarged spring-manufacturing plant is equipped with the finest types of machinery and oil-burning furnaces, and operated with the best skilled labor obtainable.
—J. G. Brill Company, Philadelphia, Pa.
—American Car Company, St. Louis, Mo.
—John Stephenson Company, Elizabeth, N. J.

FORT PITT CAR SPRINGS. Car springs manufactured from the finest grade of spring steel, oil tempered; these comprise bolster springs, equalizer springs, truck springs, heavy draft springs, light draft springs, etc. In fact every style of coil steel springs used for passenger, freight and electric railway service.
—Fort Pitt Spring & Manufacturing Company, Pittsburg, Pa.

RAILWAY STEEL SPRINGS. Helical and elliptical springs for all types of electric railway trucks.
—Railway Steel Spring Company, New York.

STANDARD SPRINGS. These works manufacture elliptic, double elliptic, coil and other springs suitable for electric traction equipment.
—The Standard Steel Works, Philadelphia, Pa.

PITTSBURGH SPRINGS. This company makes springs for high-speed cars, locomotives, passenger cars, freight, coal, dump and traction cars; also governor, valve and machinery springs. All springs are oil tempered.
—Pittsburgh Spring & Steel Company, Pittsburgh, Pa.

TAYLOR ELLIPTIC SPRINGS. These springs are made of crucible spring steel of the regular standard railroad spring steel analysis. All springs are accurately made of the proper dimensions to allow ample spring action under various loads, and are tested to carry successfully the weight of car for which they are intended.
—Taylor Electric Truck Company, Troy, N. Y.

UNION SPRINGS. The springs made by this company are furnished in helical and elliptical form for all classes of interurban and street railway service.
—Union Spring & Manufacturing Company, New Kensington, Pa.

STEPS, CAR

BRILL CAR STEP. The platform step made by this company is composed of malleable iron hangers and a wooden tread. Two ⅜ in. tie rods pass under the tread and are let into it. The toe piece, or fender, is bolted at three points to the platform knee and screwed to the back of the tread; it is also malleable iron with an open design free from points on which clothing might be caught The hangers are secured to the crown-piece and the end sub-sill with two ⅜ in. bolts to each.
—J. G. Brill Company, Philadelphia, Pa.
—American Car Company, St. Louis. Mo,
—G. C. Kuhlman Car Company, Cleveland, Ohio.
—John Stephenson Company, Elizabeth, N. .

Q AND C STANWOOD CAR STEPS. This car step is made of thin strips of Bessemer steel square sheared, bent so as to form corrugations across the step. Rods pass through the frame and steel re-inforcing strips which prevent the step from sagging. The step is handsome in appearance, always looks the same and never requires repairing. It gives a perfectly non-slipping surface and is safe in all kinds of weather. The open form of construction admits of the free passage of dirt, mud and snow and prevents any accumulation of dirt on the step.
—Railway Appliances Company, Chicago and New York.

STEP TREADS

(See "Treads, Step")

STOCK GUARDS

AMERICAN CATTLE GUARDS. This company is prepared to furnish stock guards for railways.
—American Bridge Company of New York, New York.

CLIMAX CATTLE GUARDS. These guards have a smooth surface with inverted V-shaped ridges. They are manufactured from shale clay burned hard, vitrified and glazed. They will not burn, warp, rust or decay, and barring accident, will last indefinitely. The replacing of a few broken blocks maintains and renews the guards perpetually at small expense. The blocks are 24 in. long, 8½ in. wide and 4 in. high—just long enough to span the ties center to center. Any combination of blocks can be used to meet requirements.
—The Climax Stock Guard Company, Chicago, Ill.

KALAMAZOO "PERFECT" STEEL SURFACE CATTLE GUARD. There are many types of cattle guards which keep off trespassing cattle by presenting a bristling front of jagged points. This guard is a departure as it renders crossings physically impossible without hurting the animals. At the initial step they slide toe first against a slot at the base and cannot advance, but are free to withdraw without slightest injury. The "Perfect" turns the most recalcitrant steers and bronchos at troublesome crossings. Made in three sections only, ready-to-place, saves much expense; offers no catching points for dragging chains; is readily removable during track overhauling; chokes weed growth; has a solid anchorage in track and cannot rattle to pieces; after assembling guards are dipped in an asphaltum bath to fill all crevices and cover all surfaces with a thick, tenacious coat; is proof against corrosion; is self-cleansing of snow and rubbish by draught, and does not emit jingling sounds from passing trains. Other styles of cattle guards, both steel and wood, are also made by this company.
—Kalamazoo Railway Supply Company, Kalamazoo, Mich.

SHEFFIELD CATTLE GUARD. Made from soft sheet steel with triangular points punched up so thickly all over them that no animal can secure a comfortable footing thereon. These sheets are 26 ins. wide and 8 ft. or 9 ft. long, as desired. A set consists of four of these sheets, or enough for one side of a single track crossing, two of the sections being placed between the rails and one on each side. No special preparation of track is necessary to put them in place. All guards are coated with asphalt before shipping.
—Fairbanks, Morse & Company, Chicago, Ill.

STOKERS, MECHANICAL

AMERICAN STOKER. Coal is supplied to the stoker through the hopper outside of the furnace. Immediately under the coal hopper, and communicating with it, is the conveyor pipe. A screw conveyor or worm is located in the conveyor pipe and conveys the coal into the magazine or retort inside of the furnace. Under the conveyor pipe and retort is located the wind-box, with its opening to the front for connection to the piping for the air supply furnished at low pressure by a blower. The upper edge of the retort is surrounded by detachable tuyeres, or air blocks, communicating with the wind-box below, the blocks being furnished with openings for discharging the air into the coal. The distribution of air to each stoker is regulated by a wind gate located at the mouth of the wind chamber.
—The American Stoker Company, Erie, Pa.

BABCOCK & WILCOX MECHANICAL STOKER. This stoker is of the traveling chain grate type, consisting of an endless chain of short cast-iron bars linked together, passing over sprockets at the front and rear, the front sprockets being revolved by a worm and worm wheel. The depth of the fuel and speed of grate can be adjusted to suit conditions.
—The Babcock & Wilcox Company, New York.

THE GREEN TRAVELING LINK GRATE. An automatic traveling chain grate designed for burning low grade bituminous coals. It consists of an endless chain, the coal being fed into a hopper passing under a grate into the fire, where it is consumed, and is passed over the tail of the grate into the ash pit in the form of ash. The coal is never disturbed from the time it enters until it leaves the stoker in the form of ash, thus obviating all slicing, cleaning or firing. This style of chain grate is adapted for any type of boiler.

—GREEN ENGINEERING COMPANY, CHICAGO, ILL.

RONEY MECHANICAL STOKERS. Built in all sizes, automatic feed, eliminating to a great degree the expense and general inefficiency of hand firing boiler furnaces, particularly adapted to steam generating plants of large capacity. Constructed upon the inclined rocking grate principle with special coking fire arch where bituminous fuel is used. Its essential features are (a) simplicity of operation; (b) responsiveness to steam demand; (c) adaptability to any type of boiler; (d) adaptability to usual kinds of coal, especially the cheaper grades, which may be burned to better advantage than is possible by hand firing.

—THE WESTINGHOUSE MACHINE COMPANY, PITTSBURG, PA.

STOPS, EMERGENCY

(See "Emergency Stops")

STORAGE BATTERIES

(See "Batteries")

STOVES

(See also "Heaters, Car")

MURRAY STOVES. These are cast iron stoves and designed for stations, car barns and work shops. They are not ornamental, but exceedingly useful.

—THE MURRAY IRON WORKS COMPANY, BURLINGTON, IA.

SUPERHEATERS

BABCOCK & WILCOX STEAM SUPERHEATER. This device for superheating steam is placed in the space above the tube sections and below the drums in a Babcock & Wilcox boiler. It consists of seamless drawn steel tubes bent into U form and expanded into wrought steel boxes or manifolds. The steam from the boiler enters the upper manifold box, divides among the U tubes and becomes superheated during its passage through them, the pressure remaining unaltered. The superheated steam outlets are taken from the lower manifold box.

—THE BABCOCK & WILCOX COMPANY, NEW YORK.

FOSTER SUPERHEATER. For superheating steam or heating air. All pressure parts of steel. All joints expanded. Only cast iron exposed to hot gases. Large mass of metal in the construction prevents fluctuations in superheat and obviates necessity for dangerous flooding devices with their complicated piping and valves, requiring skilled attendance. Contains no bent tubes. Made entirely of straight cold drawn seamless steel tubes with corrugated cast iron covering shrunk on. Easily inspected inside and out. Can be installed in independent setting with furnace for coal, wood, oil or gas. Superheat may be regulated from 0° to maximum amount for which installation is designed.

—POWER SPECIALTY COMPANY, NEW YORK.

PARKER SUPERHEATERS. Consist of cast steel headers and small cold-drawn seamless steel tubes. They are located just above the bottom row of evaporating tubes and the degree of superheat can be varied by making the openings through the baffles larger or smaller. The device is flooded while getting up steam but takes care of itself at all other times. Combined with the Parker boiler, which delivers steam of uniform dryness, this superheater gives a very unusual uniformity to the superheat, due to the fact that the flow through it is arranged to vary in proportion to the fire.

—PARKER BOILER COMPANY, PHILADELPHIA, PA.

STRIPS, PROTECTING

(See "Paving Materials")

STRUCTURAL IRON WORK

(See "Bridges and Buildings")

SWEEPERS, SNOW

(See "Snow Plows and Sweepers")

STRAINERS, WATER

LIBERTY TWIN STRAINER. Claimed to be the only strainer made which can be cleaned successfully without shutting off or checking the water supply. It consists of two chambers, each containing a straining apparatus, one of which is a duplicate of the other. Two valves operated under pressure change the flow of water from the dirty chamber to the clean one. It can be placed in the suction line in the power plant where it is accessible for cleaning. (See advertisement.)

—LIBERTY MANUFACTURING COMPANY, PITTSBURG, PA.

SWITCHES, ELECTRIC TRACK

(See also "Track Work")

CHEATHAM AUTOMATIC ELECTRIC SWITCHING DEVICE. This consists of three parts: First—A trolley pan attached to the overhead wire, with which the trolley wheel connects when switch is to be thrown; second, a track attachment consisting of an iron box containing a cylinder inside of which are two solenoid magnets which operate a single core armature connecting with the switch tongue; and third—a circuit changing box placed on a pole at curb of sidewalk; this normally connects with one track magnet until a motorman uses power through the trolley pan on bracket attached to overhead wire, which causes it to change the connection to the other track magnet. In operating the switching device the motorman simply turns off the current when desiring to set switch for straight track, and when desiring to set it for the curve he turns on power to second notch. No alteration or attachment to car is necessary.

—SAMUEL BOWMAN, ST. LOUIS, MO.

SWITCHES AND SWITCHBOARDS

ANDERSON SWITCHES AND SWITCHBOARDS. Special attention has been given to developing switches and switchboards of large capacity, and much time devoted to the production of high conductivity copper castings for this purpose, also to mechanical construction, good contacts and workmanship. This line includes knife and quick break switches; switchboards for electric railway; light and power plants; section cut-out switches for electric railways; cab and car heater switches; service switches; distant control, end cell and voltmeter switches; automatic time switches, also various other special switches designed for unusual conditions.

—ALBERT & J. M. ANDERSON MANUFACTURING COMPANY, BOSTON, MASS.

CONDIT SWITCHES AND SWITCHBOARDS. All types of switches are manufactured and switchboards erected by this company.

—CONDIT ELECTRICAL MANUFACTURING COMPANY, BOSTON, MASS.

CONSOLIDATED SWITCHES AND SWITCHBOARDS. Double quick-break knife switch, No. 204, consisting of two quick-break knife switches and two fuses mounted on a slate base. Cover and frame are of iron finished in black japan. Double snap switch, No. 164, and three-intensity regulating switch, No. 158, also snap switch, No. 151. Special switchboards made for elevated and surface cars.

—CONSOLIDATED CAR HEATING COMPANY, ALBANY, NEW YORK, CHICAGO.

CROUSE-HINDS, SWITCHES AND SWITCHBOARDS.

—CROUSE-HINDS COMPANY, SYRACUSE, N. Y.

CUTTER ELECTRICAL AND MANUFACTURING COMPANY, PHILADELPHIA.

(See item under "Circuit Breakers")

"OHIO BRASS" SWITCHES. The line section switch is furnished with wooden cover for mounting on pole, for use as a section cut-out switch. It is made single pole, capacity from 400 to 1,000 amp., and for circuits of 110-600 volts. Front connections only. The standard quick break switch is mounted on a slate base, capacity from 400 to 1,000 amp., 110-600 volts. Makes a quick, wide break and may be relied upon to open circuits up to and over its rated capacity. Front connection only. (See Bulletin No. 1, page 649.)

THE OHIO BRASS COMPANY, MANSFIELD, OHIO.

SWITCHES AND SWITCHBOARDS. The General Electric Company has designed a complete line of standard switchboards for every class of service, but is prepared to fill promptly and satisfactorily specifications of a special nature. The instruments, meters and appliances furnished with these boards represent the latest and best engineering practice. Standard lines of lever switches, toggle brush switches, oil switches and circuit breakers have been perfected for all voltage and ampere capacity ranging from 1 to 10,000 amperes and 10 to 60,000 volts.

—GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

WESTERN ELECTRIC KNIFE SWITCHES. Particularly designed for first class work. Rated on 50 amp. per sq. in. for sliding and 100 amp. for bolted contact surfaces. Blades are of best grade cold rolled copper. Jaws and studs are of hard drawn copper. Handles and cross bars have a polished ebony finish and are of well seasoned maple, which is superior to fiber compounds because far less brittle. Nuts are galvanized copper plated and oxidized to prevent rusting. "Draw file" and "polished and lacquered" finishes. These switches conform to all requirements of the National Board of Fire Underwriters.

—WESTERN ELECTRIC COMPANY, NEW YORK AND CHICAGO.

WESTINGHOUSE SWITCHBOARDS. This company builds anything in the way of switchboards from the smallest motor-panels to the largest electrically operated boards. Many different types of boards have been standardized, and it is advisable that such a board be selected when possible, although any kind of marble or slate with a choice from instruments and apparatus of many types and finishes can be furnished if desired.

—WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, PITTSBURG, PA.

WESTINGHOUSE SWITCHES. The output of this company includes knife switches, hook switches, field discharge switches, fused switches, plug switches, plunger switches, oil switches, electrically as well as hand operated switches. The best drawn lake copper is used for current carrying parts, and the sectional areas and contact faces of all parts have been calculated in accordance with the best practice and a liberal allowance for overload. In knife switches blades of certain definite capacities are selected as units, and switches of capacities which are multiples of the unit are built by combining in parallel the required number of unit blades.

—WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, PITTSBURG, PA.

SWITCHES, TRACK

(See "Track Work")

SUB-STATION, PORTABLE

(See "Cars, Portable Sub-Station")

SUB-STRUCTURES, TRACK

(See "Track Work")

TANKS, METAL

METAL TANKS. Made by Broomell, Schmidt & Steacy Company, York, Pa.

PHOENIX TANKS. Metal tanks for storage purposes are constructed by this company.

—PHOENIX IRON WORKS COMPANY, MEADVILLE, PA.

TAPES AND CLOTHS

(See also "Insulating Tapes")

ASBESTOS "LISTING" OR WOVEN TAPE. Asbestos "Listing" is a fire-proof, flexible, woven cloth tape, suitable for wrapping all forms of electrical wires, cables, as well as for other uses. It is made in widths from ½ in. to 4 ins. and 1-16 in. to ¼ in. thick. It is supplied in lengths of 50, 100 and 150 ft. (See advertisement.)

—H. W. JOHNS-MANVILLE COMPANY, NEW YORK.

HOPE TAPE. Special grades and qualities required in the building and repair of dynamos, motors and other electrical apparatus. Every detail of manufacture (quality of stock, uniformity of width and thickness, evenness of finish, etc.) has been carefully worked out under the advice of the best electrical engineers, and special machinery constructed to produce material as nearly perfect as may be for each special purpose. A complete line, including a large variety of widths, qualities, and thicknesses from .003 upward.

—HOPE WEBBING COMPANY, PROVIDENCE, R. I.

MAGNETO ASBESTOS-GAUZE TAPE. An asbestos tape or ribbon having a gauze backing. This tape is 1-100 in. thick, very tough and strong, with evenly cut edges. It is put up in coils 8 in. in dia. and ¾ in. to 3 ins. in width; other widths up to 36 ins. made to order. This material was gotten out primarily for winding armature,

but is extensively used for other purposes, where a strong fire-proof wrapping tape is desired. (See advertisement.)
—H. W. Johns-Manville Company, New York.

MORGAN & WRIGHT TAPE. A rubber tape prepared especially for electrical purposes.
—Morgan & Wright, Chicago, Ill.

TELEPHONES

MAYER & ENGLUND TELEPHONES. This railway telephone has no miniature parts to cause vexation and delay. The Mayer & Englund Company has two types of railway telephones. One is of the portable variety with standard sized parts arranged compactly and enclosed in a neat, strong oak box, provided with a long cord for plugging into a jack box erected on the pole. The other is of the stationary type enclosed in a malleable iron box for installing directly on the pole.
—Mayer & Englund Company, Philadelphia, Pa.

WESCO PORTABLE RAILWAY TELEPHONES. These telephones are supplied with short poles, by which connection may be made from the car with connecting boxes placed upon the line poles at convenient intervals. Should a car stop too far from the connecting box, the connecting pole may be carried to the nearest connecting box. These, as well as the company's regular exchange and bridging telephones, are made throughout of the best materials, and equipped with long distance solid back transmitters, bi-polar receivers, with concealed cord connections and permanently adjusted diaphragm and hard rubber receiver shell.
—Wesco Supply Company, St. Louis, Mo.

TESTING INSTRUMENTS

(See "Instruments, Electric Measuring," and "Bond Testers")

THIRD RAIL, TYPES OF

KINSMAN INDUSTRIAL THIRD RAIL. Designed for service where the requirements are comparatively light or temporary. Is composed of timbers mounted upon posts screwed into standard glass insulators which are firmly embedded in the wood, making a well insulated, substantial device which can be taken up in sections. The contact for the shoe is of sectional iron or copper firmly locked at the joints as well as to the stringer, forming the body of the structure, the whole making a light, compact and durable substitute for the ordinary steel third rail. Particularly adapted for contractors and others where the trolley and its supports are unavailable or inconvenient.
—Kinsman Electric & Railway Supply Company, New York.

FARNHAM INVERTED PROTECTED THIRD RAIL. A Tee rail or other form, special or standard, for contact on the underside by the current collector shoe. Protected against the elements, and also prevents persons from coming into accidental contact with the energized rail. This rail is capable of reinforcement to any capacity up to 4,000 hp., and forms a standard construction of maximum stability and safety assuring minimum cost of maintenance. (See also advertisement.)
—The Farnham Company, Chicago, Ill.

THIRD RAIL INSULATORS

(See "Insulators, Third Rail")

THIRD-RAIL PROTECTION

(See "Shields, Third-Rail")

TICKETS AND TRANSFERS

(Also Ticket Boxes and Cases.)

AMERICAN TICKET CASES AND BOXES. To satisfy the demand of railway ticket auditors for durable, neat and convenient ticket receptacles, this company makes several types, such as adjustable tube local ticket cases, combination ticket cases and coupon ticket cases, with folder rack. Two coupon hooks are used in connection with these cases, the Bacon style for wooden bars and the Blades for metal bars.
—American Railway Supply Company, New York.

GLOBE TICKETS AND TRANSFERS. These tickets and transfers are made on special machinery, built by the company. All issues and numbering are guaranteed correct and only the best grade card-board, paper and ink are used. The company controls many patent tickets and transfers and gets up special styles to meet particular requirements. (For illustration, see advertisement.)
—Globe Ticket Company, Philadelphia, Chicago, San Francisco.

MACDONALD TICKET BOX. A drum shaped device made to contain one hundred or more cash receipts which are numbered in consecutive order and locked in the holder by a seal bolt arrangement. The fares and station names are arranged in two parallel columns in such a way as to engage beneath pointers, the object being to provide a cash receipt for use on electric railways that can be handled rapidly enough to meet heavy traffic, and at the same time insure a high degree of protection to the company, the conductor and the traveling public.
—The MacDonald Ticket & Ticket Box Company, Cleveland, Ohio.

NATIONAL TICKETS AND TICKET CASES. This company designs and print, in any desired quantity all classes of tickets suitable for railway use. It also manufactures ticket cases.
—National Ticket Company, Cleveland, Ohio.

"OHMERGRAPH" TRANSFER ISSUING MACHINE.
(See item under Transfer-Issuing Machines.)

STROMBERG-ALLEN TICKETS AND TICKET CASES. Aside from a full line of railway tickets this company also manufactures ticket punches, ticket cases, daters, blank books, stationery, etc.
—Stromberg, Allen & Company, Chicago, Ill.

TICKET CHOPPERS AND DESTROYERS

GLOBE TICKET CHOPPER. This chopper is a ticket collecting box of neat and strong construction. It is arranged, by a series of plate glass guides, to convey the tickets to a pair of cancelling rolls, where they rest in a position favorable for examination by the gateman, then are passed between the steel rolls by a turn of the wheel, and cancelled by punching slots in them. While the tickets are unmistakably cancelled they still can be audited if desired. Net weight, 151 lbs. Floor space, 17 in. by 17 in. (For illustration see advertisement.)
—Globe Ticket Company, Philadelphia, Chicago, San Francisco.

PATTEN TICKET DESTROYER. This machine destroys used tickets and transfers, so as to leave no chance for fraud, the old method of burning being slow and undesirable. It can be set up in the auditor's department and all tickets destroyed under his supervision. The cuttings can be sold for paper stock or otherwise disposed of. The machine is strongly built and durable, having a cast iron frame, babbitted bearings, cutting cylinder and bearings crucible steel. The machine is fitted to run by hand or power, but a 1 h.p. motor is recommended. Price oP application.
—Paul B. Patten, Salem, Mass.

GLOBE POWER TICKET DESTROYER. This destroys the daily returns of tickets and transfers. It is a simple, inexpensive machine, easily operated and with ordinary intelligence and care will last for years, thoroughly destroying any paper or card-board fed through it. It will mutilate from 50,000 to 100,000 tickets or transfers per hour. Floor space 17x17 in., weight 150 lbs., speed 400 revolutions per minute, 1½ h.p. A large number of these machines are in use with gratifying results. (For illustrations see advertisements.)
—Globe Ticket Company, Philadelphia, Chicago, San Francisco.

TICKET PUNCHES

(See "Punches, Ticket")

TIES

(See "Poles and Ties")

TIE PLATES AND BRACES

(See "Track Work")

TIMBER PRESERVING MACHINERY

ALLIS-CHALMERS TIMBER- PRESERVING MACHINERY. Stationary retorts are frequently 6 ft. in diameter and 125 ft. long. By means of a narrow track running the length of the cylinder, cars loaded with timber can be easily run in. Closed with an air tight fitting door at the open end, the air is pumped out. The cylinder is then filled with creosote or other preservative. For railroads the best type is the portable retort, mounted on railroad trucks. The boilers, pumps and solution tanks are also mounted on trucks. Timber along various lines of the railroad can be treated successively with little delay and no cost for special foundations.
—Allis-Chalmers Company, Milwaukee, Wis.

TOILET APPARATUS

DAYTON DRY CLOSETS. The hopper is made of porcelain, with ivory white finish; has patent seat raising device, which lifts the seat when the lid is raised and holds it until in a perpendicular position, thus preventing the seat being fouled if used as a urinal. The seat, however, when it reaches a perpendicular position becomes automatically disengaged and can be returned to its place, the lid following the seat unless held in position; this insures the lid being closed after an operation, so that the next person desiring to use the closet will not find the lid up and seat down and soiled.
—The Dayton Manufacturing Company, Dayton, O.

DAYTON NICKELINE WASHSTANDS. Lavatories made of nickeline have of recent years taken the place of marble. These are manufactured in all shapes and sizes to fit any space provided for same in railway cars. Special attention is called to the folding lavatories for state or toilet rooms to be used where space is limited. These stands are preferable to marble as they eliminate the constant breakage and reduce repairs to a minimum. The folding lavatory cabinets are made of mahogany, cherry, quartered oak, or any other kind of wood that may be specified.
—The Dayton Manufacturing Company, Dayton, O.

DAYTON WATER CLOSETS FOR PASSENGER CARS. A toilet that can be satisfactorily introduced in a railway car must possess many requirements not found in ordinary closets. The company's experience of years has enabled it to perfect various types which are now being used on many important steam and electric railways. These closets are made so that when in use there is no water below level of seat, obviating all danger of freezing while the body of the car is warm.
—The Dayton Manufacturing Company, Dayton, O.

TOOLS, MACHINE

(See "Machine Tools")

TOOLS, TRACK AND MISCELLANEOUS

(See also "Grinders.")

BETHLEHEM FOUNDRY & MACHINE COMPANY, SOUTH BETHLEHEM, PA. This company makes a number of special devices for construction work, among them being the following: Single drum inclined winches; Bethlehem winches; dandy winches; buggies; bogie rollers; grapples; screw punches; hydraulic beam punches; flange punches; horizontal hydraulic jacks; ground lift hydraulic jacks, and jack screws.

BROWN BONDING TOOLS. Hand power grinders, flexible shafts, emery wheels, arbors drills, etc, for applying rail bonds. (See advertisement.)
—Harold P. Brown, New York.

BROWN FLEXIBLE SHAFTS. For use with emery wheels, portable hand power grinders, etc., on track and shop work. Strong, cheap, simple and compact. Designed after ten years' experience with the ordinary expensive and delicate flexible shafts; will stand rough handling by the ordinary track labor. (See advertisement.)
—Harold P. Brown, New York.

FAIRBANKS-MORSE CLAW BAR. The claw is made separately and secured to bar by means of bolt. The claw is the part of the bar that receives the hardest wear and gives out first. In this bar the claw is made of special crucible steel, securing the greatest durability, and when worn out the claw only needs to be renewed, the bar lasting almost indefinitely. It will go under heads of spikes that other bars will not take and pulls the spike straight.
Fairbanks, Morse & Company, Chicago, Ill.

"OHIO BRASS" TRACK TOOLS. Track bonding tools are made by this company for installation of "All Wire" soldered bonds. These tools are especially designed for bonding work and make it possible to install "All Wire" bonds quickly and at the same time insure perfect joints.
—The Ohio Brass Company, Mansfield, Ohio.

SECURITY DRILL CLAMP. This device grips the base of any rail, and holds on until desired to let it go.

There is no bend or spring to it, and it always stays in alignment. The total weight of this clamp is 34 lbs.
—The F. Bissell Company, Toledo, O.

WATSON-STILLMAN TRACK TOOLS. These include street car motor lifts, rail benders, car wheel presses and many other hydraulic tools specially adapted to street railway service.
—Watson-Stillman Company, New York and Chicago.

TOWER WAGONS

(See "Wagons, Tower")

TOWERS, COOLING

(See also 'Condensers")

ALBERGER COOLING TOWERS. Representing the most modern and improved apparatus for cooling water for re-use in steam and ammonia condensers, rolling mills, gas engines and compresser jackets, chemical works and all places where a continual supply of cold water is required and is not available from a natural source. Built in two distinct types, forced draft and natural draft, and provided with the greatest amount of effective and practically indestructible cooling surface geometrically arranged to insure the least resistance to the air. Absolutely even distribution of water over the surface, effected by means of the Alberger automatic rotary distributor.
—Alberger Condenser Company, New York.

WHEELER COOLING TOWERS. Where cooling water for condensing purposes cannot be obtained from a natural source, a cooling tower is installed, through which cooling water, after being heated in condensers, is passed and cooled with the aid of a blast of air produced by fans, thus carrying away the heat put into the water from the exhaust steam and allowing the cooling water, which is being used continuously, to be returned to the condenser. These are made in various types and sizes, and can be adapted to the varying conditions found in engineering practice.
—Wheeler Condenser & Engineering Company, New York.

WHEELER-PRATT WATER COOLING APPARATUS. See item under Condensers.
—C. H. Wheeler Condenser and Pump Company, Philadelphia, New York, Chicago and San Francisco.

WORTHINGTON COOLING TOWER. Consists of a vertical steel shell provided with fans which deliver air over a filling of tile or galvanized pipe. The hot water passes through a vertical central discharge column into a revolving distributor, which lays it evenly upon the filling, over which it trickles while being cooled by the upward blast of air, and then falls to the cold water tank in the tower base. The tower may be arranged for ground foundation or roof, or for natural draught service. Two hundred and fifty towers have been installed since 1893 for miscellaneous service, mostly for cooling condensing water.
—Henry R. Worthington, New York.

TRACK WORK

ALABAMA FROG & SWITCH COMPANY, ANNISTON, ALA. This company has excellent facilities for manufacturing railroad crossings, frogs, switches, switch stands, as well as special work of every description for steam and electric railways.

AMERICAN BRIDGE COMPANY OF NEW YORK NEW YORK. Among the other railway manufactures of this company may be named transfers and turntables.

THE AMERICAN FROG & SWITCH COMPANY, HAMILTON, OHIO. This company, which is prepared to supply all varieties of track work for electric railways, has designed, in connection therewith, a number of special devices, such as the American spring frog Nos. 1 and 3, the American split switch No. 3 and the American re-enforced split switch with two adjustable head rods, No. 34.

ATLAS TRACK SPECIALTIES. These include not only the well-known Atlas rail-joint in various forms, but also girder braces, rail braces, etc.
—Atlas Railway Supply Co., Chicago, Ill.

BARBOUR-STOCKWELL COMPANY, CAMBRIDGEPORT, MASS. This company manufactures a variety of track work for electric railway purposes, including switches, mates and frogs, and crossings with hard steel centers.

BEAVER DAM TIE PLATES AND RAIL BRACES These plates and braces are made of malleable iron only, the manufacturer having found them to be lighter, stronger and more durable than those made of rolled steel.
—Beaver Dam Malleable Iron Company, Beaver Dam, Wis.

BUDA SEMAPHORE SWITCH STANDS. These stands have all the advantages of ordinary stands of the color and shape order, but have additional points in favor. They may be seen at a quarter distance and position of the semaphore arm is a more positive and natural indication of the position of the switch points. Interurban roads find them a safe and desirable stand, and their use tends toward unification of signal standards and to the avoidance of confusion in interpretation.
—Buda Foundry & Manufacturing Company, Chicago, Ill.

BUDA SPECIAL WORK. Such as frogs, crossings, switches, hard centers, crossings, complicated street intersections, etc. Much depends upon accuracy and only the best construction is desirable.
—Paige Iron Works, a Department of The Buda Foundry & Manufacturing Company, Chicago, Ill.

THE CLEVELAND FROG AND CROSSING COMPANY, CLEVELAND, OHIO. This company is a large manufacturer of Lucas' steel rail frogs and crossings, spring rail frogs, split switches, switch stands, tie bars, and track supplies in general. One of the company's specialties is the Porter self-cleaning derailing switch.

DUFF STEEL RAILWAY SUBSTRUCTURE. A method of track construction, consisting of a continuous steel arch support under each rail, and tie pieces of channel shape binding girders together across the track. Rails are fastened to girders by pressed steel clips without bolts or any parts that can get loose or broken. Rail joints are fully supported without interfering with the standard splice bars or rail bonds. Specially adapted for railway track in paved streets, as pavement is not broken up by removal of cross ties, and track does not require frequent renewal. (See advertisement.)
—American Railway Tie & Girder Company, Pittsburg, Pa.

ELLIOT FROG & SWITCH COMPANY, EAST ST. LOUIS, ILL. Maker of all types of electric railway track work, including frogs, switches, crossings, etc.

FALK SPECIAL TRACK WORK. Hardened center-cast-steel track work is integral with all principal wearing surfaces specially treated to combine toughness with hardness. Steel bound track work dispenses with bolts, angle plates or knees, and, being thoroughly welded together by heavy steel castings, is integral in its nature. It is a compromise between the built-up and higher price hardened-center-work. The '04 frog (built up) is made up with heavy open-hearth steel knees and corner filler blocks, provided with guards and riser protection for points. (See advertisement.)
—The Falk Company, Milwaukee, Wis

INDIANAPOLIS SWITCH STANDS. This company furnishes all types of stands, such as main line high stands, pony stands and parallel throw automatic target stands, as well as plain ground throw, for yard and switch use, all of which are designed to meet the requirements of steam and interurban railways—also for mine track and industrial railways.
—The Indianapolis Switch and Frog Company, Springfield, O.

THE INDIANAPOLIS SWITCH & FROG COMPANY, SPRINGFIELD, OHIO. This company manufactures special work for steam, electric and interurban railways, also mine and industrial tracks; all construction especially adapted to meet the requirements of high speed heavy traffic railways. The self-contained easer crossing and improved tongue switches and mates for turnouts and car barn layouts possess features of exceptional merit. Special attention is given to equipping interurban railways with crossings, frogs, switches and stands of all designs equal in every respect to standard steam railway specifications. Surveys are made when desired.
—The Indianapolis Switch & Frog Company, Springfield, Ohio.

"JOHNSTOWN" SWITCH STAND. This stand has a throw parallel with the track and is used with either rigid or spring split switches. It is suitable for steam or interurban railroads or yard use. It is furnished with either a low or high target or without target as required. The target rod is provided with a bayonet to fit lamp socket. It is supplied with an automatic latch and lever rest. The latch is released by the foot and can be locked with an ordinary switch lock. (See advertisement.)
—The Lorain Steel Company, Philadelphia, Pa.

LORAIN CAST STEEL "GUARANTEE" CROSSINGS. Made of cast steel and have renewable hardened steel plates at points of maximum wear. The outside arms are provided with forged or cast steel combination joints, or are made to conform to connecting sections. (See advertisement.)
—The Lorain Steel Company, Philadelphia, Pa

LORAIN GIRDER RAIL FROGS AND CURVE CROSSES. "Guarantee" frogs are made to accommodate any section of girder rail with hardened renewable centers at points of intersection. According to the special requirements of the case, the frogs may be made of cast steel with arms of same material, or arms of rolled steel, held in position by cast iron. Cast steel frogs are made of open hearth cast steel as durable as rail steel; this type being made in one solid casting there are no parts to become loose. Solid cast filler frogs: In this construction the point rails are held together independently of the bolts by the solid cast filler, which is poured hot after all the rails are assembled. Cast-in frogs: In this type rails are firmly held at intersection without bolts or brackets. Unbroken main line frogs are for the purpose described in title. Are made of cast steel and are recommended for use where crossing track is infrequently used, floor of groove in crossing track is gradually raised to a level with the head of main line rail. (See advertisement.)
—The Lorain Steel Company, Philadelphia, Pa.

LORAIN MATES. Mates for tongue switches are provided in either girder or tee rail, conforming to any construction indicated in the foregoing for tongue switches. (See advertisement.)
—The Lorain Steel Company, Philadelphia, Pa.

LORAIN RAILS. Steel rails of various types rolled to suit conditions of paving, etc., including girder rails, guard rails for curved track, full groove rails, half groove rails, "Trilby" rails, deep tee rails, slot rails, stringer bridge rails and shaped guard for tee rails. (See advertisement.)
—The Lorain Steel Company, Philadelphia, Pa.

LORAIN SLOT CROSSINGS. Track with slot crossing track, with or without slot, are made of cast steel, excepting the slot rails, which are of rolled steel—the cast steel rails being fitted to the rolled slot rail. Hardened steel renewable centers are provided at points of maximum wear. Variations in this type permit the slot rail to be made also of cast steel and an integral part of the crossing casting, and crossings of this description are sometimes made without the hardened renewable plates at points of maximum wear. (See advertisement.)
—The Lorain Steel Company, Philadelphia, Pa.

LORAIN SPLIT SWITCHES. Split switches are manufactured in every weight of tee rail and to any tee rail section; types varying according to wish of individual buyers. Among others, being cast manganese point split switches, reinforced split switches, rigid split switches, spring split switches, housed point split switches, spring switches with rigid ground throw, and spring switches with spring ground throw. (See advertisement.)
—The Lorain Steel Company, Philadelphia, Pa.

LORAIN STANDARD TRANSFER TABLE. Designed in such a way that no pit is necessary. The axles revolve in steel anti-friction bearings. The table is constructed entirely of steel and is made for rough usage. It can be made to accommodate any length of car desired. The transfer table rails are framed level with the rails in the car house. (See advertisement.)
—The Lorain Steel Company, Philadelphia, Pa.

LORAIN STEAM RAILROAD CROSSINGS. Made with or without the third or lift rails and with or without hardened steel renewable centers at points of intersection, both tracks guarded with same section of rail and are securely bottled together, having necessary fillers. There is a wide variation in the types of steam railroad crossings, such variations being made in order to conform to the local conditions and the individual ideas of steam and street railroad companies, by whom the same are used. (See advertisement.)
—The Lorain Steel Company, Philadelphia, Pa.

LORAIN STREET CROSSINGS, REGULAR CONSTRUCTION. One street track crossing another street track. Crossing to be built of any guard, girder or tee rail section. Rails in crossing are rigidly held in place by means

(INDEX TO ADVERTISERS, PAGES 15 AND 18)

of corner plates or brackets, securely bolted, or by cast iron poured around the rail intersections. "Guarantee" construction rails are held rigidly in place by cast iron poured around the rail intersections and having renewable hardened steel plates inserted at points of maximum wear; such crossings can be made having the outside arms of the same section of rail as rail sections abutting, thus obviating the use of combination joints. (See advertisement.)
—THE LORAIN STEEL COMPANY, PHILADELPHIA, PA.

LORAIN TEE RAIL FROGS. "Guarantee" frogs. Solid cast filler frogs and cast in frogs are made also in tee rail and of the same general construction indicated above for girder rail frogs. Rolled steel filler frogs are extra strong, being provided with rolled steel fillers. Riveted plate frogs are riveted down to bed plate of size varying with angle of frogs. Spring frogs are made with either one or both wings movable, to provide unbroken main line in either one or both tracks, as may be required. (See advertisement.)
—THE LORAIN STEEL COMPANY, PHILADELPHIA, PA.

LORAIN TONGUE SWITCHES. Tongue switches of the "Guarantee" type are made with hardened renewable centers after the manner described for this type of construction in crossings and frogs. Armored heel tongue switches are provided with renewable plates, protecting and covering heel of tongue, designed to protect the heel from wear and obviate the possibility of excessive movement of worn tongues. Cast steel tongue switches are made of solid cast steel with tongues of hard forged steel. Connected tongue switches (tongue switch and tongue mate), tongue connection being an adjustable rod enclosed in a cast iron box. Tee rail tongue switches of "Guarantee" construction and of the "built up" type. Spring tongue switches in either tee or girder rail, action of tongue being made automatic by means of spring adjustment. (See advertisement.)
—THE LORAIN STEEL COMPANY, PHILADELPHIA, PA.

LORAIN TRACK WORK embraces every variety of girder and tee rail, special work including ordinary surface work of girder or tee rail, with switch pieces either of hardened renewable center construction or of built-up type, and curves spiralized or plain as may be required; also electric conduit and cable work of every kind and variety.
—THE LORAIN STEEL COMPANY, PHILADELPHIA, PA.

NEW YORK SWITCH AND CROSSING COMPANY, HOBOKEN, N. J. This company manufactures special track of all kinds, such as switches, frogs, crossings, stands, transfer and turn tables for steam and industrial railways. Girder rails, hard center construction for electric and steam roads a specialty.

PENNSYLVANIA STEEL COMPANY'S TRACK WORK. This company manufactures steel rails of all sections and weights, frogs, swithces, crossings and special track work for electric railways.
—PENNSVLYANIA STEEL COMPANY, PHILADELPHIA, PA.

WEIR FROG COMPANY, CINCINNATI, OHIO. This company has about thirty different designs of crossings adapted for the crossing of electric railways over steam roads. They are built in accordance with the latest specifications and plans. It can furnish split switches of any design, but has over one hundred of its own, with and without adjustable head rods, or spring head rods, or springs. Point rails re-enforced, or plain. Frogs can be furnished either rigid or spring rail, bolted-up construction in about ninety designs. Switch stands can be furnished from plain ground throw without target, to a ladder stand with a 20 ft. target, either rigid or automatic stands. The company also makes guard rails, rail braces, derailers, etc.

WHARTON MANGANESE STEEL SPECIAL TRACK WORK. Crossings, frogs and switches made with specially strong cast iron or cast steel bodies, with girder rails, of section to be joined, cast into the ends and centers of Manganese Steel, inserted at points of greatest wear. In T-rail work, frogs, etc., cast solidly of Manganese Steel. The Manganese Steel centers outwear the adjoining rail. Special attention is given to accuracy and finish, to insure smooth riding The company has the sole right in America for the use of genuine Manganese Steel in track work.
—WM. WHARTON, JR. & COMPANY, INCORPORATED, PHILADELPHIA, PA.

TRANSFERS

(See "Tickets and Transfers")

TRANSFER-ISSUING MACHINES

"OHMERGRAPH" TRANSFER-ISSUING MACHINE. The Ohmergraph is a light machine carried on the side or chest of the conductor. It perforates the month, day, direction, hour and fractions of hours. It is encased in aluminum and contains transfers put up in rolls of 200 to 300. It is impossible to punch and issue transfers without recording them in this machine. An audible bell ring accompanies each transfer issued.
—OHMER FARE REGISTER COMPANY, DAYTON, OHIO.

TRANSFORMERS

AMERICAN TRANSFORMERS. Durable and safe apparatus of the oil-cooled type, made for all voltages. Large spacings are allowed and generous quantities of iron and copper are used, giving cool operation. Coils are thoroughly baked and impregnated with insulating varnish. Only a slight increase in temperature is caused by several hours under one and one-quarter load. At three-quarters load the efficiency varies between 93.17 per cent. and 97.90 per cent., according to size. Each transformer is tested before leaving factory by running at double potential and applying 15,000 volts immediately after running on full load.
—WESTERN ELECTRIC COMPANY, NEW YORK AND CHICAGO.

BULLOCK TRANSFORMERS. Oil-filled transformers are made for a wide range from 50 Kw. up, for all the standard voltages used in transmission work. They are made in two types—oil filled self-cooled-and oil-filled water-cooled. Self-cooled transformers are provided with corrugated sheet iron cases, depending on radiation from the case to get rid of the heat; they are not made for outputs above 250 Kw. Water-cooled transformers are provided with boiler-plate cases, and the heat is carried off by water circulating through a coil of seamless copper pipe. Water-cooled transformers can be supplied for any desired output.
—ALLIS-CHALMERS COMPANY, MILWAUKEE, WIS. (ELECTRICAL DEPARTMENT, BULLOCK ELECTRIC MANUFACTURING COMPANY, CINCINNATI, OHIO.)

GENERAL ELECTRIC TRANSFORMERS. These transformers are manufactured in all sizes ranging from the small 6 kw. lighting transformers up to the monster 7,500 kw. units, which are now under way at the Schenectady works. This range in size includes oil cooled, air-blast, and water-cooled types. The first type is preferable when first cost is of less importance than minimum attendance, and the units are comparatively small. For large units either air-blast or water-cooled types must be used, the selection depending upon line voltage and local conditions. The Company's engineers are prepared to decide these questions for the customer.
—GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

WESTINGHOUSE TRANSFORMERS. In addition to the several lines of smaller transformers for lighting and power service, such as types N, OD and C, this company has met the demand for larger units, and now 70,000 volt transformers of 3,000 kw. capacity are designed with the same accuracy as 5,000 volt transformers of ten years ago. These large transformers are of the oil-insulated water-cooled type. The Interborough Rapid Transit Company of New York operates 198,000 kw. of Westinghouse air-blast transformers in New York City alone.
—WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, PITTSBURG, PA.

TRAPS, STEAM

ALBANY RETURN STEAM TRAPS. Return steam traps will not only remove the condensed water from steam-jacketed cylinders and from steam separators using high pressure steam, but will also return the same water into the boiler direct without the aid of a pump or the steam loop; and will do this from systems working under varying pressures, from 100 to 200 lbs., returning the water at temperatures from 212 deg. to over 380 deg. Thousands of these have been made and sold during the past 32 years.
—THE ALBANY STEAM TRAP COMPANY, ALBANY, N. Y.

ALBANY NON-RETURN STEAM TRAPS. This trap is styled the "Class C" non-return trap and is best adapted for working on steam pressures of from one up to 100 lbs.; in construction it is similar to the old pot, or bucket trap, that has been in use over fifty years, and perhaps at the present time there are more traps of this one kind than of all the other kinds put together. The improvement in construction of this trap is providing for the renewing of the valve and its seat, when necessary, and this can be accomplished in a few minutes, without removing the top of the trap. The joints are all scraped and fitted metal to metal, and all the parts are interchangeable.
—THE ALBANY STEAM TRAP COMPANY, ALBANY, N. Y.

GOLDEN TILTING STEAM TRAP. The proper amount of condensation entering through a feed trunnion, passing into the receiver, will cause the same to "tilt." As it does so it opens the auxiliary valve, allowing the pressure to act on the piston, which in turn opens the main valve, allowing water in receiver to discharge through the outlet in trunnion. The balance weight on lever causes the receiver to "tilt" back to its filling position, which releases the auxiliary valve, allowing the main valve to close. There are no floats, valves or buckets inside of traps; all working parts are outside.
—GOLDEN-ANDERSON VALVE SPECIALTY COMPANY, PITTSBURG, PA.

MOREHEAD RETURN TRAP. This automatic steam trap takes the condensation from steam heating apparatus and returns it direct to the boiler without waste. The heating surface is rendered more effective by the quick removal of the condensation and the heat from same is utilized in the boiler. The trap consumes less than 10 lbs. of steam per h.p. hour, whereas an ordinary duplex boiler-feed pump requires from 90 lbs. to 120 lbs. The construction of this trap is such that it requires no attention or repairs. It will not race or stick, is noiseless, requires little room and no foundation.
—AMERICAN BLOWER COMPANY, DETROIT.

STURTEVANT STEAM TRAPS. Especially designed for use with the Sturtevant heaters, although equally well fitted for operation with steam heaters or radiators of any other construction. The body of the trap contains a pot, which floats and closes the connection between the interior and exterior until sufficient water accumulates in this space to overflow into the pot and sink it. Free passage for the water is thus afforded from the pot up to the outer air, which continues until the levity of the pot becomes sufficient to cause it to rise and close the outlet. The periodic delivery continues as long as there is water to discharge or sufficient steam pressure to cause the trap to act.
—B. F. STURTEVANT COMPANY, HYDE PARK, MASS.

WILLIAMS STEAM TRAP. The discharge of this trap resembles a gun, and its construction obviates all possibility of steam waste. There is no duty that it will not perform, its capacity being practically unlimited. The maker cites an instance where one 2 in. trap is doing the work of seven $1\frac{1}{2}$ in. traps of other manufacture. These traps are very compactly built to permit their installation in places where little head room is obtainable.
—THE WILLIAMS GAUGE COMPANY, PITTSBURG, PA.

TREADS, STEP

EMPIRE CARBORUNDUM SAFETY TREAD A top-piece for stairs and car steps, employed for the double purpose of preventing pedestrians from slipping and the steps from wearing out. This type of tread is composed of hard grains of carborundum grit set in the channels of a rolled metal plate. As the grains offer varying resistance to wear, this tread combines the advantages of a permanently rough surface and long life
—EMPIRE SAFETY TREAD COMPANY, BROOKLYN, N. Y.

MASON SAFETY TREAD. Consists of a steel plate $\frac{1}{4}$ in. thick, the upper surface cut with longitudinal alternating grooves; one set of grooves V-shaped, the other set dovetailed and filled with lead. The purpose of the lead is to prevent slipping. The open grooves permit all dirt deposited upon the tread to be readily swept out. This form of tread is claimed to be superior to any other from the fact that the steel supporting ribs are continuous, giving longer wear and preventing the possibility of the lead being pressed over into the open grooves. The treads are curved when required to fit any form of step. (See illustrated advertisement.)
—AMERICAN MASON SAFETY TREAD COMPANY, BOSTON, MASS.

UNIVERSAL SAFETY TREAD. A lead tread for car steps, platforms and floors. Clean, safe, durable.
—UNIVERSAL SAFETY TREAD COMPANY, NEW YORK.

TROLLEY BASES, POLES, HARPS AND WHEELS

(See "Bases," "Poles," "Harps" and "Wheels, Trolley")

TROLLEY WAGONS

(See "Wagons, Tower.")

TRUCKS, CAR

AMERICAN CAR COMPANY'S "M. C. B." TRUCK. A simply and powerfully constructed truck adaptable to a large variety of conditions. The center trusses of the frame are brought under castings to which the transoms are secured and the ends bolted through the pedestals and frame. Ends of the frame are depressed for clearance and are trussed by extending the tie bars to meet them. End crossings are secured to the side bars with heavy gusset plates, forming a square and substantial frame. The bolster is of the swing type and is mounted on double, triple and quadruple elliptics, according to the weight of truck and carrying capacity required.
American Car Company, St. Louis, Mo.

AMERICAN CAR & FOUNDRY COMPANY.
(See item under "Cars")

AMERICAN STEEL MOTOR TRUCK. This truck will safely carry an 85,000 lb. car at a speed of 70 miles an hour. M. C. B. construction is followed throughout, using equalizers and swing link bolsters. Dust-proof side bearings oiled from the center are employed. In general the design insures easy riding and low maintenance cost.
—American Locomotive Company, New York.

BALDWIN MOTOR AND TRAILER TRUCKS. These are of the M. C. B. type or in accordance with customer's specifications, of best material and workmanship guaranteed forever against inherent defects; all joints are machined and bolt holes taper reamed in accordance with best locomotive practice. Strains due to motor are carefully calculated and allowed for as well as strains from weight of car and roadbed. Special designs for fast interurban and heavy street railway service. Trucks are built to operate with any motor customer may specify. On account of good design and first class construction, these trucks save repairs, keeping maintenance charges to the minimum.
Baldwin Locomotive Works, Philadelphia, Pa.

BRILL "EUREKA" MAXIMUM-TRACTION TRUCK. The truck for low and narrow city cars. Seventy-five per cent. of the load is on the drivers, giving traction that enables it to start rapidly and climb heavy grades. When taking curves, a spring-post between the pony wheels is compressed by an inclined plate attached under the car transferring for the time more of the load to these wheels. The brake system includes differential levers which proportion the amount of pressure on each pair of wheels according to the load which they carry. Having no bolster, there is ample space for a large motor and free access to it. Solid forged side frames. (Advertisements in last pages.)
—J. G. Brill Car Company, Philadelphia, Pa.
—American Car Company, St. Louis, Mo.
—John Stephenson Company, Elizabeth, N. J.

BRILL NO. 21-E TRUCK. Cars mounted on this truck are carried two inches lower than on any other single-truck. Another distinctive feature is the diagonal cross-bracing at the center of the frame. Each side frame is solid forged in a single piece. No rivets, no built-up work, no possibility of getting out of square, no sagging at the ends. The spring arrangement gives complete support and steady cushion—no bounding motion. Self-oiling journal boxes run six months without re-oiling and are absolutely dust-proof. (Advertisements in last pages.)
—J. G. Brill Company, Philadelphia, Pa.
—American Car Company, St. Louis, Mo.
—John Stephenson Company, Elizabeth, N. J.

BRILL NO. 27-E TRUCK. A perfectly equalized truck for high-speed service. The spring system comprises three sets of springs working in series, each set having to do with the equalization. Not only is the load perfectly equalized on the wheels, but is also equalized on the frames The only high-speed truck that has a cushioned side swing. No lurch or jar in taking curves. Load carried on the frame at wide-apart points, which, together with a spring base for the frame as long as the wheel base, absolutely prevents frame tilting under violent brake action. Solid forged frames, always safe and sound. (Advertisements in last pages.)
—J. G. Brill Company, Philadelphia, Pa.
—American Car Company, St. Louis, Mo.
—John Stephenson Company, Elizabeth, N. J.

BRILL NO. 27-F TRUCK. This truck is a modification of the Brill No. 27-E high speed truck, to adapt it to a short wheel-base and outside-hung motors. The spring system is equal in elasticity to that of he No. 27-G type, three sets of springs being used in both, and he method of equalization is the same in principle and result. The side frames are solid forged, and the transoms are secured to them with forged single and double corner brackets. In this truck the brakes are usually hung on the end crossings. (Advertisements in last pages.)
—J. G. Brill Car Company, Philadelphia, Pa.
—American Car Company, St. Louis, Mo.
—John Stephenson Company, Elizabeth, N. J.

BRILL NO. 27-G TRUCK. An easy riding short base double truck for fast and heavy city and suburban service. Semi-elliptical springs take the place of equalizing bars. Spring links connect the side swing, amplify the action of the semi-elliptical springs, and cushion the load upon the frames. The elastic side swing prevents jarring of the car at the entrance of curves and gives soft contact of wheel flanges with rail heads. The truck can be used under narrow and low cars. The brake shoes are usually hung inside the wheels to simplify rods and levers. Solid forged side frames. (Advertisements in last pages.)
—J. G. Brill Company, Philadelphia, Pa.
—American Car Company, St. Louis, Mo.
—John Stephenson Company, Elizabeth, N. J.

BRILL "M. C. B." TRUCK. The frame is solid forged in one piece, lessening the number of bolts, doing away with trussing at the ends and only requiring gusset plates at the transoms. The pedestals, the spools between the ends of the pedestals, and the tie bars which connect and brace each pair of pedestals are also solid forged. The equalizing bars are double, each forged in a single piece without welding. The side trusses are secured between the tie bars and transom castings and brought over the equalizing springs. All parts are machined to templets and put together with turned bolts in reamed holes.
—J. G. Brill Company, Philadelphia, Pa.
—American Car Company, St. Louis, Mo.
—John Stephenson Company, Elizabeth, N. J.

BRILL SOLID FORGED SIDE FRAMES. Brill trucks are the only ones built with side frames—side bar, yokes and extensions—solid forged in a single piece. Riveted and built-up frames are at best an uncertain quantity, and although flanged to obtain transverse strength, are dependent upon a multitude of joints, each one of which is undergoing constant deterioration caused by side strains, shocks and vibrations. Cast-steel side frames are equal to strains from every direction and will keep the truck square, but are not proof against crystallization, and sooner or later break. Only six out of the many thousands of solid forged frames made have broken or needed repairs. (Advertisements in last pages.)
—J. G. Brill Company, Philadelphia, Pa.
—American Car Company, St. Louis, Mo.
—John Stephenson Company, Elizabeth, N. J.

DORNER M. C. B. TRUCK. Is extra strong, with heavy patented top frame. All parts are machine fitted. There is no lost motion. Very powerful brakes are used and the boxes and castings are of steel. It is especially adapted for high speed interurban and elevated railway service, as well as for electric locomotives. A large number of these trucks are now in satisfactory service. (See illustrated advertisement.)
—The Dorner Manufacturing Company, Chicago, Ill.

LACONIA HIGH SPEED DOUBLE TRUCKS. These are adapted for both interurban and city service; have cushioned swing bolsters, which prevent cars from receiving shock while rounding curves; arranged for any style motor either inside or outside hung; brakes inside hung of extra strong construction and on steam car lines; wheels of Laconia make either spoke or double plate Trucks furnished with either 4 ft. 0 in., 4 ft. 4 in., 5 ft. 0 in., 5 ft. 4 in. or 5 ft. 7 in. wheel base.
—The Laconia Car Company Works, Boston, Mass.

LORD BALTIMORE TRUCKS. A line of high grade electric car trucks comprising M. C. B. type for heaviest high speed service; short wheel-base centre bearing trucks; maximum traction trucks with bolster and king pin, giving all the stability of a centre bearing truck; and single four wheel-trucks. All are fitted with oil and dust tight boxes, and a perfect brake mechanism, giving maximum power with minimum movement of levers, and having all pivotal points fitted with hardened finished steel pins and bushings; constructed to permit changing of wheels and brakeshoes with greatest facility.
—The Baltimore Car Wheel Company, Baltimore, Md.

PECKHAM ELECTRIC CAR TRUCKS. These trucks comprise the following styles: "Standard" and 'Extra Long" single trucks designed for 20 ft. to 22 ft. electric cars, "Maximum Traction" truck designed for city and suburban service, under cars operating with but one motor per truck; a "Center Bearing" truck carrying the motor outside of the driving axle; "Short Wheel Base" M. C. B. No. 25 truck designed for service under double truck cars operating through short radius curves, practically an M. C. B. construction without equalizing bars. M. C. B. Nos. 30, 40 and 40 trucks are constructed for heavy high speed passenger service, following the same general line of construction so long successful under steam railroad cars, and the "Diamond Frame" No. 100 double truck for freight car service. For illustrations of the above trucks see regular advertisements.
—The Peckham Manufacturing Company, Kingston, N. Y.

ST. LOUIS TRUCKS. For city service the No. 47 short wheel base truck is best adapted. Solid steel frames machine fitted to angle iron end cross bars, making a rigid frame. Machine fitted pedestals. Swing bolster of wrought steel, consisting of top and bottom plates, trussed with cast iron separators. Bolster supported by two double elliptic springs, and cushioned by coil spring for side thrust. One coil spring over each journal box. Inside hung brakes with slack adjusting device at each end of brake hangers. Arranged for outside motor suspension. The short wheel base enables the builder to lower the distance at which car body is carried above the rail and is adapted to short radius curves. The wheel base is 4 ft. 6 in. and the weight 5,700 lbs.
—St. Louis Car Company, St. Louis, Mo.

STANDARD STEEL CAR TRUCKS. This company manufactures trucks for all types of electric cars, long wheel base, short wheel base and maximum traction, each of the M. C. B. equalizer bar type, and also trucks for single truck cars. They are solid forged of open hearth steel without welds. The brakes and motors are carried on the equalizer bars instead of the truck frame. The brake shoes are automatically adjusted so that they require no attention until worn out. The swing of the bolster is retarded by a friction device which makes the riding much smoother than with other designs.
The Standard Steel Car Company, Pittsburg, Pa.

STEPHENSON "M. C. B." TRUCK. An inexpensive, durable and easy-riding truck. The frame is trussed above and below the pedestals and provided with cast steel pedestals. Gusset plates at the center are of malleable iron and are lipped over the frame to which they are securely bolted. Besides connecting the upper flange of the channel transoms to the side frames they serve as guides to the bolster and also carry the bolster hangers and the hangers of inside brakes. The frame is forged in a single piece and to obtain extra clearance is curved at the corners besides being depressed.
—John Stephenson Company, Elizabeth, N. J.

TAYLOR TRUCKS. These trucks embrace thirty types, both single and double for passenger, freight and locomotive service. All wrought metals used are steel, and the cast parts malleable. All of these trucks are built on the Standard Master Car Builders' lines, and incorporate the best principles known in railway truck construction. The springs used in these trucks are made by the truck builders and are accurately tested. Trucks made to suit the specific requirements of railway companies.
—Taylor Electric Truck Company, Troy, N. Y.

TRUING DEVICES, COMMUTATOR

(See Commutator Compounds and Truing Devices.)

TURBINES, HYDRAULIC

(See Hydraulic Machinery.)

TURBINES, STEAM

ALLIS-CHALMERS STEAM TURBINES. A horizontal turbine of the multiple expansion parallel flow type. Cylinder consists of several transverse sections permanently secured together. Rotor built of steel. Channel shaped shrouds riveted to ends of blades, giving great stiffness and eliminating danger of stripping. Balance pistons of special design, small in diameter, thus reducing distortion of cylinders under varying temperatures. Bearing and cylinder covers easily removed for inspection. Arrangement of bedplates such as to leave space between foundations open to floor line for condensers. Fluctuating loads handled automatically.
—Allis-Chalmers Company, Milwaukee, Wis.

CURTIS STEAM TURBINES. This turbine is manufactured by the General Electric Company and is especially adapted to railway work. Its advantages may be thus summarized: High steam economy at all loads! High steam economy with rapidly fluctuating loads Small space per K. W. capacity Uniform angular ve-

locity. Simplicity in operation, and low expense for attendance. Freedom from vibration. Steam economy not impaired by wear in long service. Adapted to high steam pressure and high superheat. Condensed water is kept entirely free from oil and may be returned to the boilers. Built in sizes from 15 K.W.–8,000 K.W. Also made in horizontal form from 15 K.W.–300 K.W. for direct current work. Self contained and automatic. A special line is offered for operation on exhaust steam from reciprocating non-condensing engines.
—GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

HAMILTON-HOLZWARTH STEAM TURBINE. This turbine is of the horizontal type. It has a large number of stationary disks and running wheels, but expands only in the stationary blades. The radial height of the vanes in these blades is gradually increased from high to low pressure, corresponding to the volume to which the steam expands in its course. The hub of the running wheel runs, with minimum practical clearance, in the bore of the stationary disks, thus restricting the leakage losses to the lowest figure. The stationary disks are located in grooves in the turbine casings.
—HOOVEN-OWENS-RENTSCHLER COMPANY, HAMILTON, O.

RATEAU-BALLWOOD STEAM TURBINE. This turbine is of the action type, as the energy of the steam is transformed into velocity by expanding in a series of fixed distributors. To each distributor there is one moving wheel, the two forming a group or element. The moving wheels turn between the distributors which are in the form of vanes projecting radially almost to the shaft which carries the moving wheels so that between succeeding vanes is formed a cell giving rise to the term multi-cellular as applied to this type. Between succeeding cells the fall in pressure is slight and as the only leakage is that through the clearance between the fixed distributor vanes and the shaft, the nature of the design makes this very slight. Considerable play can be allowed therefore between the fixed and moving parts—a very important matter in the operation of any turbine when it can be obtained along with the highest efficiencies, as is the case with this turbine.
—THE BALL & WOOD COMPANY, NEW YORK.

WESTINGHOUSE-PARSONS STEAM TURBINE. The essential features of this turbine are (a) simplicity—utilizes simple rotary motion and consists of only two main parts, rotor and stator, or casing. By lifting the cover of the latter the entire machine interior is exposed; (b) compactness—space occupied from one-half to one-fifth that occupied by Corliss engines; (c) high economy throughout wide ranges of load; (d) large overload capacity in machines; (e) rotation absolutely uniform; (f) continuous oiling system, under low static head no pressure employed; (g) condensation pure and free from oil; (h) steam expansion complete, i. e., to condenser pressure; (i) especially suited to the use of superheated steam.
—THE WESTINGHOUSE MACHINE COMPANY, PITTSBURG, PA.

VACUUM IMPREGNATING APPARATUS

DEVINE VACUUM AND IMPREGNATING APPARATUS FOR COILS. This comprises a line of special apparatus which has been designed to enable electric railway shops to carry out successfully the vacuum-drying and impregnating methods so valuable in securing the thorough insulation of field and armature coils.
—JOSEPH P. DEVINE, BUFFALO, N. Y.

VALVES AND GATES

ALBANY GATE VALVE. These valves are made extra heavy. The seats of the valve are annular rings, threaded on the outside to screw into the body of the valve from the inside. On the interior of these rings, or seats, are projections not unlike the teeth of an internal gear. A small wrench fits over these projections and after removing the cap and withdrawing the stem and wedge, the wrench can be inserted and the seats removed and new ones substituted, or the old ones repaired. These qualities and the facility with which the parts can be replaced make these valves very desirable.
—THE ALBANY STEAM TRAP COMPANY, ALBANY, N. Y.

ALBANY GLOBE VALVES. These valves embody the principle of removing and renewing the wearing parts without disturbing the bodies of the valves from their position in a line of pipes. It is a fact well known to engineers and steam users generally that any improvement in steam valves, whereby they could be renewed or made tight without removing the body of the valve from the pipe, and at the same time be simple, durable and cheap, would be appreciated. With high pressure steam, a valve seat will only last for a limited time, even when made of the best steam metal; and once leaking, the only remedy is refitting, or a new valve, with the consequent expense, trouble and delay. These valves are made specially heavy, and adapted for use in fitting up electric light and power stations.
—THE ALBANY STEAM TRAP COMPANY, ALBANY, N. Y.

ANDERSON FLOAT VALVE. This valve is used to maintain a uniform stage of water in the tank or reservoir.
—GOLDEN-ANDERSON VALVE SPECIALTY COMPANY, PITTSBURG, PA.

ANDERSON CUSHIONED NON-RETURN VALVE (ANGLE OR GLOBE). These valves supply a very vital part of the general piping system of power plants. The valve, when placed between the boiler and header, will equalize the pressure between the different units of a battery of boilers as they remain closed as long as the boiler pressure is lower than that of the header. When the boiler pressure equals that of the head pressure, they open and will remain in that position without chattering or hammering. They will automatically cut off a boiler in case of accident to the boiler and also act as a safety stop to prevent steam being turned into a cold boiler, while men are working inside.
—GOLDEN-ANDERSON VALVE SPECIALTY COMPANY, PITTSBURG, PA.

ANDERSON CUSHIONED TRIPLE-ACTING NON-RETURN VALVE. The use of high steam pressures with many branched pipes has necessitated the employment of a valve to act as a safeguard in emergencies, such as the bursting of a pipe or fitting, or other accident. This cushioned triple-acting non-return valve is designed to avert absolutely this constant danger. The pilot valve can be located at any desirable place, thus having perfect control from distant points. This valve is a non-return valve, an automatic emergency stop valve, and a hand stop valve.
—GOLDEN-ANDERSON VALVE SPECIALTY COMPANY, PITTSBURG, PA.

ANDERSON PATENT ALTITUDE VALVE. This valve is used to maintain a uniform stage of water in tank or reservoir, doing away with the annoyance of tank fixtures. It is especially adapted for large buildings.
—GOLDEN-ANDERSON VALVE SPECIALTY COMPANY, PITTSBURG, PA.

CRANE VALVES AND GATES. This company has been manufacturing steam supplies for over half a century, such as stationary, marine and locomotive pop safety valves, drainage fittings; extra heavy brass and iron valves and fittings, hydraulic valves and fittings; Ferrosteel flanged fittings and valves; steam traps; steam and oil separators; malleable and Ferrosteel companion flanges, and electrically and hydraulically operated and steam actuated valves. In addition the company is prepared to turn out complete piping equipments for power plants, and has facilities for making all kinds of piping.
—CRANE COMPANY, CHICAGO, ILL.

FABER SELF-CLEANING BLOW-OFF VALVE. A jet of steam, at full boiler pressure, blows across the faces of both seat and disc after the water is shut off, but before final closing, thus insuring a clean tight joint. It can be opened and closed as often as a steam valve without leaking. The workmanship and material are in accordance with the best steam valve practice. (See advertisement.)
—LIBERTY MANUFACTURING COMPANY, PITTSBURG, PA.

FOSTER RELIEF OR FREE EXHAUST VALVE. On condensing engines, where the engineer is not always in attendance, instant relief to the exhaust is afforded by this relief or free exhaust valve, in case of failure of the condenser and loss of vacuum. The simplicity of this construction and ingenious mechanism makes it a perfect valve and one in which the working parts will not become corroded or affected by scale or grit. It is self-contained and when thrown open remains so until closed by hand. Made of the best grade of iron, and internal working parts of composition.
—FOSTER ENGINEERING COMPANY, NEWARK, N. J.

FOSTER AUTOMATIC NON-RETURN STOP VALVE. Takes the place of the ordinary stop valve on boilers and is a safeguard where two or more boilers are connected to a single steam pipe or header. In case of an accident, such as the bursting of a tube, occurring in a battery of boilers carrying different pressures, the valve closes automatically, cutting out the disabled boiler. It also shuts off steam pressure from other boilers to cold boilers undergoing repairs, or in which steam is being raised. Made in $2\frac{1}{2}$ in. to 10 in. sizes, bodies of gray iron, semi-steel or cast steel as desired. Internal parts are made of government composition for ordinary service or special metal for superheated steam.
—FOSTER ENGINEERING COMPANY, NEWARK, N. J.

FOSTER AUTOMATIC NON-RETURN EMERGENCY STOP VALVE. Embodies all the valuable features of the Foster non-return valve, with important additional features. This valve closes automatically in case of any break or rupture in main steam pipe and may also be closed from a distance by means of small globe valves on emergency pipes leading to the main valve, through pilot valve. Pilot valve can be arranged in large plants to cut out one, two or three boilers, or any section, or close all sections from a central point.
—FOSTER ENGINEERING COMPANY, NEWARK, N. J.

FOSTER BACK PRESSURE VALVE. This valve is self contained, without direct-acting springs or weighted levers. Direct-acting springs, owing to the variation of their tension with the degree of compression, cannot furnish uniform back pressure; weighted lever valves are apt to chatter and pound themselves loose. The compensating spring movement in Foster regulator valves makes the action of this valve very sensitive and positive; a dash-pot, within the valve, ensures its noiselessness. The valve has drainage relief for condensation and can be thrown out of commission by the turn of a screw, when back pressure is not required.
—FOSTER ENGINEERING COMPANY, NEWARK, N. J.

FOSTER FLOAT VALVE. Quick and sensitive in action, simple and compact in form. It can be placed anywhere in the supply pipe to a tank, and connected by cord or wire to a small operating float in the tank. It will not leak and is invaluable for application on steam pipe to pump returning water of condensation from enclosed tanks. Sizes ⅜ in. to 8 ins., above 2 ins. with iron bodies. Cumbersome floats unnecessary. Renewable seats.
—FOSTER ENGINEERING COMPANY, NEWARK, N. J.

FREEPORT VALVES. A modified form of globe valve body with poppet or rising valve spindle, allowing a free flow of the steam or water fully equal to gate valves, made with either rising or telescoping spindles, solid or removable seats and valve discs, and all are of the regrinding type.
—THE WM. T. BONNER COMPANY, BOSTON AND NEW YORK.

NATIONAL BLOW-OFF VALVE. This valve has a renewable disk and seat.
—GOLDEN-ANDERSON VALVE SPECIALTY COMPANY, PITTSBURG, PA.

WALWORTH GATE VALVES. These are furnished with bronze seats and are designed especially for high pressure work.
—THE WALWORTH MANUFACTURING COMPANY, BOSTON AND NEW YORK.

WILTBONCO CUSHION PRESSURE SEATED CONTROL COCKS AND BLOWOFF VALVES. A new type of control cock, wherein the pressure of steam or water is utilized to hold the plug to its seat. Being otherwise free of all mechanical resistance, very little force is required for operating the valve. Awarded gold medal at Louisiana Purchase Exposition, St. Louis, 1904.
—THE WM. T. BONNER COMPANY, BOSTON AND NEW YORK.

VARIABLE SPEED MOTORS

(See Motors, Electric.)

VARNISHES

(See "Paints and Varnishes")

VENTILATING APPARATUS

(See "Heating and Ventilating Apparatus")

VESTIBULES, PORTABLE

BRILL PORTABLE VESTIBULE. Where closed or open-sided vestibules are not used, this portable vestibule will be found a valuable accessory, increasing the efficiency of the motorman by protecting him from storm and wind, shielding passengers entering or leaving the car, and aiding to keep the car warm in winter by reducing draughts when the doors are open. It is substantially though lightly constructed, bears directly on the dasher railing, is held upright by straps around the hood supports, and is connected with the hood by a narrow canvas bellows. The central sash is arranged to slide to one side; the side sashes are stationary.
—J. G. BRILL COMPANY, PHILADELPHIA, PA.
—AMERICAN CAR COMPANY, ST. LOUIS, MO.
—G. C. KUHLMAN CAR COMPANY, CLEVELAND, OHIO.
—JOHN STEPHENSON COMPANY, ELIZABETH, N. J.

SJOBERG CAR VESTIBULES. The portable vestibules of this type are furnished with either three or five lights. The center light is fastened into a sliding frame suspended on a curved or angular overhead track by adjustable swivel sheaves. Suitable guides at the bottom are provided with springs or rollers to keep the sash from rattling when opened or closed. The vestibules are connected to the iron dash rail and to the bonnet overhead and usually made to project far enough over the dash to allow the free operation of the controller handle. This company also builds stationary vestibules and all other kinds of car wood work.
—J. P. Sjoberg & Company, New York.

VOLTMETERS

(See "Instruments, Electrical Measuring")

WAGONS, TOWER

LEONHARDT TOWER WAGONS. Owing to the complaints of railway men about tower wagons with over one-half of the tower always projecting above the wagon bed or overhanging in the rear, this company began to build its improved wagons, of which no part of the tower raises above the driver's seat, nor does any portion project over the rear nor extend under the bed. The tower folds up like a penknife, and is easily and quickly raised and lowered. All lumber is aired seasoned. All iron work of the best forged refined iron. The wagons are built in three sizes. (See illustrated advertisement.)
—Leonhardt Wagon Manufacturing Company, Baltimore, Md., U. S. A.

TRENTON TROLLEY WAGON. A light, durable and easily operated tower vehicle built for one or two horses; may also be used with facility for pole painting and tree trimming. The two-horse wagon is built with platform gear to fit any gage from 4 ft. 8 in. out. The body is 11 ft. long (not including steps or footboard) by 4 ft. 3 in. wide; frame-work white oak; locker and large body space front and two large lockers at rear of tower. The tower is firmly set in sills, thoroughly braced angle iron slides bolted to posts on outside corners of upper and inside corners of lower tower, elevated by steel cables running over revolving sheaves set on sliding bearings; height extended, 19 ft. 4 in.; lowered, less than 11 ft. The revolving platform revolves on large wrought-iron circle, bolted securely to the top of the tower. Platform 9 ft. long by 4 ft. wide, strongly trussed, and provided with a positive clutch to hold it firmly in any poosition; folding guard rails, with hand-forged hinges. An adjustable scaling ladder 21 ft. long is also furnished.
—J. R. McCardell & Company, Trenton, N. J.

WAYBILLING

EGRY WAY BILLING. This system is recognized to be as complete and thoroughly practical as it is economical, accurate and convenient. Avoids unnecessary rewriting, eliminates constant handling of carbon and stationery, prevents errors and discrepancies, provides clear, legible copies and saves money and time. Traffic departments of interurban lines will find it to their advantage to look into the details of this method.
—The Egry Autographic Register Company, Dayton, Ohio, Dept. W. B.

WASTE-SAVING MACHINES

(See "Oil and Waste-Saving Machines")

WATER-SOFTENING APPARATUS

(See "Boiler Cleaning Compounds.")

WATER WHEELS AND GOVERNORS

(See "Hydraulic Machinery")

WATTMETERS

(See "Instruments, Electrical Measuring")

WHEEL GRINDERS

(See "Wheel Truing Brake Shoe," under Brake Shoes; also Machine Tools.)

WHEEL GUARDS

(See "Fenders and Wheel Guards")

WHEELS AND AXLES

AMERICAN CAR AND FOUNDRY WHEELS AND AXLES. This company is the largest manufacturer of chilled cast iron wheels in the world, the approximate annual capacity being 1,500,000 wheels. The wheel foundries are located at Detroit, Mich.; Berwick, Pa.; St. Louis, Mo.; Madison, Ill.; Chicago, Ill.; Huntington, W. Va.; St. Charles, Mo.; Terre Haute, Ind.; Jeffersonville, Ind.; Buffalo, N. Y.; Milton, Pa.; Indianapolis, Ind.; Memphis, Tenn.
—American Car and Foundry Company, St. Louis and New York.

BALTIMORE CHILLED CAST IRON WHEELS. These wheels are made for every service. Manufactured of the highest grade charcoal irons, and furnished with or without axles.
—The Baltimore Car Wheel Company, Baltimore, Md.

BRILL WHEELS AND AXLES. These companies furnish all styles of wheels, separate or on axles. Their facilities for grinding wheels and turning axles are unsurpassed, insuring accuracy and enabling them to fill orders promptly.
—J. G. Brill Company, Philadelphia, Pa.
—American Car Company, St. Louis, Mo.
—John Stephenson Company, Elizabeth, N. J.

GRIFFIN WHEELS. The street railway department of this company offers special channel spoke and double plate wheels for city and interurban service.
—Griffin Wheel Company, Chicago, Ill.

LACONIA WHEELS. Made either 30 ins. or 33 ins. diameter, with flange and tread to suit purchaser, either spoke or double plate. Nothing used in their manufacture but new pig iron and old wheels of Northern manufacture, each lot of pig iron being carefully analyzed by company's chemist to insure getting the right mixture of materials, and a record is kept of each lot of wheels for future reference.
—The Laconia Car Company Works, Boston, Mass.

NATIONAL CAR WHEELS. This company manufactures steel tired and all kinds of chilled cast iron street car wheels for city and interurban service.
—National Car Wheel Company, New York.

RAILWAY STEEL SPRING COMPANY'S STEEL TIRED WHEELS. For city and suburban electric railway electric equipment.
—Railway Steel Spring Company, New York.

SCHOEN SOLID PRESSED AND ROLLED STEEL WHEELS. These wheels are intended for city and interurban traction service, making an absolutely safe wheel for exacting conditions under heavy high speed cars. The wheel having over five times the strength of cast iron prevents chipped or broken flanges, insuring safety and preventing the housing of cars for wheel troubles. Service tests prove an economy in operating expenses as compared with cast iron wheels.
—The Schoen Steel Wheel Company, Philadelphia, Pa.

STANDARD WHEELS AND AXLES. These works manufacture both wheels and axles and furnish same ready for application. The whole wheel is forged as thoroughly as a tire bloom and subsequently rolled to the required form and size, thus so increasing the strength of the hub and web that a much lighter design is permissible, reducing largely the weight in comparison with steel tired wheels. The method of manufacture appears to give a wheel embodying three important requisites for the heavy equipment and fast running in suburban service, i. e., lightness, strength and durability.
—The Standard Steel Works, Philadelphia.

TAYLOR FUSED STEEL-TIRED WHEEL. This is a solid or integral wheel without bolts or retaining rings to loosen in service, the application of which necessitates the cutting away of both tire and center for their insertion. The tire is of rolled steel, the center of cast iron, poured into the tire under proper conditions for the effecting of a perfect weld or fusion, adding to the strength of the tire the strength of the iron, which supports the tire across its entire width. This wheel has been manufactured by the company for more than thirty years.
—Taylor Iron & Steel Company, High Bridge, N. J.

TWENTIETH CENTURY WHEEL. This is a channel spoke wheel, especially designed for long life, and results obtained from wheels of this design, of which this company is the original manufacturer, show stronger spokes and flanges, more uniform chill and greater mileage. It is a wheel well adapted for heavy high-speed interurban service. (See advertisement and illustration.)
—St. Louis Car Wheel Company, St. Louis, Mo.

WOODWORTH-ENGERT COMBINATION WHEEL. Consists of a cast steel spoked or plate center having a projecting shoulder on its inner side and a corresponding bevel on the outside. The tire has corresponding shoulder and bevel to match those on the center. The space between bevel and shoulder has a sufficient drop to prevent tire from shifting after same has been shrunken onto center. To prevent longitudinal displacement a ⅝ in. bolt with eccentric head flush with the inside of wheel is placed opposite each spoke. Bolts are staggered, 11-16 being in the tire and 5-16 in the center and vice versa, thus forming a series of keys. By reason of the manner in which the tire is shrunk onto the center there is no strain on any of the bolts. In case of broken tire, bolts prevent same from leaving center. Can be renewed with little labor and slight expense. (See advertisement.)
—The Woodworth-Engert Company, Cleveland, Ohio.

WOODWORTH-ENGERT SHRUNKEN TIRED WHEEL. This wheel consists of a cast steel center having on its periphery a shoulder which fits into a corresponding groove in the tire, thus making it impossible in the tire to shift on the center. No special equipment is necessary for re-tiring the wheels. It has given the best satisfaction on a number of prominent interurban railways and is guaranteed to stand up under the most severe service. It is fully guaranteed in material and workmanship. (See adverisement.)
—The Woodworth-Engert Company, Cleveland, Ohio.

WHEEL PRESSES

(See "Machine Tools")

WHEELS, TROLLEY

BRADY TROLLEY WHEELS. Having specially studied the service requirements of a trolley wheel on modern electric railways and installed special machinery for their manufacture, this company is able to offer trolley wheels made of the best material and of the most improved design at greatly decreased costs.
—Brady Brass Company, New York.

IDEAL TROLLEY WHEEL. This is a composite wheel made with cold-rolled steel flanges and a copper contact ring held together by a lumen bronze hub. The contact ring is a machined casting of lake copper with a little alloy to give it the requisite hardness without destroying its conductivity. The ring and flanges are placed in a metal form which holds them central, while the lumen bronze hub is cast around the flanges and against the ring, assuring rigid construction and positive electrical contact between ring and hub, independent of the flanges. These wheels have graphite bushings. Two sizes are made. The small wheel is 4½ in. dia., weighing less than 2 lbs. complete with bushing; larger is 6 in. dia., weighing about 3 lbs.
—Lumen Bearing Company, Buffalo, N. Y.

J-M TROLLEY WHEELS. This company's solid copper wheels are made by an entirely new process and are demonstrating every day in actual service their superiority over other types of trolley wheels heretofore used on electric railways. (See advertisement.)
—H. W. Johns-Manville Company, New York.

KALAMAZOO TROLLEY WHEELS. These wheels are made of pure lake copper especially treated for this purpose only. The result is a wheel that is soft but tough, and while it has the long life of a wheel made of hard metal, it is in itself soft and guaranteed not to injure the wire. There are a great variety of styles, thus making it possible to fit any overhead construction. (See advertisement.)
—The Star Brass Works, Kalamazoo, Mich.

RECORDING FARE REGISTER COMPANY'S TROLLEY WHEELS. Furnished in all sizes. They are made without bushings, a bearing being made in the wheel itself, and requiring no oil. Also multi-ampere trolley wheels in three sizes, 5 in., 6 in. and 7 in., consists of a trolley made wheel with very large area of contact, having a three-inch flange on each side. Made either with a bearing or a bushing which requires no oil. Also sleet wheels of all sizes. Trolley wheel bushings, made from solid castings, machined (not cored), being free from all sand, grit and scale; rifled grooves running entire length of the bushing and filled with special "don't oil" graphite compound. Self-oiling trolley wheels axles; no bushings required where these axles are used. Consists of a steel axle filled with lubricant, same being fed to the wheel by wooden plugs. Requires re-filling only at the end of 5,000 miles.
—The Recording Fare Register Company, New Haven Conn.

(CONTINUED ON PAGE XLIX.)

WHEELS, TROLLEY—Continued.

UNION STANDARD TROLLEY WHEELS. Twenty-five types are now manufactured and new forms are being added as necessity demands. All wheels are fitted with special composition bushings filled with graphite. The grooves are of various forms, including compound curve, deep or U-shaped and square styles. The diameters range from 4-7 in.; length through hubs, 1½ in. to 3 in., and bores ½-in. to ⅝-in. The Union Standard line of wheels is most complete and no trouble will be found in selecting a wheel to fill any specification, either ordinary or special.
—R. D. NUTTALL COMPANY, PITTSBURG, PA.

WESCO TROLLEY WHEELS. These wheels are made of pure Lake Superior bar copper, treated by a special process in moulding, which gives the same carrying capacity as hard drawn copper wire, and toughens the material to give the greatest mileage possible. They are fitted with an oil chamber in addition to a graphite bushing, which prolongs the life of the bushing to equal that of the wheel. Made in the standard models found on the various street and interurban electric railways. They fit the standard harps. They do not wear out the trolley wires.
—WESCO SUPPLY COMPANY, ST. LOUIS, MO.

WINDING MACHINES

(See "Armatures and Field Coils")

WIRES AND CABLES

ALUMINUM ELECTRICAL CONDUCTORS. An electrical conductor made of pure aluminum, having a conductivity of 62 in the Mathiessen scale, a tensile strength of 23,000 lbs. per sq. in., and a very high efficiency. Aluminum conductors are especially adapted to railway feeders and transmission lines. The popularity of aluminum conductors is due to their high efficiency, combined with their low cost. The purchase price is less than copper and the cost of erection and maintenance is also less, the weight of an aluminum conductor being only 47 per cent. that of a copper conductor of same capacity.
—PITTSBURG REDUCTION COMPANY, PITTSBURG, PA.

AMERICAN ELECTRICAL WORKS, PROVIDENCE, R. I. Manufacturers of all kinds of bare and insulated wires and cables for electrical work, including the following: Railway feeder and trolley wire; electric light line wire; incandescent and flexible cords; Americanite, magnet, office and annunciator wires, and cables for aerial and underground use.

AMERICAN STEEL & WIRE COMPANY'S HARD DRAWN COPPER WIRE. This wire is known and in use in every country on the globe where electric railways are in existence. Its wearing qualities are well known in cities where the roads have an almost continuous traffic and it is recognized as standard wherever maximum conductivity, strength and superior finish are sought for. Although odd shapes are little called for, this company is prepared to furnish all varieties: Figure 8, grooved and round.
—AMERICAN STEEL & WIRE COMPANY, NEW YORK.

BISHOP SUBMARINE CABLES. This company is the only one in America using gutta-percha insulation. Gutta-percha is claimed to be more uniform, longer-lived and more easily repaired than any other insulation.
—BISHOP GUTTA-PERCHA COMPANY, NEW YORK.

DELTABESTON MAGNET WIRE. This wire is insulated with practically pure asbestos, which has been treated so that its insulating qualities are exceptionally good. At the same time its wonderful resistance to heat renders it absolutely indestructible as far as any temperature rise to which it may be subjected in ordinary service is concerned. At the present this wire is supplied in any size from No. 4 to No. 18 B. & S. gage.
—D. & W. FUSE COMPANY, PROVIDENCE, R. I.

EASTERN INSULATED WIRES AND CABLES. This company manufactures insulated wires and cables for railway, lighting and power transmission systems. "Clark" wire a specialty.
—EASTERN ELECTRIC CABLE & WIRE COMPANY, BOSTON, MASS.

GENERAL ELECTRIC WIRE AND CABLES. Some years ago the General Electric Company introduced the grooved trolley wire. Since then the success attained n general railway work had led to its use in all classes of service. In addition to ease of installation, smooth operation, and positive grip of ears on the wire, the readiness with which the line may be moved has led to its adoption in mines for coal haulage, and industrial plants. The General Electric Company manufactures at Schenectady all classes of magnet wires, insulated cables and National Electric Code wires.
—GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

MAGNET WIRE. This wire requires more care in its manufacture than any other type of wire. The copper must be of high electrical conductivity, the annealing must be just right and the size of great uniformity. Moreover there is room for a wide choice in the cotton used and our selection of combed sea island cotton, free from all the grease and oil that ordinary cotton is heir to, is a most successful one. The success of field and armature coils is largely dependent upon magnet wire, and specialization in these lines is productive of a reliability and endurance which is appreciated by all electric railway managers who consider their first duty to their company and the public to be that of giving uninterrupted service and whose motto is: "A car on the road is worth two in the barn."
—THE MAGNET WIRE COMPANY, NEW YORK.

MONTREAL WIRES AND CABLES. The Wire & Cable Company, Montreal, has been giving considerable attention lately to the manufacture of wires and cables for electric railway purposes. It has manufactured a considerable amount of hard drawn copper power transmission cable with hemp centers, and has also executed several contracts for trolley and feeder wire in connection with the recent developments in Canada. In order to take care of the constantly increasing demand, the company is enlarging its floor area from 113,844 to 152,666 sq. ft. These extensions are mainly additions to the bare wire mill and the lead covered cable department. It expects to have to continue building operations still further in the spring. The plant has been built entirely on American methods, one of its characteristics being the application of the direct electrical drive, and the consequent absence of belting and shafting.
—THE WIRE & CABLE COMPANY, MONTREAL, CAN.

NATIONAL WIRES AND CABLES. This company is a large manufacturer of bare copper wire and cable, weatherproof wire and cable, as well as paper insulated cables for all classes of railway, lighting, power, telegraph and telephone work.
—THE NATIONAL CONDUIT CABLE COMPANY, NEW YORK.

OKONITE INSULATED WIRES AND CABLES. The wires and cables manufactured by this company are all insulated with the well-known Okonite rubber insulation, mentioned elsewhere in this dictionary under "Insulations and Insulating Compounds."
—THE OKONITE COMPANY, NEW YORK.

"PHONO-ELECTRIC" WIRE. This is an exceptionally tough wire for trolley purposes, its great strength assuring a permanent and reliable overhead construction.
—BRIDGEPORT BRASS COMPANY, NEW YORK.

ROEBLING WIRES AND CABLES. This company makes paper insulated, lead incased cables from 2,000,000 cm. to 4-0 dia. for 600 volts and 250,000 cm. to 0 for 15,000 volts. All sizes and constructions of rubber insulated, lead incased cables; also magnet wire, weather proof wire, copper trolley wire and other bare and insulated wires and cables of all kinds.
—JOHN A. ROEBLING'S SONS COMPANY, TRENTON, N. J.

STANDARD WIRES AND CABLES. Made from copper of highest known conductivity and depending upon service requirements; furnished either plain or tinned conductor in round or special shapes or insulated with the following, either singly or in combination, namely: Silk, cotton, weatherproof, dry or saturated fiber, dry or saturated paper, rubber and special varnished cloth. Conductors insulated with these various insulations are furnished in single or multiple form and finished outside, according to requirements, with tape, braid, lead sheath, supplemented where necessary by saturated fibrous cover, steel wire armor or flat, steel tape armor.
—STANDARD UNDERGROUND CABLE COMPANY, PITTSBURG, PA

WATERBURY WIRES AND CABLES. This company manufactures seamless rubber insulated wire and underground cables; signal, telephone, telegraph and fixture wires; and paper insulated lead encased cables for power, lighting, telegraph and telephone circuits.
—WATERBURY & COMPANY, NEW YORK.

WRIGHT WIRES AND CABLES. This company manufactures wires and cables of all descriptions, including the following: Annealed, bright, coppered, tinned and galvanized wire; straightened and cut, round and flat wire; iron, tinned, galvanized, brass, copper, wire cloth; galvanized poultry netting; wire clothes lines and wire lathing; riddles, coal and sand screens, and steel sparks netting, staples. See also definitions under "Fences" and "Lockers."
—WRIGHT WIRE COMPANY, WORCESTER, MASS.

WIRE CONNECTORS

(See "Clamps and Connectors")

WOODWORK, CAR

(See "Vestibules," "Doors," etc.

WOODWORKING MACHINERY

AMERICAN NO. 2 VERTICAL BORER. This is a substantial, well-built machine. The bit is 18 in. from the post and has a throw of 12 in. Stops are provided to regulate the depth of hole. The table has a universal movement and may be tilted forward and to either side. The table is adjusted vertically by hand wheel and when at its lowest point the distance from the bit socket to the table is 26½ in., and when raised to its highest point the distance from the table to the bit socket is 17½ in. The distance from front of table to guide is 30 in. The table is 24 in. wide. The boring bit may be run at two different speeds. (See advertisement).
—AMERICAN WOODWORKING MACHINERY COMPANY, NEW YORK.

AMERICAN NO. 200 AUTOMATIC KNIFE GRINDER. A transverse reciprocating movement of the knife bar regulated in extent from 2 ins. to full length of machine (30 ins., 36 ins., 42 ins. and 50 ins.). Movement of of the wheel toward the work can be regulated to grind from 1-3,000 in. to 1-200 in. to each back and forth movement of the knife bar frame. Will cease grinding at any point for which it may be set. Thus there is no danger that cutters will be overground through inadvertence or inattention of the operator. Supplied with hood and water tank, adapting machine to wet or dry grinding. (See advertisement.)
—AMERICAN WOODWORKING MACHINERY COMPANY, NEW YORK.

AMERICAN HOLLOW CHISEL MORTISING MACHINE. Useful for mortising in hard woods. Fitted with a hollow chisel, through which projects a boring bit, and when brought up to the timber it bores the hole, and the chisel following it simultaneously squares out the four corners and sides, with no jarring to the machine. A finished mortise of any length, and from ½ in. to 1¼ ins. square and free from chips, is thus made. The stroke is variable from ½ in. to 4½ ins. in depth. The table is counterbalanced and is adjusted vertically by worm and worm wheel, provided with vertical and horizontal stops, by which one or more mortises can be made. The table is 3 ft. 6 ins. long, 10 ins. wide, and travels 6 ins. each way from center of chisel, making a mortise 12 ins. long with one clamping. (See advertisement).
—AMERICAN WOODWORKING MACHINERY COMPANY, NEW YORK.

AMERICAN NO. 1 POWER MORTISER. Designed to do heavy hard wood mortising, such as hard wood doors, as well as lighter work. The conical brass boxes used are split and fitted into conical bearings. The larger or quill box is threaded on lower end with nut to take up wear, and the smaller or spindle box is provided with clamp or jamb nuts to take up wear. The reverse is also conical, with nut on small end to take up wear. It will mortise to the centre of material 5 in. wide with clamp table, and with plain table to the center of material 6 in. wide. The table tilts to an angle, is provided with clamping device, hold-downs and rack and pinion feed. (See advertisement).
—AMERICAN WOODWORKING MACHINERY COMPANY, NEW YORK.

AMERICAN 54 IN. BAND RE-SAW. Adapted for general work in hard or soft wood. Lower wheel has solid web, and the strain line of the blade lies within the bearings on both wheels. Main shaft is of hammered crucible steel, 3½ ins. dia., and the boxes are self-oiling with positive circulation. All six feed rolls are geared, and the teeth of the blade run within 1 in. of the center line of the last rolls. They can be tilted to saw clapboards, and set to self-center or to slab off, as required. Speed is adjustable as 8 is to 1, and may be as high as 120 feet per minute. Guides have hardened rear safety rolls and bronze side plates all adjustable. Capacity, 30 ins. vertically, and from ⅛ in. to 20 ins. horizontally; 16 ins. can be split in the center and a veneer cut from 12 ins. wide. (See advertisement.)
—AMERICAN WOODWORKING MACHINERY COMPANY, NEW YORK.

AMERICAN 36 IN. BAND SAW. The most popular size made, and is well adapted to general scroll sawing in hard or soft wood. Frame is cast hollow in one piece. Table, 32 ins. by 32 ins., of wood or iron; tilts to an angle of 45 deg. for bevel sawing; shafts are of steel; lower wheel is of iron, and upper one has hard wood rim glued up of kiln dried veneers. "Mohawk Dutchman" guide is used. Upper shaft runs in [illegible] angle box, and all boxes are divided to take up wear, and are adjustable for alignment. Elastic weighing strain lever is provided, as in all the company's scroll band saws. Capacity, 14 ins. vertically and 36 ins. horizontally. (See advertisement).
—American Woodworking Machinery Company, New York.

COLUMBIA SANDERS. Built with three, two or one drum on the same general design, all working up to 6 in thick, 30 ins to 84 ins. wide. It is suitable for every kind of work, from the heavy cuts required in a planing mill to the highest finish of the pinao factory. The cylinders are provided with a device for taking up the slack of the sandpaper automatically while the machine is running. To keep the sandpaper constantly snug around the drum is the first requisite for smooth sanding, and the automatic part of it obviates frequent stops. Also preserves the life of the sandpaper and enables it to do much more work than if used in any other way. The cylinders produce a straight flat surface and leave no dips or round edges and ends. (See advertisement.)
—American Woodworking Machinery Company, New York.

AMERICAN NO. 7½ COMBINATION SAW AND DADO MACHINE. Adapted for cutting off, ripping, miter and bevel sawing, dadoing, etc. The travel of the saw produces only a very slight movement of the tightener frame. Saw may be brought forward 23 in. by a foot treadle; carriage carrying saw runs on ball bearings. Table is 3 in. by 4 in. The right hand table is pivoted to the frame and may be swung upward, while the left hand table is arranged to slide outward and so constructed as to always keep the table parallel. Ripping gage may be set at any angle. The cross-cut gages are instantly clamped to the table, and can be changed from stationary to sliding gages, and may be set at any angle to 45 deg. The gages can be reversed so that the saw will force the board against the face of the gage if desired. Will cut 4 in. thick, and will cut through a 1 in. board 21 in. wide. Arbor has 3 in. vertical adjustment. (See advertisement).[1]
—American Woodworking Machinery Company, New York.

AMERICAN SELF-FEED RIP SAW TABLE. The No. 2 table is designed for ripping all kinds of stock up to 25 in. wide and 6 in. thick. The table is 40 in. wide by 55½ in. long, provided with two adjustable idler rolls and an iron throat plate so arranged that two or more saws can be used at the same time, 6½ in. apart or less. The table has a locking gage and index plate. The feed consists of a corrugated and spur feed roll in front, and a corrugated feed roll with spreader in rear of saw, all 5 in. in diameter. There rolls can be set up close to a 10 in. saw, or can expand to take in a 20 in. saw. The feed rolls can be adjusted for ripping 6 in. thick and are driven by chain sprocket wheel and expansion gearing. There are three changes of feed—60, 120 and 180 linear ft. per minute. The arbor is 1⅜ in. in diameter and runs in three self-oiling boxes 5½ in. long. Pulley on arbor is 7 in. by 7½ in.; speed, 2,500. Table No. 1 has a capacity up to 20 in. by 6 in., and No. 0 up to 16 in. by 6 in. (See advertisement).
—American Woodworking Machinery Company, New York.

AMERICAN NO. 2½ TWO-SPINDLE SHAPER. Adapted to general work in all wood shops; frame is cast in one piece and contains tool closet; spindles are of cast steel, 1⅜ in. in diameter, with ground journals and self-oiling boxes set 24 in. apart; top sections are usually 1¼ in. in diameter and may be made separable when so ordered; box slides are scraped to bearings with take-up gibs and clamp handles; table is usually of iron, 38 in. by 54 in., with removable plates for collars; two sets (8) of steel slotted collars, four filling collars, one set (4) of blank knives and pedal belt shifter are furnished, belt guide stands supplied on order. (See advertisement.)
—American Woodworking Machinery Company, New York.

AMERICAN BOSS TIMBER SIZER. A heavy, powerful, simple and easily handled machine, working 20 ins. or 30 ins. wide 12 ins., 14 ins., 16 ins., 18 ins. or 20 ins. thick. All of the adjustments are easily and quickly made and those necessary for a change from one class of work to another are all made from the operator's positions at the side or end of the machine, and so quickly and easily as to make this machine capable of covering a very large range of work, from surfacing four sides (full capacity of machine) to cut sills, flooring, decking or any similar work. Made with six and eight feed rolls. Standard machines include regular heads and straight knives and necessary wrenches.
—American Woodworking Machinery Company, New York.

AMERICAN NO. 50 DOUBLE SURFACER. This standard double surfacer works 26 ins. and 30 ins. wide by 8 ins. thick; built on new designs, with table as short as practicable for length of belts, to allow short pieces to be handled easily. The feed consists of four rolls, operated by improved expansion gearing attached to shafts working in self-oiling boxes. The top feeding-in roll is divided. The sections of the divided roll rise perfectly true, and each roll is operated by one screw, doing away with all bevel gearing and leaving all parts easily accessible. The divided roll permits the feeding of unevenly sawed lumber or two boards of different thicknesses at one time. (See advertisement).
—American Woodworking Machinery Company, New York.

AMERICAN "PEACEMAKER" DOUBLE AND SINGLE SURFACERS. Built as double or single surfacer, with solid or divided infeeding roll. A heavy, strong and compact machine for smooth and rapid work. Will plane 26 ins. wide and from ⅛ in. to 8 in. thick. Top and bottom heads solid steel forgings tapped on two sides. Top head bolted at both ends. The bed is held very rigidly. Chip breakers and pressure bar are carefully fitted. There are four feed rolls, strongly geared. Pressure bar over the under head raises and lowers by hand wheel. There are two rates of feed, 45 ft. and 64 ft. (See advertisement).
—American Woodworking Machinery Company, New York.

AMERICAN NO. 1 TENONING MACHINE. For door, sash and other work. Will cut a tenon 7 ins. long at one operation and 9½ ins. long by twice passing through the machine. Any thickness of tenon can be cut up to 5½ ins. thick by 15 ins. wide. Both head stocks are adjustable vertically, while the top head stock has also an independent vertical adjustment. The cope head stocks are attached to the main head stocks and adjust with them. They have also independent vertical and horizontal adjustment. The carriage has a combined roller movement, which greatly facilitates the work both in ease of operation and the quantity turned out. The hold-down is convenient, and the fence is adjustable to any required angle. The cut-off saw attachment works by a lever and has a graduated scale. It can be regulated to cut different lengths of tenon while the machine is in operation. The cutter head spindles are 1½ ins. in dia. Cope spindles are 1 in. dia. in the boxes and ⅞ in. dia. where the heads go on. (See advertisement.)
—American Woodworking Machinery Company, New York.

J. A. FAY & EGAN COMPANY, CINCINNATI, OHIO. The history of wood working machinery for use in car shops is largely the history of this company. Its experience dates back over a period of 75 years, when the steam railroad was little more than a dream and the electric car was unthought of. This company has kept constantly alive to the needs of car manufacturers, and at the present time it can supply anything wanted in the line of car woodworking machinery.

FAY & EGAN AUTOMATIC BAND RIP SAW NO. 109. This saw takes 30 ins. between saw and fence and 14 ins. under the guide. Five 8 in. power geared feeding rolls. Special straining device.
—J. A. Fay & Egan Company, Cincinnati, Ohio.

FAY & EGAN AUTOMATIC DOUBLE TENONER. Designed with a base or foundation plate, which supports the working parts in a very superior manner. Made in two sizes: No. 9 to tenon from 6 ins. up to 54 ins. in length. No. 10 to tenon from 6 ins. up to 78 ins. in length. Takes material up to 20 ins. wide or 7 ins. thick.
—J. A. Fay & Egan Company, Cincinnati, Ohio.

FAY & EGAN BAND RESAW NO. 104. A resaw for heavy and light work. Resaws 24 ins. wide, receives 20 ins. between rolls, will saw to the center of 16 ins. Improved arrangement of feed rolls. Extra heavy shafts. New sensitive straining device. Improved guides. 60 in. wheels, 8 in. blade. Solid lower wheel. Wheels running between bearings.
—J. A. Fay & Egan Company, Cincinnati, Ohio.

FAY & EGAN DOUBLE-CYLINDER TIMBER DRESSERS. Dresser No. 111 is an exceptionally fine and powerful timber dresser in every respect. Made in two sizes to plane material on four sides, 20 or 30 ins. wide, and 20 ins. thick. The company also makes a smaller size of this machine to plane up to 20 or 30 ins. wide and 10 ins. thick, calling it No. 125.
—J. A. Fay & Egan Company, Cincinnati, Ohio.

FAY & EGAN EXTRA HEAVY DOUBLE-SPINDLE SHAPER NO. 87. This machine is designed for extra heavy work, such as wagon and carriage work, railroad work, etc.; for shaping gearing, wagon tongues, plow beams, and all kinds of heavy, hardwood cutting. The table is of iron or wood, and is 61x48 ins., amply large for any kind of work.
—J. A. Fay & Egan Company Cincinnati, Ohio.

FAY & EGAN HEAVY DOUBLE-CYLINDER PLANER NO. 140. Planes 24, 27 or 30 ins. wide and 8 ins. thick, with center-geared, divided or sectional rolls. Both cylinders slotted on all four sides. All gears mounted on shaft, eliminating all studs.
—J. A. Fay & Egan Company, Cincinnati, Ohio.

FAY & EGAN INSIDE MOLDER NO. 133. This is an excellent machine for making light or heavy molding, casing, drop siding, etc. Is constructed with four feed rolls, 7 ins. in dia. Interchangeable rollers. Sectional chip breaker before cut of top head, to provide for the irregularities of the knives. Made in two sizes to work from ⅜ to 12 or 15 ins. in width.
—J. A. Fay & Egan Company, Cincinnati, Ohio.

FAY & EGAN "LIGHTNING" FLOORING MACHINES. The No. 106 is made in two sizes to work material 9 and 15 ins. wide and up to 6 ins. thick. Six or eight rolls, 9 ins. in dia. A very rapid, powerful and efficient flooring machine. The company also makes this machine with lower cylinder placed before the upper, calling it No. 107; and with one upper and two lower cylinders calling it No. 108.
—J. A. Fay & Egan Company, Cincinnati, Ohio.

FAY & EGAN SIX-ROLL, DOUBLE-CYLINDER PLANER AND MATCHER NO. 129. An excellent machine for general and special purposes to plane and match 10, 16, 20, 24, 27 or 30 ins. wide and 8 ins. thick. Cylinders four sided, slotted and double belted. Six 6 in feed rolls. Tight and loose pulleys for feed belt. Two speeds of feed.
—J. A. Fay & Egan Company, Cincinnati, Ohio.

FAY & EGAN VERTICAL HOLLOW CHISEL CAR MORTISING MACHINE NO. 4. A powerful and reliable machine. Boring attachment. The vertical movement of the ram is 16 ins., and the extreme lateral motion, with the housing, is 14 ins.
—J. A. Fay & Egan Company, Cincinnati, Ohio

(INDEX TO ADVERTISERS, PAGES 15 AND 18)

DEALERS IN ELECTRIC RAILWAY SUPPLIES

MANUFACTURERS' AGENTS

GILES S. ALLISON, NEW YORK. Dealer in all classes of railway supplies. Direct representative of the Security Register Company's self-recording and other types of fare registers; the Skinner station indicator and car sign; Valentine & Company, varnishes and colors; the Orient adjustable register rod handle; the Armstrong oiler. Makes a specialty of second-hand rolling stock for steam and electric railways. Acts also as purchasing and selling agent for railroads.

F. BISSELL CO., TOLEDO, OHIO. Dealers in electric railway supplies of all kinds.

THE W.R. GARTON COMPANY, CHICAGO, ILL. Manufacturers, manufacturers' agents and dealers in electric railway and mine supplies. The lines covered comprise such articles as are used for the construction and maintenance of electric railway high tension circuits and trolley lines, including wire, insulators, hangers, cross arms, pins, braces, lag screws, bolts, trolley hangers, pull offs, cross overs, section insulators, section switches, aside from a general line of diverse materials, many of which are specialties, such as circuit breakers, lightning arresters, poles, bonds, trolley wheels, bushings and harps. The company is pushing the following specialties: Thomas soldered rail bonds, Lima porcelain insulators; Armalac, an insulating compound; Shaw non-arcing lightning arresters for high A.C. circuits; Garton lightning arresters, etc.

GENERAL RAILWAY SUPPLY COMPANY, PITTSBURG, PA. Manufacturers' agent and dealer in electric railway and lighting supplies. This company carries a large assortment in its warehouse and is fully equipped to furnish materials and supplies for the equipment and maintenance of electric railway, mine and industrial haulage plants. Has selling arrangements for Westinghouse and General Electric repair parts and represents the following well known manufacturers: R. D. Nuttall Company, gears, pinions and trolleys; General Electric Company, line material and rail bonds; International Register Company, registers; the Heil Rail Joint Welding Company, cast welded joints, and the Wilson Trolley Catcher Company, trolley catchers and retrievers.

J. A. HANNA COMPANY, CLEVELAND, OHIO. Sole sales agent for Niles cars and Western sales agent for Peckham trucks. Is prepared to supply promptly electric, gasoline and steam cars, either complete with trucks or car bodies and trucks separately. Its specialty s the complete rolling stock equipment of interurban electric railways, passenger coaches, parlor cars, express-freight cars, portable sub-stations, cars, etc., complete with various types of Peckham trucks.

W. R. KERSCHNER, ALLENTOWN, PA. Manfacturers' agent for the companies, as follows: The Columbia Machine Works & Malleable Iron Company, Brooklyn, N. Y., electric railway supplies; The Catskill Foundry & Machine Works, Catskill, N. Y., steel gears and pinions; The Traction Equipment Company, Brooklyn, N. Y., grid resistances for cars.

KINSMAN ELECTRIC & RAILWAY SUPPLY COMPANY, NEW YORK. The railway supplies furnished by this company embrace almost everything required in the construction and maintenance of railways, buildings and office supplies.

ERVIN G. LONG, NEW YORK. Eastern representative of the Union Spring & Manufacturing Company, Van Dorn & Dutton Company, Van Dorn-Elliott Electric Company, and export agent of the Sterling-Meaker Company and the W. T. Van Dorn Company. He gives special attention to export business in all kinds of electric traction equipment and supplies, recent orders having been executed by him for Japan, Siam, India, England, Italy, South Africa, Australasia, Argentina, Brazil and Peru. Mr. Long has had fourteen years' experience handling electrical materials, and has an extensive acquaintance with the operators of electric tramways abroad.

THE MAYER & ENGLUND COMPANY, PHILADELPHIA, PA. This company devotes its entire attention and energy to designing, manufacturing and jobbing electrical and mechanical supplies for street and interurban railways and electrically operated industrial plants, and is recognized to-day as a leader in its line. One of the main specialties handled by this company is the protected rail bond, which was adopted by the Interborough Rapid Transit Company, of New York, after a most elaborate series of competitive tests. Keystone compound, of which this company makes its overhead trolley wire insulating devices, has earned an enviable reputation for the company in this line. The company is the Eastern sales agent for many leading manufacturers, including the International Register Company; is district representative for the R. D. Nuttall Company's gears and pinions; acts as agents for the Crouse-Hinds Imperial headlight and also for the Brady Brass Company's motor and axle bearings. A large stock of standard railway material is kept in the company's eight story building in Philadelphia.

ELMER P. MORRIS COMPANY, NEW YORK. Dealer in overhead line material, trolley wire grooving machines, trolley poles, wheels and harps; armature and field coils; incandescent lamps; headlights; drills; grinders; track construction tools; electrical instruments, etc.

PORTER & BERG, CHICAGO, ILL. President and treasurer, J. W. Porter; vice-president, E. R. Mason; secretary, Max A. Berg. After several years as sales agents for the leading manufacturers of electric railway supplies and specialties, and exclusive territorial agents for many articles of approved design and construction, they have become widely known in the railway supply field. The present sales and general office is augmented by a splendid sample room where the purchaser is enabled to examine and judge advantageously materials and apparatus set up or in operation. Apart from the general office is a handsomely furnished private office for street railway men who desire headquarters while in the city.

FRANK RIDLON CO., BOSTON, MASS. Manufacturers' agents for electric railway equipment and supplies.

STUART-HOWLAND COMPANY, BOSTON, MASS. Besides this company's line material (including bracket arms) described elsewhere in this dictionary, the company also makes standard head lights, "spiral" trolley cord, trolley wheels, steel wheels, a complete line of ears, and several other specialties. It is exclusive territorial selling agent for Garton-Daniels lightning arresters, visible die punches, Helios arc lamps, Sterling incandescent lamps, Chase-Shawmut rail bonds and enclosed fuses, "Amesbury" trolley wheels, case hardened axles, insulating tapes and compounds, switches, and cut-outs, live wire pick-ups, Ham trolley catchers, boxes and sanders, Dale clusters, and a variety of wiring devices. The company is also a jobber in all kinds of railway, telephone and lighting supplies, and carries in stock practically everything required in the equipment and maintenance of street railways. (See advertisement.)

—STUART-HOWLAND COMPANY, BOSTON, MASS.

SHAW ENGINEERING & MANUFACTURING COMPANY, NEW YORK. General sales agent for the American Ventilating Company, manufacturer of ventilators for railroad cars, buildings and window ventilation; Eastern sales agent for Moloney Electric Company, St. Louis, Mo., on transformers, and Dorner Manufacturing Company, of Chicago, Ill., on bearings, brake shoes, fenders and guards, motor lifts, snow plows, snow sweepers, spring trucks, wheels and axles; also conducts a general business in all kinds of electric railway and lighting supplies, under the management of H. M. Shaw.

JOHN B. WATSON, PHILADELPHIA, PA. In almost every trade, the broker is a recognized factor, employed by both buyer and seller. In one form or another he is an essential feature in the financing of electric propositions; but when it comes to his employment for the purchase of material entering into the construction of these projects, there is an opposition which is incomprehensible. Like all professional men, the broker is selling ideas or knowledge of conditions, rather than merchandise, and it is his concentration of effort in this direction, his ability to command and to judge system, details and extended markets that makes his services valuable. The possession of this kind of knowledge enables Mr. Watson to conduct a large brokerage business in the electric railway field.

WENDELL & MACDUFFIE, NEW YORK. Dealers in electric railway supplies; exporters and handlers of McCardell tower wagons; fire, police and telegraph alarms; asbestos building materials; steel castings; gears and pinions; rails; car replacers; babbitt metal; metallic weather strips, etc.

WESCO SUPPLY COMPANY, ST. LOUIS, MO. Within the compass of a paragraph it is not possible to give an adequate idea of the immense range covered by this company's electric railway supply business. Examination of its general catalogue, however, will show that the company handles practically everything that enters into the construction of the track, overhead and operating equipment (except power generation) of an electric railway

WESTERN ELECTRIC COMPANY, NEW YORK AND CHICAGO. This company's line of overhead railway material and general railway supplies is complete in every detail. A few of its specialties ready for shipment are: Galvanized line material, crossarms, high potential insulators, poles, tape, insulating compounds, arc lamps, armature and field coils, Perkins 500 volt switches, Stombaugh guy anchors, Hipwood car fenders, galvanized strand, street hoods and fixtures, incandescent lamps, lightning arresters and weather-proof wire. A full line of construction tools always in stock. The company is a large manufacturer of electrical material, including Electrose insulation, American transformers, arc lamps, knife switches, third rail insulators, which are described elsewhere in this dictionary.

CHARLES N. WOOD ELECTRIC COMPANY, BOSTON, MASS. Manufacturers' agents for electric railway supplies.

SECOND-HAND MATERIAL

GILES S. ALLISON, NEW YORK. Makes a specialty of second-hand rolling stock and car equipments.

THE CHICAGO HOUSE WRECKING COMPANY, OF CHICAGO. ILL. Purchases general stocks of merchandise of every kind at sheriffs' and other sales, and carries a full line of everything in the way of mill supplies, including belting, shafting, hangers and the like. Is also engaged in general construction and dismantling business, and consequently has all kinds of boilers, engines and machinery, electrical material, building supplies and general material of every kind for sale.

DALLETT & COMPANY, PHILADELPHIA, PA. This firm has been established thirty years and with some of the best practical experience at their command, has been successful throughout. Dealers in railway and trolley supplies and contractors' equipment of all kinds, locomotives, cars, rails, steam shovels, etc., etc., carrying a large stock on hand at all times.

CHARLES E. DUSTIN COMPANY, NEW YORK. The sale of second-hand equipment has become a valuable and recognized branch of the electrical and steam machinery business. By reason of consolidations, enlargements and radical changes in systems, much material of standard makes, attractive sizes and of the highest grades is being constantly released and made available for smaller installations or additions to existing plants. It is not worn out or obsolete apparatus, but in service is equally as good as though just out of the shop, and at a very much less cost, with the additional advantage of prompt delivery. In most cases after purchase, this company takes such material into its works at Jersey City and puts it in the best condition. The company buys everything from central stations to individual pieces, and, consequently, is able to constantly carry a large stock of direct-connected units, belted generators, engines, boilers, cars, railway motors and equipments; in fact, every variety of material that is used in street railway systems or central stations.

ELECTRIC RAILWAY EQUIPMENT COMPANY, PHILADELPHIA, PA. This company confines its efforts to the sale of second-hand cars, trucks and electric motor equipments. It acts as purchasing or selling agent for railway companies that do not have the advantages or knowledge of the business that it has or for those companies that cannot give the time to it. It is its purpose to handle only the very best materials and to be in position at all times to furnish desirable material in first-class condition and very promptly.

HENRY A. HITNER'S SONS, PHILADELPHIA, PA. This company is not only a large dealer in second-hand machinery, but also buys and sells all kinds of structural work for elevated railways, bridges and buildings.

(INDEX TO ADVERTISERS, PAGES 15 AND 18)

HYDE BROS. & COMPANY, PITTSBURG, PA. Relaying and new rails are among the principal specialties of this company. Tee rails of all sizes are kept in stock.

IRON CITY STEEL COMPANY, PITTSBURG, PA. This company makes a specialty of both new and relaying rails, spikes, bolts and all track equipment, and is always in the market to either buy or sell any of this material.

CHAS. F. JOHNSON, BUFFALO, N. Y. Buys and sells all kinds of electric railway track work, ties, poles, rolling stock, generating machinery, motors, engines, boilers, etc.

W. R. KERSCHNER, ALLENTOWN, PA. Dealer in second-hand apparatus. All railway motors are thoroughly overhauled and put into first-class condition, being practically equal to new motors. New gears and pinions are furnished with all motors sold. Controllers are likewise overhauled the same as railway motors. Second hand cars and generators also sold.

HENRY LEVIS & COMPANY, PHILADELPHIA, PA. Dealers in all classes of rails and track work.

THE MALES COMPANY, NEW YORK AND CINCINNATI. Dealers in second-hand material for electric railways, including rolling stock and construction apparatus.

ELMER P. MORRIS COMPANY, NEW YORK. Dealers in all kinds of electrical and other material and apparatus suitable for the construction and operation of electric railways.

OWEGO BRIDGE COMPANY, PHILADELPHIA, PA. While not regular dealers in second-hand material, the Owego Bridge Company has often been able to save money for its customers by supplying bridges released from steam railroads. Using this material in connection with new work from its shops several electric railways have been supplied throughout at considerable saving in cost, at the same time a greater capacity is obtained. The company repairs and erects these jobs in any section of the country.

FRANK RIDLON COMPANY, BOSTON, MASS. This company conducts a large second-hand business, making a specialty of generators and motors. Its excellent repair facilities enable it to place such apparatus on sale in first-class operating condition.

ROSSITER, MacGOVERN & COMPANY, NEW YORK. This company makes a specialty of standardizing street railway and lighting companies, power house apparatus and railway motor equipments, taking in part payment station apparatus and motor equipments for which there is no further use, and supplying in cases of stations machinery best adapted to the purpose. In case of equipments the type of motor best adapted to local conditions, making it possible for its clients to reduce their stock of extra supply parts. And also accomplishes the greatest result of all, viz.: Standardizing the motor equipments, making all parts interchangeable. This company makes it possible for street railway, power transmission and lighting companies to extend their service, thus increasing their earning capacity where it might not be possible, on account of the important first cost of absolutely new apparatus, by reason of the fact that it first of all furnishes standard high grade machinery, such as General Electric and Westinghouse, that has been used, but is nevertheless guaranteed to be similar in all respects to new apparatus, at a substantial reduction below the cost of new, and in addition to this the company makes a liberal allowance for any apparatus that its clients might have on hand the use of which they desire to discontinue.

THOMPSON-BONNEY COMPANY, BROOKLYN, N. Y. This firm manufactures and deals extensively in the following: Armatures and field coils, journal bearings, center, side bearings and armature bearings, car brakes, packing, rattan for sweepers, car steps, trucks, ventilators, trolley bases, also a general line of second hand material such as generators, railway motors, trucks, cars, sweepers and other appurtenances used in the operation and maintenance of railways.

—THOMPSON-BONNEY COMPANY, BROOKLYN, N. Y.

BENJAMIN WATSON, NEW YORK. Dealer in second hand rolling stock for interurban and street railway service. Rolling stock also overhauled.

JOHN B. WATSON, PHILADELPHIA, PA. Second hand or released material is material that has been in service and is fitted to go into use again, either as it is, or after overhauling. Naturally coming out in every form and condition it varies from what should go into the scrap heap to what is practically as good as new, and the prices vary accordingly. Under these conditions, a good technical knowledge, combined with keen commercial sense is required, and that Mr. Watson can employ them is evidenced by the successful installation of some ten electric railways during the past year alone with second hand apparatus.

CHARLES N. WOOD ELECTRIC COMPANY, BOSTON, MASS. Dealer in second-hand electric railway material, such as generators and motors for railway service.

FINANCIAL, ENGINEERING, ETC.

ACCOUNTANTS AND AUDITORS

THE AUDIT COMPANY OF ILLINOIS, CHICAGO, ILL. This firm is a public accountant and auditing firm prepared to examine and report on the books and bookkeeping methods of railway, lighting and power companies.

ADVERTISING, STREET CAR

AMBROSE PETRY COMPANY, DETROIT, MICH. A few years ago advertising privileges were eased to street car advertising men indiscriminately, and in a great many instances to local parties. Within the past three or four years there has been considerable tendency toward concentration, and it is now the general rule to lease the privilege in the cars to some company controlling large numbers of cars throughout the different cities. The reason for this is obvious. A general street car advertising concern is able to supply good, clean advertising cards which are really attractive, and a car fitted up and cared for as it should be is an improvement on the bare racking or plain printed cards. The Ambrose Petry Company has enjoyed valuable experience in this line and is prepared to give detailed information on this subject. It operates extensively throughout the United States and Canada. The executive office of the company is at Detroit, its Eastern office at New York and its Western office at Chicago. Other offices are at Toledo, Dayton, Youngstown, Indianapolis, Grand Rapids, Bay City, Tacoma, Spokane, Los Angeles, San Francisco, Seattle and Vancouver, B. C.

BARRON G. COLLIER, INCORPORATED, NEW YORK. Controls the street car advertising privileges in something over seventy towns and cities throughout the United States. These privileges are secured from the traction companies by lease, and the space thus obtained and controlled sublet to individual local and national advertisers through a corps of solicitors, operating from the central and branch offices. The central office is located in New York city, the branches at New Orleans, Atlanta, Baltimore and Washington. The company is one of the pioneers in this field of work.

GEORGE KISSAM & COMPANY, NEW YORK. This company makes a specialty of street and interurban railway advertising and is prepared to negotiate for long time leases with first-class roads in any part of the United States.

"STREET CAR ADVERTISING." A monthly publication issued for railway companies; subscription price 50 cents per year in advance.

—ELECTRIC RAILROAD ADVERTISING COMPANY, ROCHESTER, N. Y.

BANKERS AND BROKERS

BROWN BROTHERS & COMPANY, NEW YORK, PHILADELPHIA AND BOSTON. Dealers in high class railway stocks, bonds and other investment securities. Travelers and commercial letters of credit issued. Cable transfers and bills of exchange bought and sold.

DUMEE, SON & COMPANY, PHILADELPHIA, PA. This company buys and sells street railway franchises in the United States and Canada, and negotiates railroad securities.

W. E. FARLOW & COMPANY, NEW YORK. This company finances electric railways and other projects after proper reorganization and when the engineering details are perfected. The company is also prepared to organize properly and take care of all engineering features, including construction, detail and management.

FARSON, LEACH & COMPANY, NEW YORK AND CHICAGO. This firm specializes in the purchase and sale of railway and municipal bonds.

W. J. HAYES & SONS, CLEVELAND, OHIO, AND BOSTON, MASS. This firm buys total issues of street railway bonds on properties issued in the larger cities.

N. W. HALSEY & COMPANY, NEW YORK. Investment securities are sold by this company and a general banking business carried on. This firm also acts as fiscal agent for corporations and negotiates entire new or refunding issues of railway, lighting and power company's bonds.

N. W. HARRIS & COMPANY, NEW YORK, CHICAGO AND BOSTON. Buy and sell entire issues of municipal, railroad, street railway, gas, electric light and power company bonds, in addition to engaging in a general banking business, acting as fiscal agents for municipalities and corporations, issuing letters of credit, etc.

R. H. GOODELL & COMPANY, NEW YORK AND CHICAGO. This banking firm is prepared, after proper investigation, to loan money to corporations for construction and extension purposes in anticipation of permanent funding operations.

KEAN, VAN CORTLANDT & COMPANY, NEW YORK. This firm transacts a general domestic and foreign banking business, and deals in high class investment securities.

PERRY, COFFIN & BURR, BOSTON, MASS. This firm is prepared to purchase total issues of street railway and electric lighting bonds.

SPENCER TRASK & CO., BANKERS, NEW YORK. This firm transacts a general banking business; acts as fiscal agent for corporations; negotiates security issues of railroads and other companies; issues monthly investment circulars describing long-term and short-term high-grade bonds, and executes commission orders upon the New York Stock Exchange and in all of the markets of the principal cities.

(INDEX TO ADVERTISERS, PAGES 15 AND 18)

BOOKS, TECHNICAL

ELECTRICAL BOOKS. The publishers of the Street Railway Journal are also the largest publishers in the world of electrical books for the engineer, the student and the practical electrician. The list includes the works of Dr. Louis Bell, Chas. P. Steinmetz, Prof. Edwin J. Houston, Dr. A. E. Kennelly, B. A. Behrend, A. V. Abbott, Kempster B. Miller, Lamar Lyndon and scores of other well-known writers of electrical books. A complete catalogue may be had upon request.
—McGraw Publishing Company, New York.

ENGINEERING BOOKS. There is no engineering book published that this company cannot supply either from stock or to order on short notice. Quotations will be made on any list submitted for libraries for street railway and electric companies. Special lists of books recommended will be submitted on request.
—McGraw Publishing Company, New York.

PRACTICAL ELECTRICITY. Makes the study of electricity a pleasure. The most valuable feature in connection with this book is its questions, which are found at the end of each of the twenty chapters. These questions bring out all the valuable points, thus assisting the reader in mastering a subject before leaving it. Every one of the 441 questions is answered in the back of the book, where is also found a dictionary defining 1,500 electrical words, terms and phrases. 471 pages, price $2.00, delivered.
—Cleveland Armature Works, Cleveland, Ohio.

STREET RAILWAY BOOKS. The publishers of the Street Railway Journal have for sale the best books on every branch of street railway engineering. Gotshall's "Electric Railway Economics;" Herrick's "Practical Electric Railway Handbook," new edition; Hanchett's "Modern Electric Railway Motors," and Meyer's "Steam Power Plants" are examples of leading books which they publish. A full catalogue will be sent on request.
—McGraw Publishing Company, New York.

DETECTIVE SERVICE

DRUMMOND EMPLOYEE'S CHECKING SYSTEM. The thorough inspection by trained men of employees and equipment of railroad companies, especially of operating crews and cars, the handling of fares and the carefulness or carelessness of employees while operating cars. This work requires a thorough knowledge of city and interurban practice in methods of collection and registration of fares and of the different kinds of registers in use.
—Drummond's Detective Agency, New York.

BENJAMIN FRANKLIN'S DETECTIVE AGENCY, PHILADELPHIA. Established in 1854. Branch office in New York. Malcolm Franklin, the principal of the home office, is the son of the founder of the business, Benjamin Franklin, and has been engaged in the profession for some twenty-four years. This agency has correspondents throughout the United States and foreign countries. While it conducts all detective investigations of a strictly legitimate character for individuals and corporations, attorneys, etc., for the past ten years it has made a specialty of conducting investigations for electric railway lines, and can furnish the best of references from some of the leading street car companies, for which it has operated, in checking conductors, accident cases, etc.

MOONEY & BOLAND DETECTIVE AGENCY, NEW YORK AND CHICAGO. Street railway work in all branches a specialty.

RAILWAYS PROTECTIVE ASSOCIATION. An association of steam and electric railroads, steamship companies, express companies and accident insurance companies for the purpose of defeating accident fakirs. Members of the association pay a small annual fee, and report all claims of every kind made against them to a separate bureau, where these records are kept. If previous records of claimant are found, also of accident witnesses on file, copies are immediately forwarded to the member reporting a claim against it.
—Drummond's Detective Agency, New York.

ENGINEERS,

Consulting, Contracting and Operating.

AMERICAN RAILWAY CONSTRUCTION COMPANY, NEW YORK. This firm is engaged in the business of financing, constructing and equipping electric and steam railways, water power plants and other public works. It was organized January 9, 1905, and is prepared to handle large contracts, and if of unquestioned merit will assist, through its financial connections, in placing securities of roads, contracts for building which are entered into with it.

THE ARNOLD COMPANY, CHICAGO, ILL. This firm has successfully completed, and is prepared to construct, a large variety of installations requiring the use of a high standard of civil, mechanical and electrical engineering.

ATLAS CONTRACT & SUPPLY COMPANY, SAN FRANCISCO, CAL. This company builds and equips steam railroads, electric railways, power and lighting plants, etc. Securities are taken in high-class enterprises.

W. E. BAKER & COMPANY, NEW YORK. This firm, which is composed of W. E. Baker and H. R. Bishop, conducts a general consulting engineering business. It has also designed and completed a number of electric railway and power plants.

PUTNAM A. BATES, NEW YORK. Plans, specifications and supervision of electrical installations. Examinations and tests of existing electrical equipments. Special investigations of existing or proposed electrical equipments and engineering enterprises for those interested. Reports as to possible betterments, from a commercial as well as from an engineering point of view, in existing establishments. Complete reports based on special investigations of electrical properties with respect to their dividend paying possibilities. Recommendations concerning alterations, substitutions and extensions to conform with new conditions and to improve the commercial success of the undertakings.

CHARLES EDWIN VAN BIBBER, BOSTON, NEW YORK AND TOLEDO. Consulting and constructing engineer for steam and electric railways, power plants and all classes of civil, electrical and mechanical engineering.

BLOOD & HALE, BOSTON, MASS. Consulting and designing engineers, particularly for elevated and heavy electric traction. Complete designs prepared for electrical and mechanical apparatus. Plans and specifications furnished for power plants.

EDWARD P. BURCH, MINNEAPOLIS, MINN. Consulting engineer for electrical work and specialist in heavy electric traction.

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STREET RAILWAY JOURNAL

ISSUE of SEPTEMBER 23RD 1905

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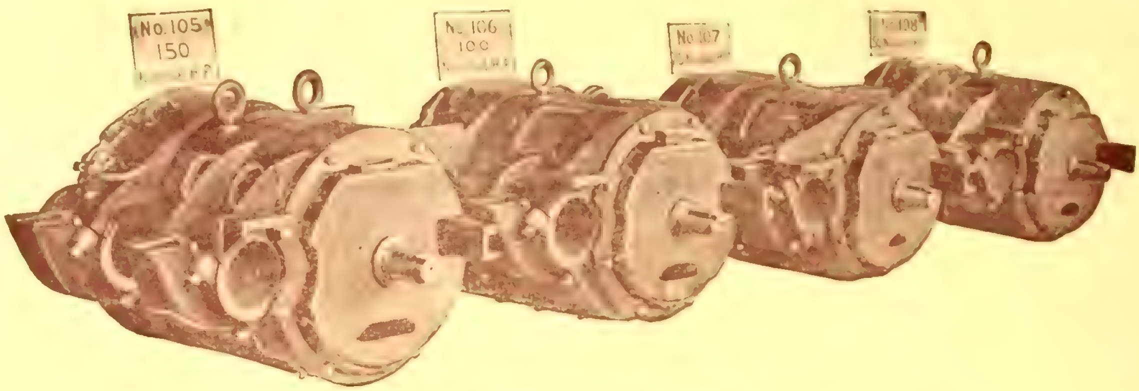

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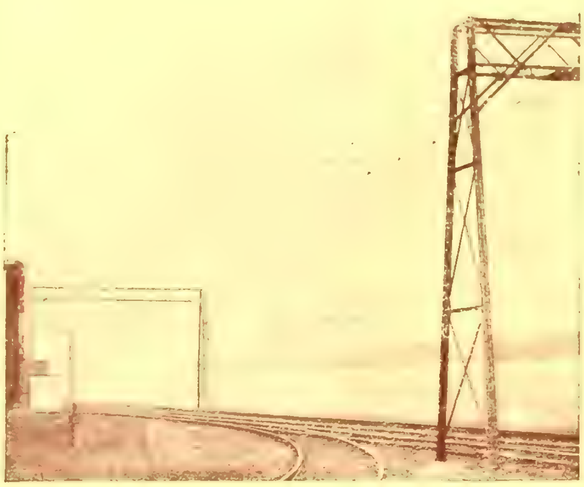

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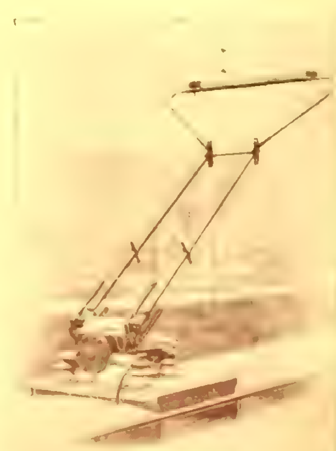

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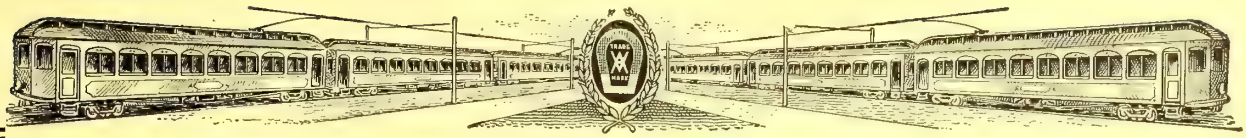

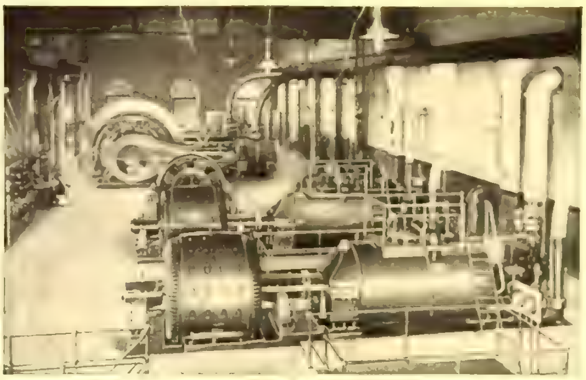

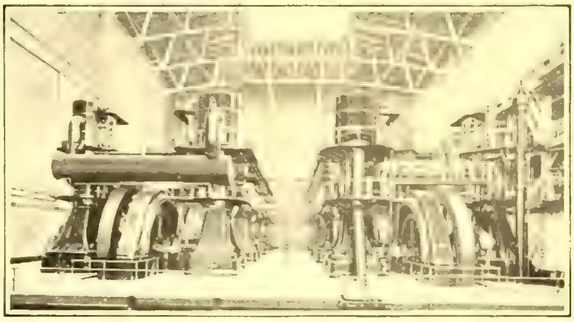

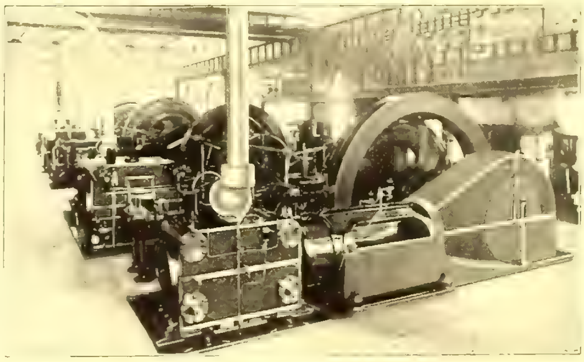

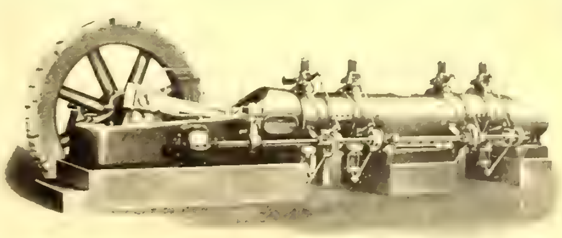

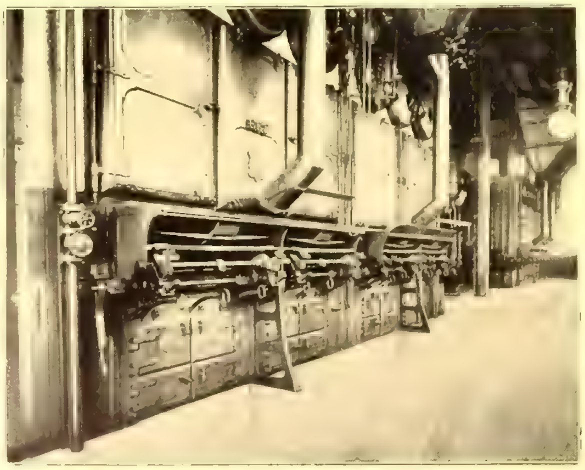


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VOL. XXVI. No. 13 SEPTEMBER 23, 1905 PHILADELPHIA CONVENTION SECTION.

TABLE OF CONTENTS.

Philadelphia, The Convention City - - - - - - - - - - - 473

Analysis of Transportation Conditions in Philadelphia - - - - - - - 474

Traffic Districts—Conditions which Affect Transportation—The Congestion Problem—Trends of Travel.

History, Organization and Financial Characteristics of the Philadelphia Rapid Transit Company 479

Early Lines—Sunday Cars—The Race Question—Introduction of Mechanical Traction—The Strike of 1895—Consolidations and Family Tree—Exchange Tickets and Transfers—Condition of Employees—Taxes—Passengers Carried and Rides per Capita—Gross Receipts—Analysis of Operating Expenses—Some Operating Factors—Fire Insurance—Depreciation Reserve.

Operating Methods in Philadelphia - - - - - - - - - - - 488

Operating Organization — Personnel — Posting Schedules — Assignment of Runs — Employment Department — Employees' Records — Conductors' Accounts and Paying Employees—Conductors' Waybills—Conductors' Reports of Delays—Benefit Associations—Steam Railroad Crossings—Street Railway Crossings—Mail Cars—Newspaper Cars—Chartered Cars.

Way and Roadway Matters in Philadelphia - - - - - - - - - - 494

Types of Track Construction—Detail Standards—The Manufacture of Special Work—Outfit for Renewing Special Work—Roadway Shops—Other Appliances for the Roadway Department—Rail Car—Portable Rail Saw—Switch Tongue-Pin Grinder—Paving.

Department of Lines and Cables - - - - - - - - - - - 503

D. C. Cables—A. C. Cables—Underground Conduits—Overhead Construction—Emergency Crews and Hurry-Up Repair Service—Reclaiming Iron Poles—Telephone System.

Generation and Distribution of Power on the Philadelphia Rapid Transit System - - 508

General Power Scheme—Direct-Current Stations—Alternating-Current Stations at Second Street and Wyoming Avenue—New Turbine Station on Delaware Avenue—Handling Coal—Handling Cinders—Cooling Condensing Water—Sub-Stations—Storage Batteries.

Car Houses, Repair Shops and Rolling Stock - - - - - - - - - 525

Repair Shops—Rolling Stock—Shifting Trucks—Car Signs—Test Car—Mechanical and Electrical Inspection Department.

Claim and Other Departments - - - - - - - - - - - - 529

Claim Department—Photograph Department—Lost Property Department—Printing Department—Testing Laboratory—Snow Fighting—Laundry for Waste and Rags—Material and Supplies Accounting.

Willow Grove and Willow Grove Terminal - - - - - - - - - 538

Willow Grove Park—New Line to Willow Grove—Other Parks—Willow Grove Terminal.

The Subway and Elevated Lines in Philadelphia - - - - - - - - 541

General Conditions—West Market Street Subway—Ventilation—Schuylkill River Bridge—Elevated Structure—Subway and Elevated Repair Shops.

Index to Advertisers, Pages 15 and 18

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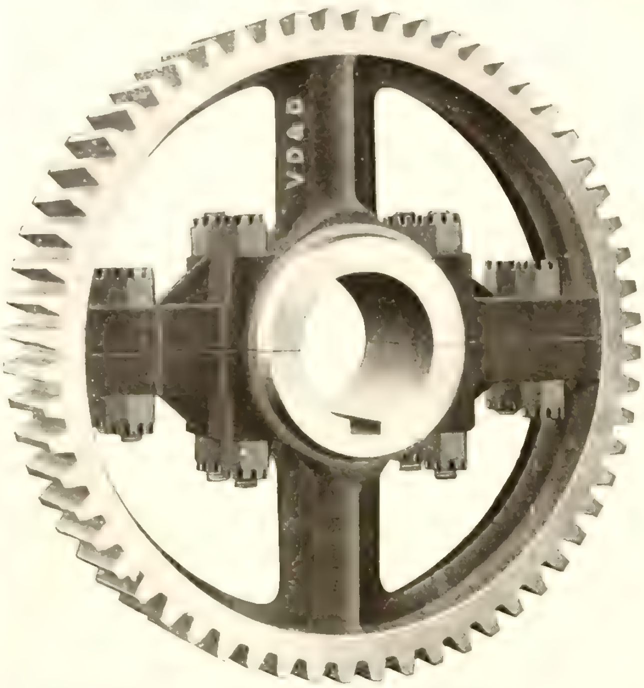

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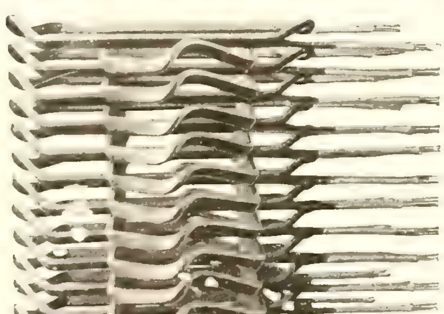

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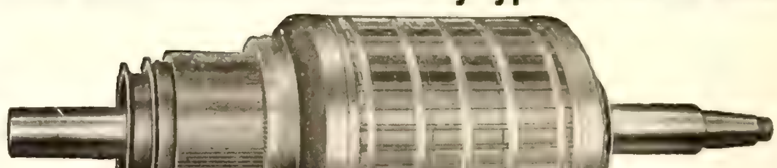

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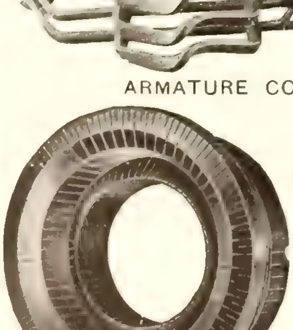

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INDEX TO ADVERTISERS

Abeles & Taussig, St. Louis.................... 133
Albany Steam Trap Co., Albany, N. Y........ 50
Allis-Chalmers Co., Milwaukee...............66, 69
Allison, Giles S., New York.................... 152
American Blower Co., Detroit, Mich.......... 58
American Brake Shoe & Foundry Co., Mahwah, N. J.............................. 142
American Car Co., St. Louis, Mo............. 191
American Ferrofix Brazing Co., Philadelphia. 100
American Locomotive Sander Co., Philadelphia and Chicago 165
American Mason Safety Tread Co., Boston, Mass. 157
American Mutoscope & Biograph Co., New York 20
American Railway Supply Co., New York.... 141
American Rattan & Reed Mfg. Co., Brooklyn, N. Y. 161
American Stoker Co., Erie, Pa................ 40
American Vulcanized Fibre Co., Wilmington, Del. 95
American Wood Working Machinery Co., New York 31
Anderson, A. & J. M., Mfg Co., Boston...... 127

Babcock & Wilcox Co., New York..........38, 39
Baldwin Locomotive Works, Philadelphia..... 5
Ball & Wood Co., The, New York............ 57
Baltimore Car Wheel Co., Baltimore, Md...... 179
Baltimore Railway Specialty Co., Baltimore, Md. 170
Banner Electric Co., Youngstown, Ohio..... 138
Barbour-Stockwell Co., Cambridgeport, Mass.. 118
Bates, Putnam A., successor to Bates & Neilson, New York.............................. 82
Bayonet Trolley Harp Co., Springfield, Ohio. 157
Bethlehem Foundry & Machine Co., South Bethlehem, Pa. 23
Bishop Gutta Percha Co., New York.......... 133
Blake Signal & Mfg. Co., Boston, Mass...... 111
Bliss, E. W., Co., Brooklyn, N. Y. 166
Bliss, R., Mfg. Co., Pawtucket, R. I. 161
Bonner, Wm. T., Co., Boston.................. 48
Bowman, Samuel, St. Louis, Mo............... 115
Boyce, Edward C., New York.................. 22
Brady Brass Co., New York and Jersey City. 6
Brill, J. G., Co., Philadelphia.............194, 199
Broomell, Schmidt & Steacy Co., York, Pa...52B
Brown Bros. & Co., New York............... 75
Brown, Harold P., New York 119
Brown Hoisting Machinery Co., Inc., Cleveland, Ohio 24
Buckeye Engine Co., Salem, Ohio............. 63
Buckeye Third-Rail Shield Co., Columbus, O. 25
Bullock Electric Mfg. Co., Cincinnati, Ohio..66-69
Burnham, Williams & Co., Philadelphia....... 5
Byllesby, H. M., & Co., Chicago, Ill.......... 77

Calman, Emil, & Co., N. Y.................... 94
Cameron, H. P., Electrical Mfg. Co., Inc., Ansonia, Conn. 100
Chase-Shawmut Co., Newburyport, Mass....... 122
Chicago Pneumatic Tool Co., Chicago......... 26
Christensen Engineering Co., National Electric Co., successors, Milwaukee, Wis...... 7
Clark's Automatic Car Fender Co., Decatur, Ill. 159
Clark Electric & Mfg. Co., New York......134, 135
Cleveland Frog & Crossing Co., Cleveland.... 115
Columbia Machine Works & Malleable Iron Co., Brooklyn, N. Y......................... 169
Consolidated Car Fender Co., New York...... 162
Consolidated Car Heating Co., Albany, New York and Chicago 156
Consolidated Engine Stop Co., New York.... 51
Continuous Rail-Joint Co. of America, Newark, N. J.................................... 116
Cooper, C. & G., Co., Mount Vernon, Ohio... 64
Creaghead Eng. Co., Cincinnati, Ohio........ 137
Crocker-Wheeler Co., Ampere, N. J.......... 65
Curtain Supply Co., Chicago, Ill.............. 146
Cutter Co., The, Philadelphia.................. 33

Dallett & Co., Philadelphia.................... 99
Dayton Mfg. Co., Dayton, Ohio.............. 163
Dearborn Drug & Chemical Works, Chicago, Ill. 42
De La Vergne Machine Co., New York...... 113
Deming Co., The, Salem, Ohio............... 56
D. & W. Fuse Co., Providence, R. I......... 139
De Witt Sand Box Co., Troy, N. Y.......... 165
Dittrick & Jordan Electric Co., Cleveland..... 101
Dorner Mfg. Co., Chicago, Ill..............180, 181
Driver-Harris Wire Co., Harrison, N. J...... 136
Duff Mfg. Co., The, Pittsburg, Pa........148, 149
Dumee, Son & Co., Philadelphia............... 77
Durkin Controller Handle Co., Philadelphia... 156

Earll, Chas. I., New York...................... 139
Edwards, O. M., Co., Syracuse, N. Y........ 159
Egry Autographic Register Co., Dayton, Ohio 145, 153
Electric Railway Equipment Co., Cincinnati, Ohio 126
Electric Storage Battery Co., Philadelphia, Pa. 35
Electrical Installation Co., Chicago........... 81
Electrical Testing Laboratories, New York.. 81
Electro Dynamic Co., Bayonne, N. J.......... 30
Engstrom, Axel H., Philadelphia.............. 82
Etter, Chas. F., Harrisburg, Pa................ 153
Eureka Automatic Electric Signal Co., Lansford, Pa. 110

Falk Co., Milwaukee, Wis..................104, 105

Farnham Co., The, Chicago.................... 92
Fay, J. A., & Egan Co., Cincinnati, Ohio.... 29
Fogarty, J, H., New York...................... 143
Ford, Bacon & Davis, New York.............. 79
Fort Pitt Spring & Mfg. Co.................... 145
Foster Engineering Co., Newark, N. J........ 50

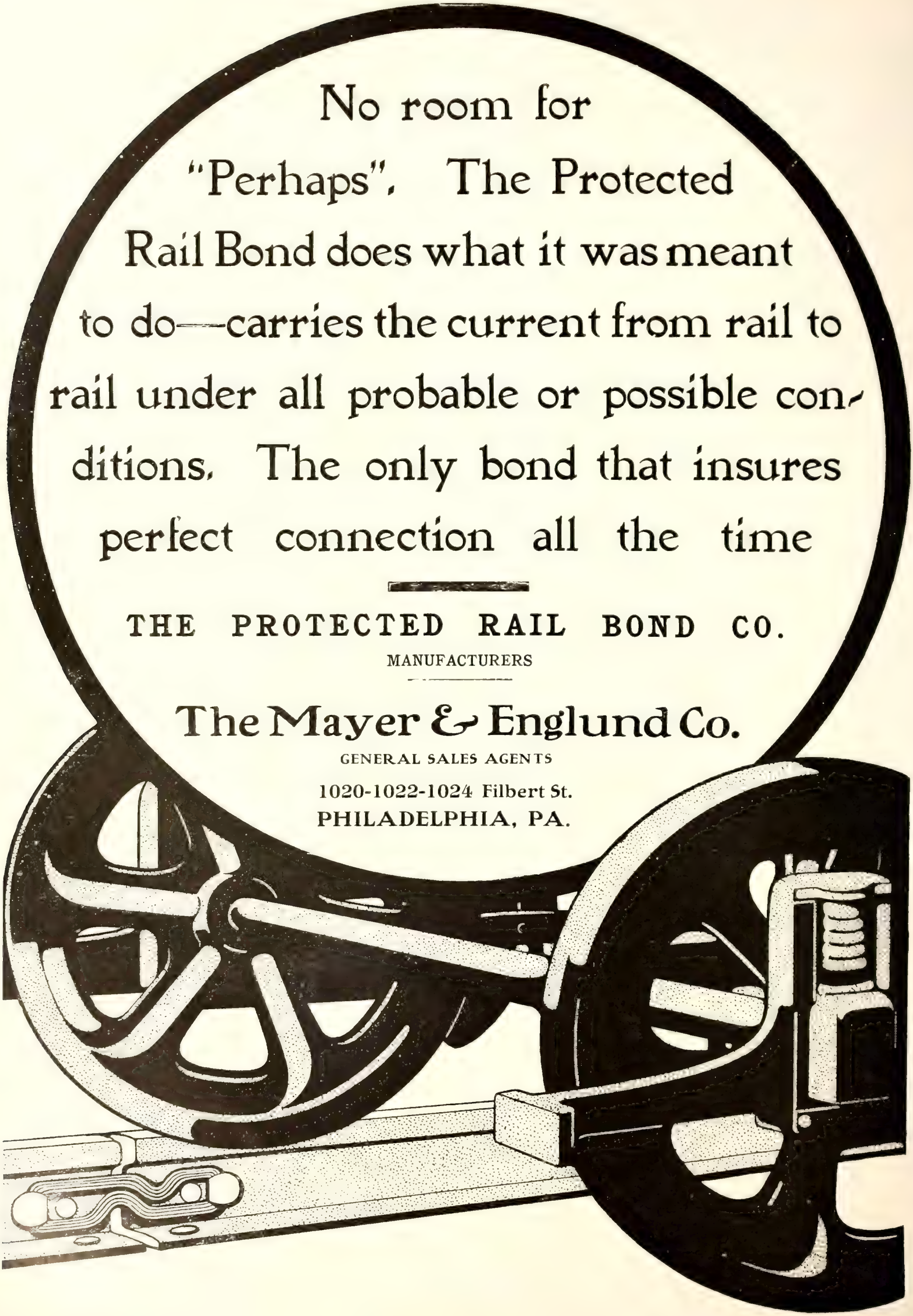
Galena Signal Oil Co., Franklin, Pa........... 172
Garton-Daniels Co., Keokuk, Ia................ 147
Garton, W. R., Co., Chicago, Ill............... 90
General Electric Co., Schenectady, N. Y., 71-74 and 200
General Railway Supply Co., Pittsburg, Pa... 90
General Storage Battery Co., New York...... 37
Germer Stove Co., Erie, Pa.................... 89
Gherky, Wm. D., Philadelphia................ 137
Globe Ticket Co., Philadelphia................ 140
Gold Car Heating & Lighting Co., N. Y...... 144
Golden-Anderson Valve Specialty Co., Pittsburg 49
Goldschmidt-Thermit Co., New York......... 106
Gould Storage Battery Co., New York........ 34
Green Engineering Co., Chicago.............. 40
Green Fuel Economizer Co., Matteawan, N. Y. 54, 55
Griffin Wheel Co., Chicago..................... 175

Hale & Kilburn Mfg. Co., Philadelphia........ 158
Halsey, N. W., & Co., New York............ 77
Hanna, J. A., Co., Cleveland.................. 183
Harris, N. W., & Co., Chicago, New York and Boston 76
Harrisburg Foundry & Machine Works, Harrisburg, Pa. 61
Harrison Safety Boiler Works, Phila., Pa.... 41
Hastings, Geo. S., & Co., Cleveland.......... 89
Heil Rail-Joint Welding Co., Milwaukee, Wis. 107
Heine Safety Boiler Co., St. Louis............ 40
Hemingray Glass Co., Covington, Ky......... 128
Herrick, Albert B., Ridgewood, N. J.......... 80
Heywood Bros. & Wakefield Co., Wakefield, Mass. 159
Hooven, Owens, Rentschler Co., Hamilton, Ohio 70

Indianapolis Switch & Frog Co., Springfield, Ohio 111
Ingersoll Company, Pittsburg, Pa.............. 19
International Register Co., Chicago, Ill...150, 151

Jewett Car Co., Newark, Ohio................ 185
Johns-Manville Co., H. W., New York........ 125
Johns-Pratt Co., Hartford, Conn............... 124
Jolt Lubricator Co., Providence, R. I........ 178

Index Continued on Page 18.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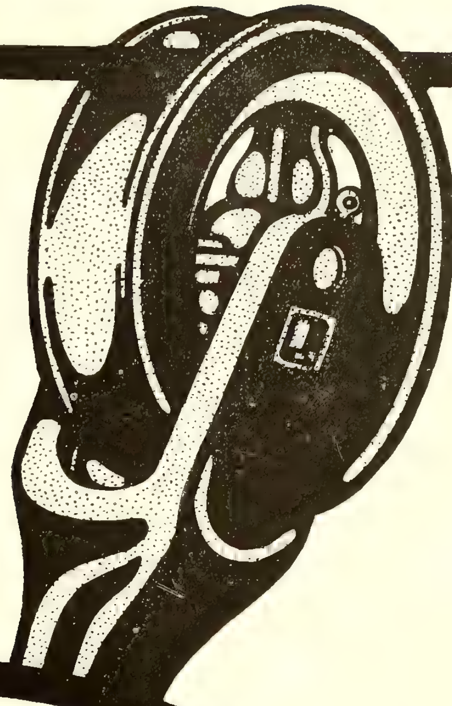


INDEX TO ADVERTISERS Continued from page 15

[illegible] 28
[illegible] 103
[illegible] Mich. 155
Kean, Van Cortlandt & Co., N. Y. 76
[illegible]
Keystone Electrical Instrument Co., Philadel- [illegible] 52
Kinsman Elec. & Railway Supply Co., N. Y. 108
Kuhlman, G. C., Car Co., Cleveland, Ohio 192

Laconia Car Co. Works, Boston 184
Leonhardt Wagon Mfg. Co., Baltimore, Md. 24
Liberty Mfg. Co., Pittsburg 44
Locke Insulator Mfg. Co., Victor, N. Y. 132
Lorain Steel Co., Philadelphia 117
Lord Electric Co., Boston 120, 121
Lord, Geo. W., Co., Philadelphia 45
Lucas & Co., John, Philadelphia 94
Lumen Bearing Co., Buffalo, N. Y. 6

MacDonald Ticket & Ticket Box Co., Cleve- [illegible] 155
Macon-Evans Varnish Co., Pittsburg 96
[illegible] Wire Co., New York 130
Matthews, W. N., & Bro., St. Louis, Mo. 21, 133
Matthews-Fahl Mfg. Co., St. Louis 21
Mayer & Englund Co., Philadelphia, Pa. 16, 17
McCardell, J. R., & Co., Trenton, N. J. 24
Mead, John A., & Co., New York 53
Mead-Morrison Mfg. Co., New York 52
Merritt & Co., Philadelphia, Pa. 23
Mica Insulator Co., N. Y. 95
Milloy Electric Co., Cleveland 139
Morris, Elmer P., Co., New ork 90
Mulford & Petry Co., New York 15
Munsell, Eugene & Co., Chicago 95
Murray Iron Works, Burlington, Ia. 60

National Battery Co., Buffalo, N. Y. 36
National Brake Co., Buffalo, N. Y. 10
National Carbon Co., Cleveland, Ohio 140
National Electric Co., Milwaukee, Wis. 7
National Lock Washer Co., Newark, N. J. 161
New Era Mfg. Co., Kalamazoo 18
New York Central & H. R. R. R. 99
New York Switch & Crossing Co., Hoboken, N. J. 112
Niles Car & Mfg. Co., Niles, Ohio 183
Nuttall, R. D., Co., Pittsburg, Pa. 167

Ohio Brass Co., Mansfield, Ohio 123
Ohmer Fare Register Co., Dayton, Ohio 154
Oil & Waste Saving Machine Co., Philadel- [illegible] 50
Okonite Co., Ltd., The, New York 129
Owego Bridge Co., Philadelphia 108

Parker Boiler Co., Philadelphia 44
Parmenter Fender & Wheel Guard Co., Bos- [illegible] 100
[illegible] Mfg. Co., [illegible], N. Y. 18, 190
Pennsylvania Railroad 99
Pepper & Bowie, Philadelphia 81
Petry Co., Ambrose, N. Y. 15
Philadelphia Air Brake Co., Philadelphia, Pa. 8, 9
Philadelphia Toboggan Co., Philadelphia 20
Pittsburgh White Metal Co., Pittsburgh, Pa. 6
Platt Iron Works Co., Dayton, Ohio 48
Pratt, Mason D., Harrisburg, Pa. 81
Pressed Steel Car Co., Pittsburg, Pa. 182
Protected Rail-Bond Co., Philadelphia, Pa. 16

Quincy Engine Works, Quincy, Ill. 62

Railway Journal Lubricating Co., Chicago 174
Register & Co., A. L., Philadelphia 77
Ridlon, Frank, Co., Boston, Mass. 164
Roberts & Abbott Co., Cleveland, Ohio 79
Rossiter, MacGovern & Co., New York 102
Royal Mfg. Co., Lancaster, Pa. 28

Samson Cordage Works, Boston 165
Sanderson & Porter, New York 78
Sangamo Electric Co. 32
Sangamo Electric Co., Springfield, Ill. 32
Sayre, L. A., & Co., Newark, N. J. 140
Schoen Steel Wheel Co., Pittsburg and Phila. 177
Schoonmaker, A. O., New York 94
Scofield Co., The, Philadelphia 82
Security Register Co., St. Louis, Mo. 152
Shaw Engineering & Mfg. Co., New York 93
Shepherd Engineering Co., Franklin, Pa. 61
Simplex Co., Newark, N. J. 32
Sipe, Jas. B., & Co., Allegheny, Pa. 95
Smethurst & Allen, Philadelphia 82
Smith, Peter, Heater Co., Detroit, Mich. 145
Southern Exchange Co., New York 133
Speer Carbon Co., St. Mary's, Pa. 140
Standard Automatic Lubricator Co., Philadelphia, Pa. 175
Standard Paint Co., New York 95
Standard Steel Works, Phila., Pa. 176
Standard Underground Cable Co., Pittsburg, Pa. 137
Standard Varnish Works, New York 96
Star Brass Works, Kalamazoo, Mich. 168
St. Louis Car Co., St. Louis, Mo. 186
St. Louis Car Wheel Co., St. Louis 176
Stephenson, John, Co., Elizabeth, N. J. 193
Sterling Electrical Mfg. Co., Warren, Ohio 138
Sterling Varnish Co., Pittsburg, Pa. 97
Stirling, The, Co., New York 43
Stiles, A. C., Anti-Friction Metal Co., New Haven, Conn. 12, 13
Stromberg, Allen & Co., Chicago 140
[illegible] 131
Sturtevant, B. F., Co., Hyde Park, Mass. 9
Symington, The T. H. Co., Baltimore, Md. 171

Taylor Electric Truck Co., Troy, N. Y. 182
[illegible], New York 49
Trask & Co., Spencer, New York 7
Trolley Supply Co., Canton, Ohio 157

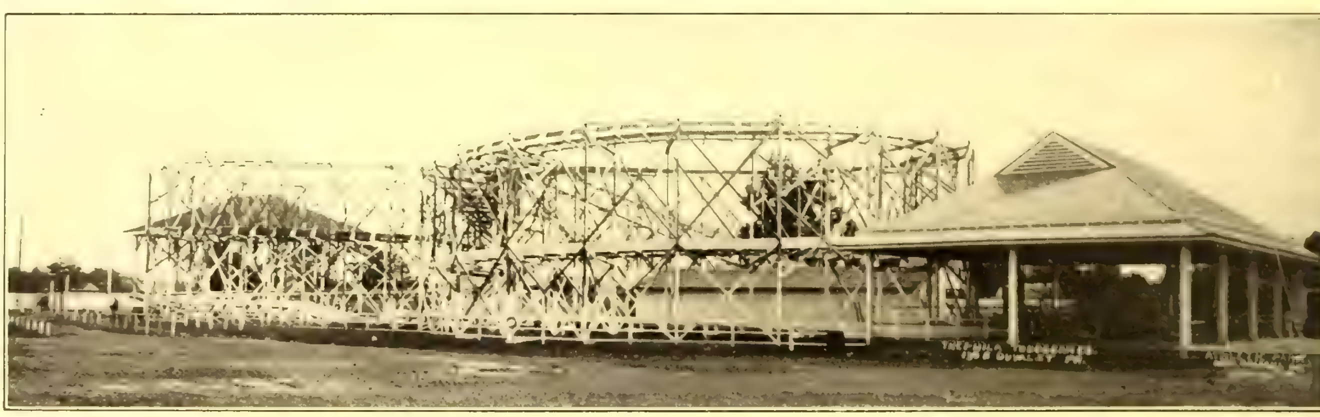
U. S. Electric Signal Co., West Newton, Mass 100
U. S. Metal & Mfg. Co., New York 141
U. S. [illegible] 49
U. S. Wood Preserving Co., New York 107

Van Dorn, W. T., Co., Chicago 179
Van Dorn & Dutton Co., Cleveland, Ohio 14
Van Dorn-Elliott Electric Co. Cleveland, Ohio 14
Vogel, H. G., Co., New York 25

Wabash Railroad 99
Wallace Supply Co., Chicago 18
Washburn, Edwin C., Minneapolis, Minn. 173
Watson, John B., Philadelphia 92
Weber Steel Concrete Chimney Co., Chicago 52A
Weber Ry. Joint Mfg. Co., New York 111
Wendell & MacDuffie, New York 91
Wesco Supply Co., St. Louis, Mo. 93
West Disinfecting Co., New York 23
Westinghouse Air Brake Co., Pittsburg, Pa. 3
Westinghouse, Church, Kerr & Co., N. Y. 77
Westinghouse Electric & Mfg. Co., Pittsburg, Pa. 5
Westinghouse Machine Co., Pittsburg, Pa. 4
Westinghouse Traction Brake Co., New York 3
Weston Electrical Instrument Co., Waverly Park, N. J. 25
Wetherill, Robt., & Co., Chester, Pa. 64
Wharton, Wm., Jr., & Co., Philadelphia 113
Wheeler Condenser & Eng. Co., New York 58
Wheeler, C. H., Condenser & Pump Co., Philadelphia 44
[illegible] 176
White J. G., & Co., New York 78
Williams Gauge Co., Pittsburg 46, 47
Wire & Cable Co., The, Montreal 136
Woodworth-Engert Co., Cleveland 141
Wright Wire Co., Worcester, Mass 136

Xylotite Product Co., Cincinnati 49

Yale & Towne Mfg. Co., New York 28



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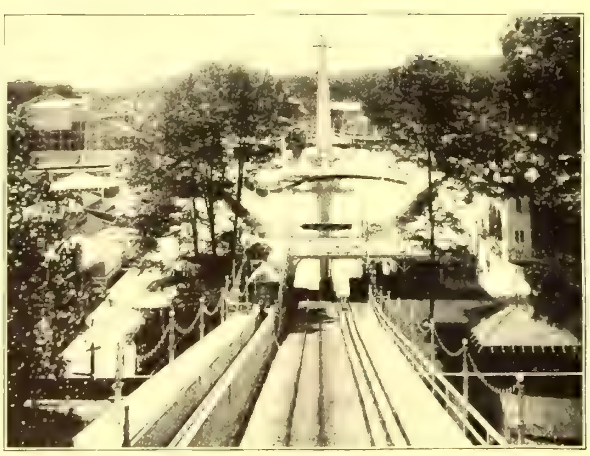

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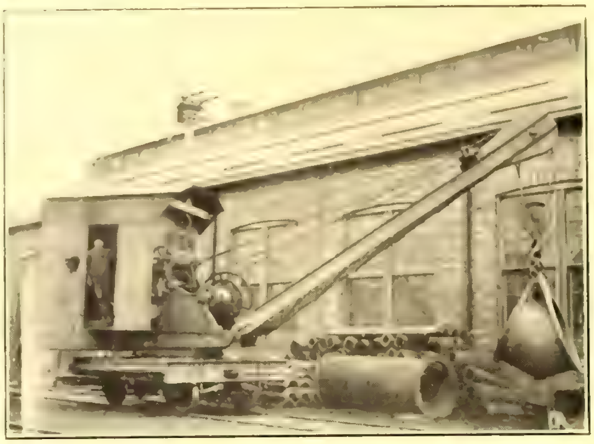

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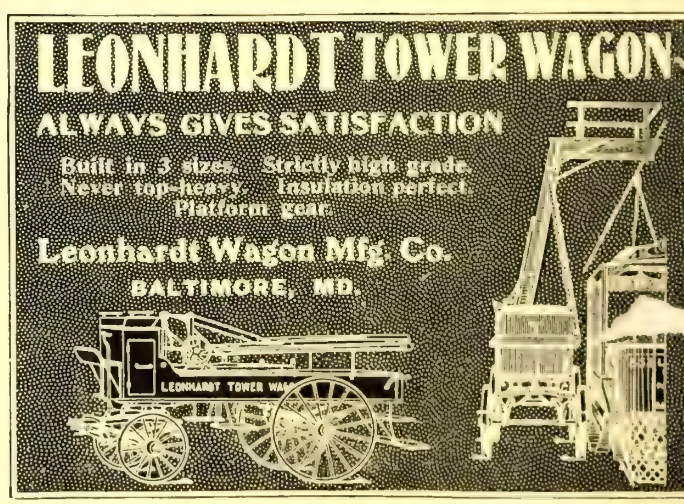

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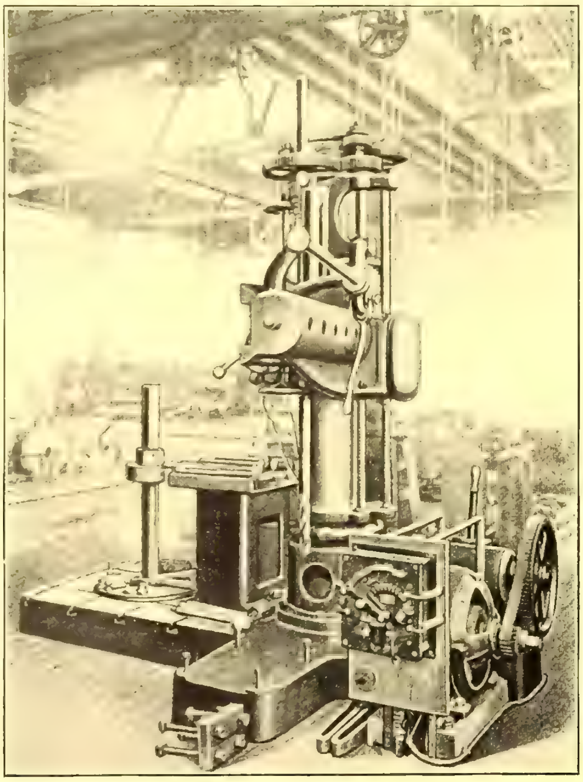

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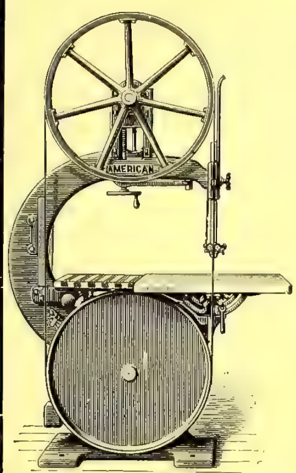

Fig. 5141. 36″ Band Saw with Web Wheel.

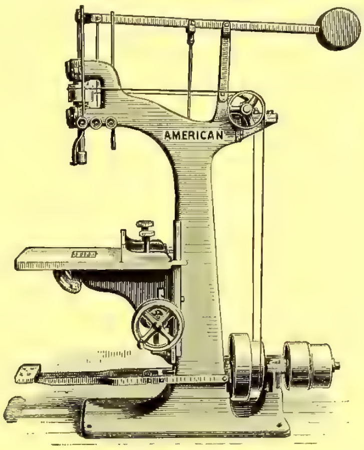

Fig. 972. No. 2. Vertical Borer.

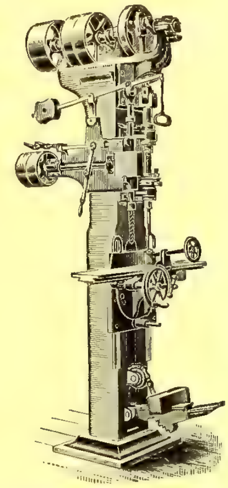

Fig. 906. No. 1 Mortiser and Borer.

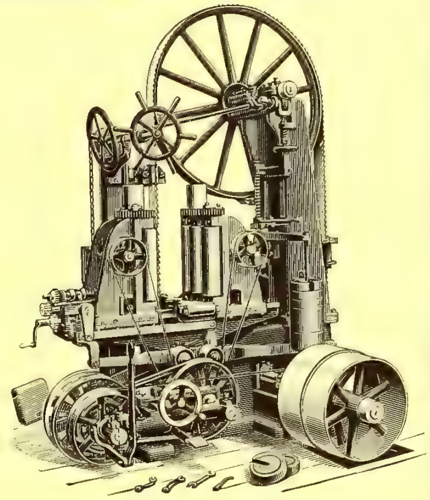

Fig. 501. 54″ Band Re-saw.

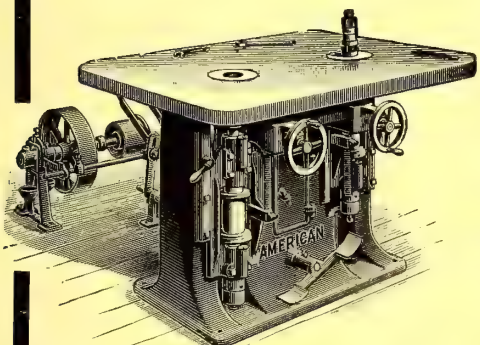

Fig. 929. No. 2½ Two-Spindle Shaper.

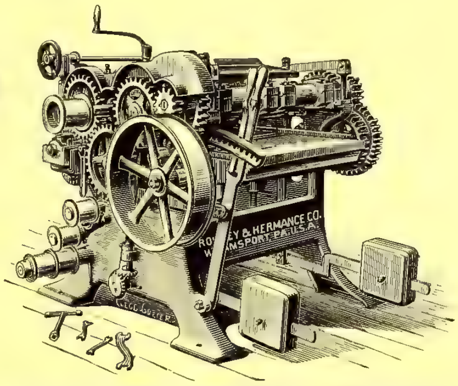

Fig. 759. 26″ x 8″ "Peacemaker," Double Surfacer.

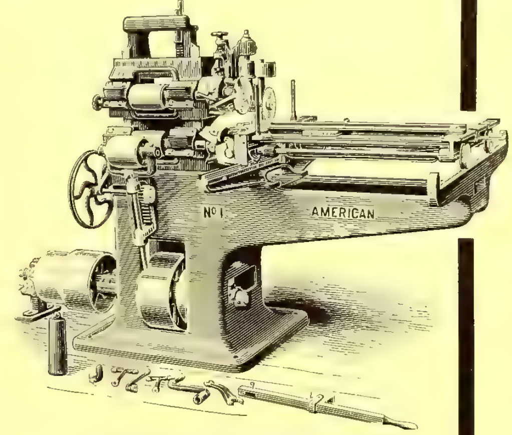

Fig. 9421. American No. 1 Tenoner.

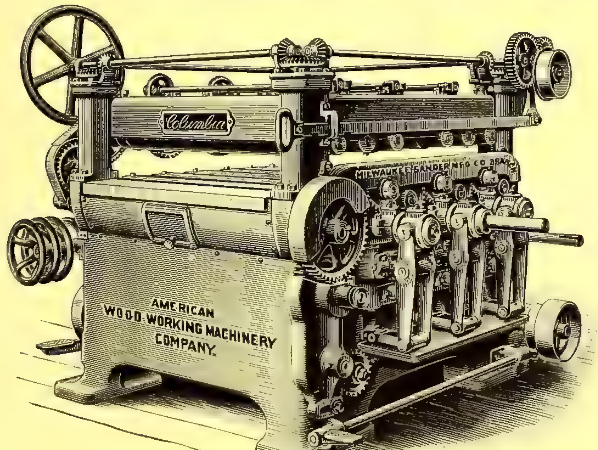

Fig. 1070. Columbia Sander, working, 30″ to 84″ wide by 6′ thick.

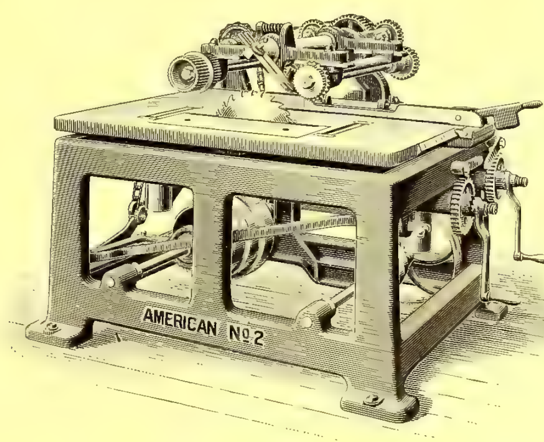

Fig. 5701. American No. 2 Self-feed Rip Saw.

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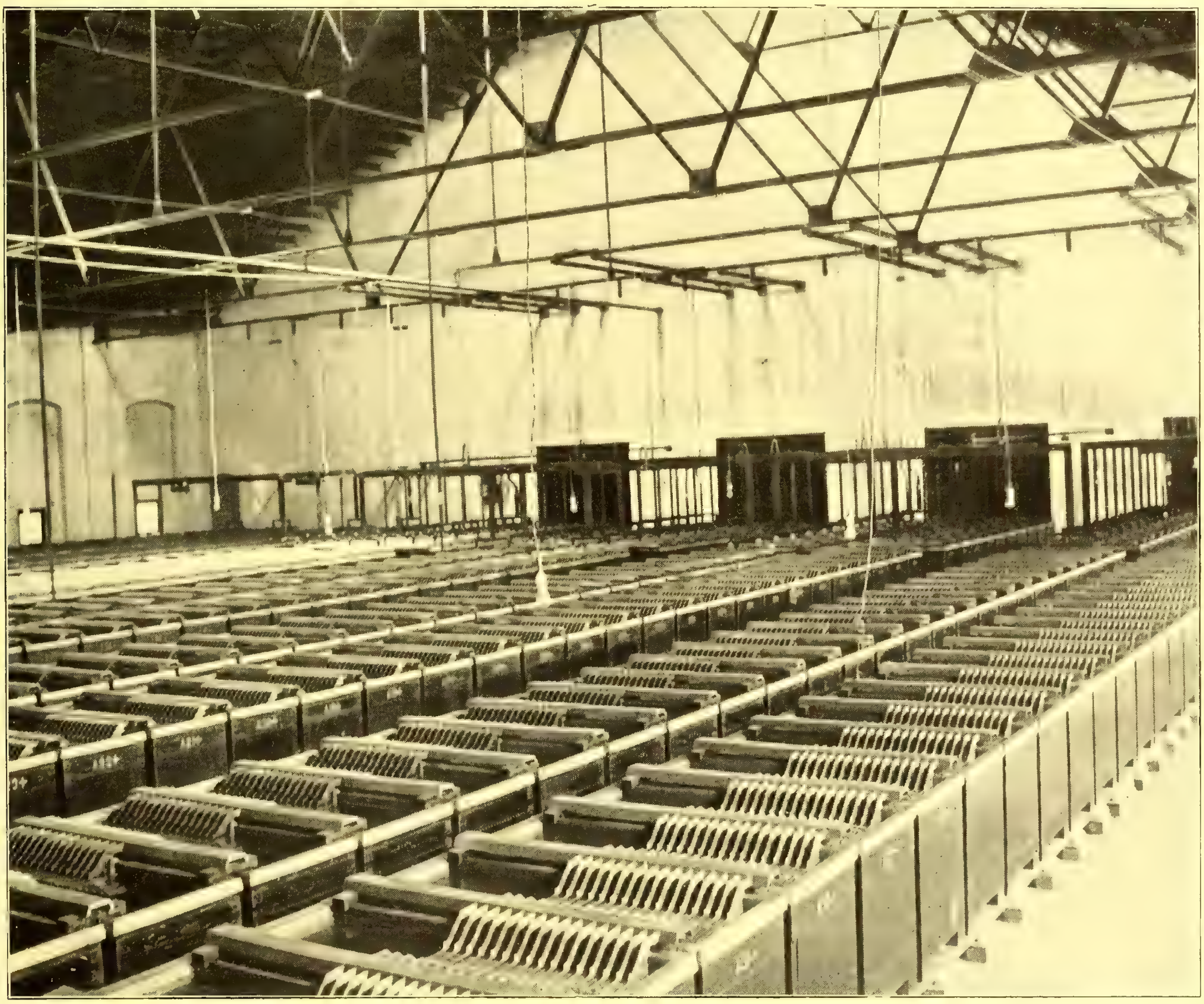

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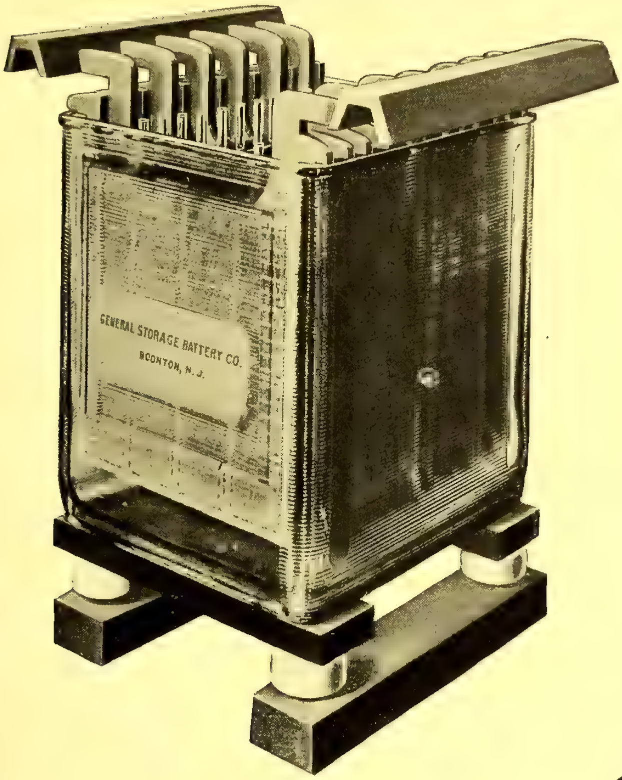

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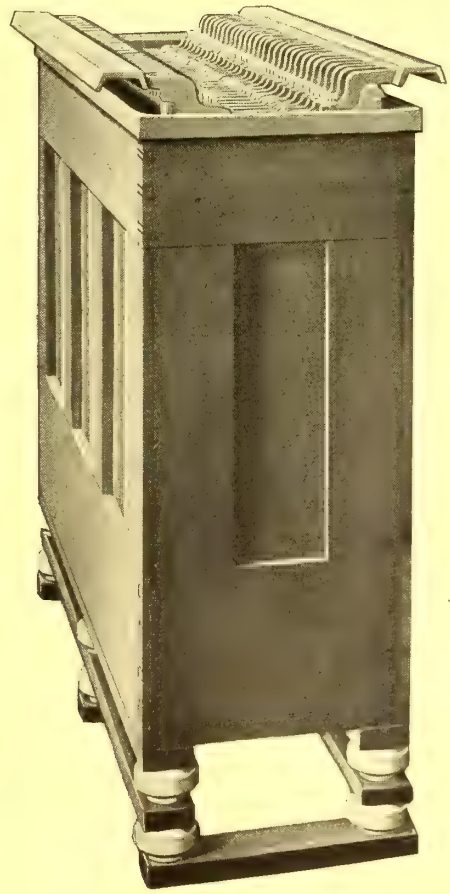

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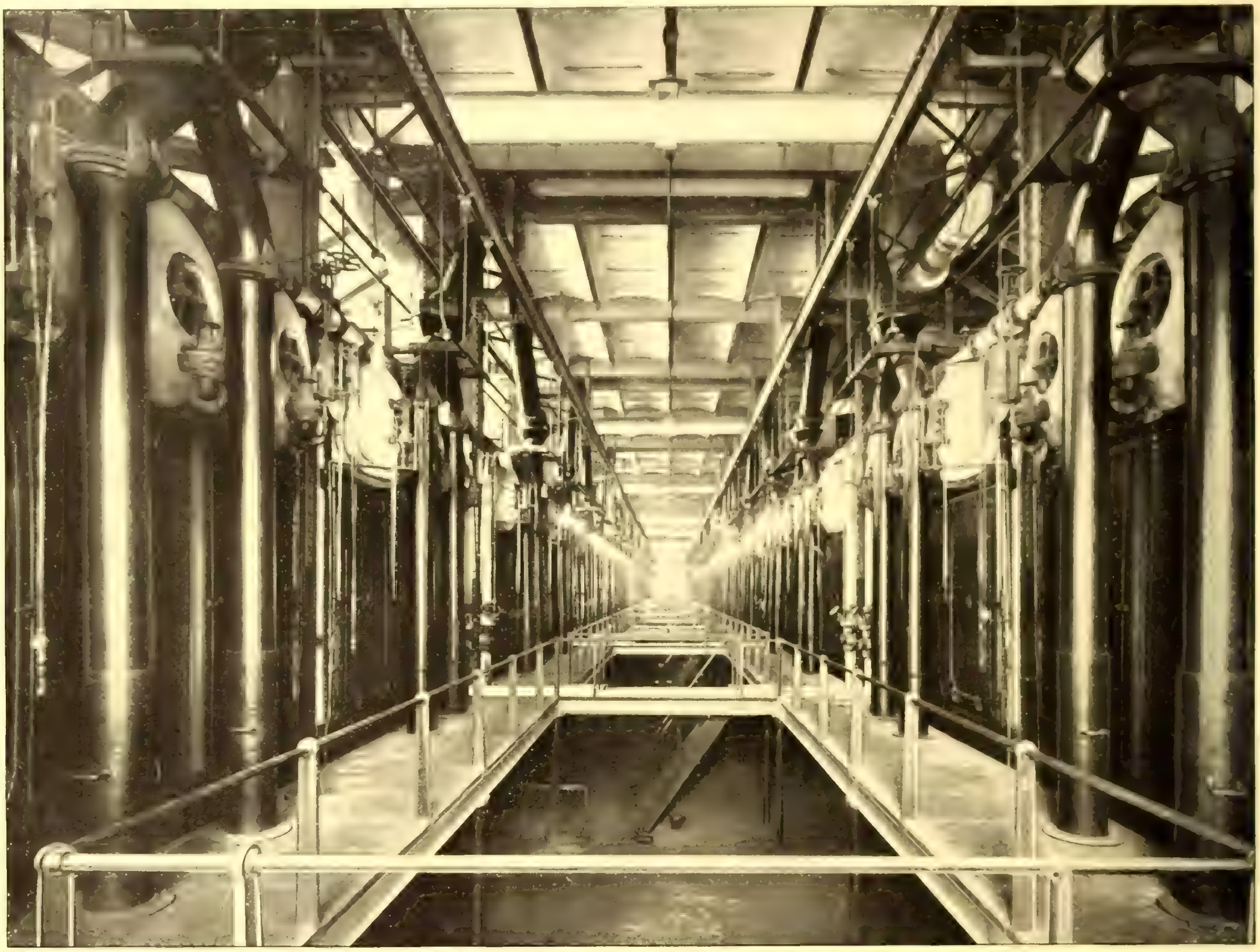

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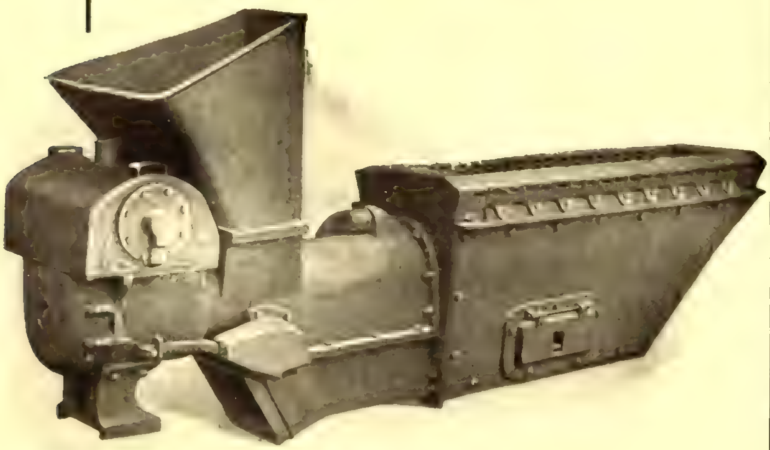

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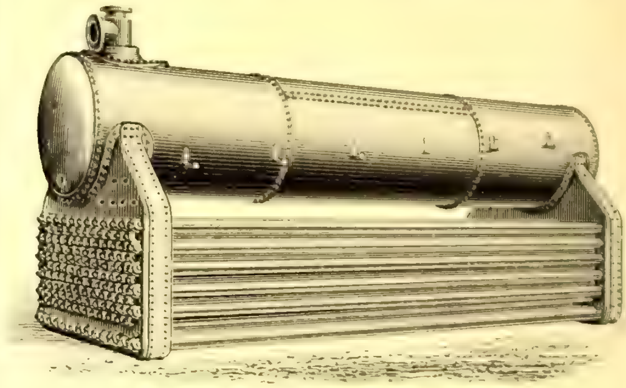

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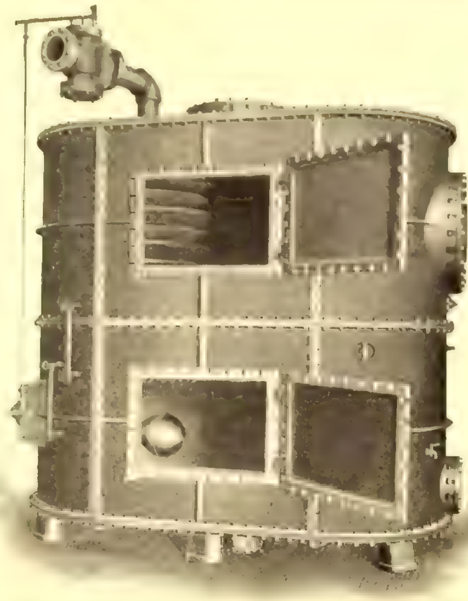

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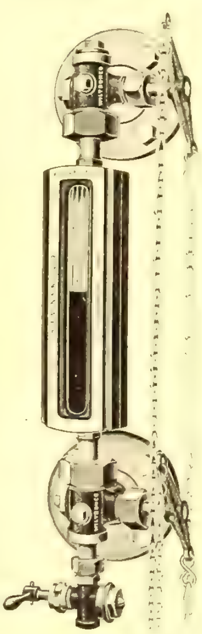
Builders of PUMPING MACHINERY, WATER WHEELS, AIR COMPRESSORS AND POWER PLANT APPARATUS



WILTBONCO

Steam Plant Accessories

Awarded Gold Medal at Universal Exposition, St. Louis, 1904.

WILTBONCO GAUGE MOUNTINGS AND REFLEX WATER GAUGES

are used by all the principal navies of the world, merchant marine, and for locomotives, automobiles, stationary and portable boilers.

"THE WATER SHOWS BLACK"

Especially adapted for high pressure

ZAHFEST GLASS (non-breakable)

For Lamps, Ventilators, Car Windows, etc.

CUSHION PRESSURE SEATED CONTROL COCKS

For all Liquids and Gases.

"FREEPORT" VALVES For all purposes, but particularly designed for high pressures and superheated steam.

"SAFETY" Plastic Metallic Packing

COOPERITE SHEET PACKING

For high pressures and superheated steam, acids, ammonia, etc.

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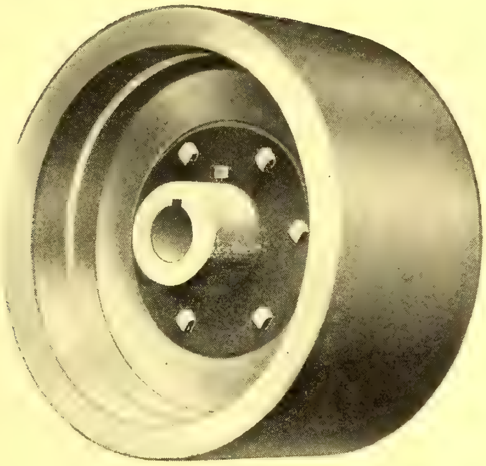
THE WM. T. BONNER COMPANY, Engineers, Contractors and Manufacturers

Boston Office, 246 Summer St. **New York Office, 141 Broadway.**

XYLOTITE
(FIBRE)
PULLEYS
AND
FRICTIONS



Strongest Pulley with the Strongest Pull

THE XYLOTITE PRODUCT CO.
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GOLDEN-ANDERSON VALVE SPECIALTY CO.

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Sole Manufacturers of

Anderson Cushioned Non-Return Valves

Anderson Reducing Valves

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Golden Tilting Steam Traps

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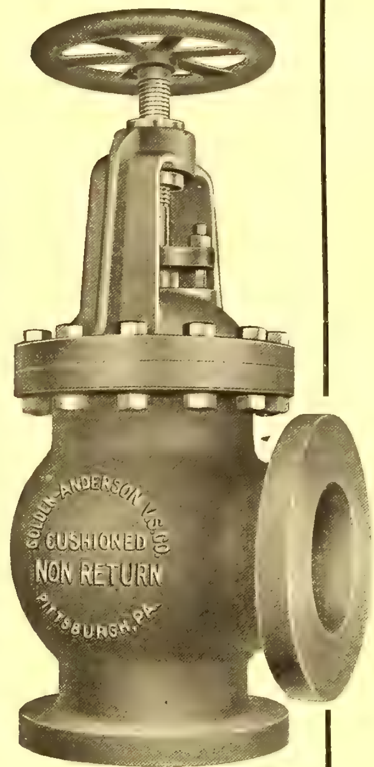
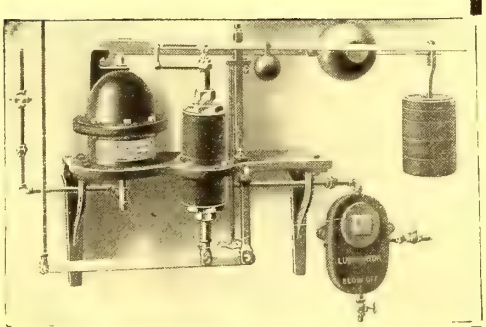
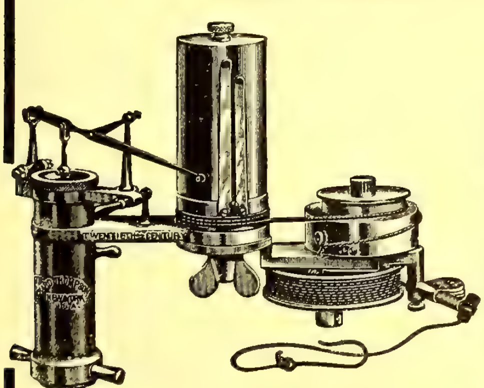


The Anderson Cushioned Non-Return Valve, Angle or Globe.

Two for Economy

One to keep tabs on your engine, one to control your draft and maintain a uniform pressure.





The THOMPSON INDICATOR and DAMPER REGULATOR should be in every Railway Power Plant. We can tell you why.

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WESTERN AGENTS
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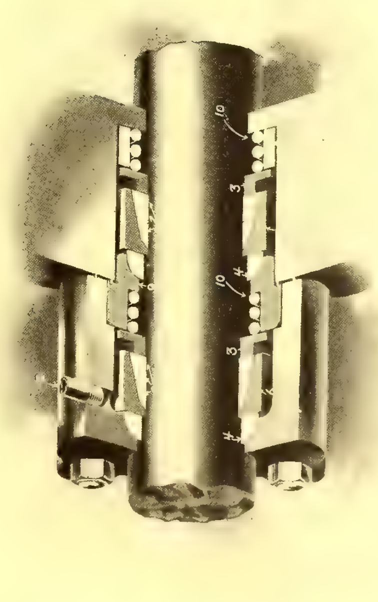
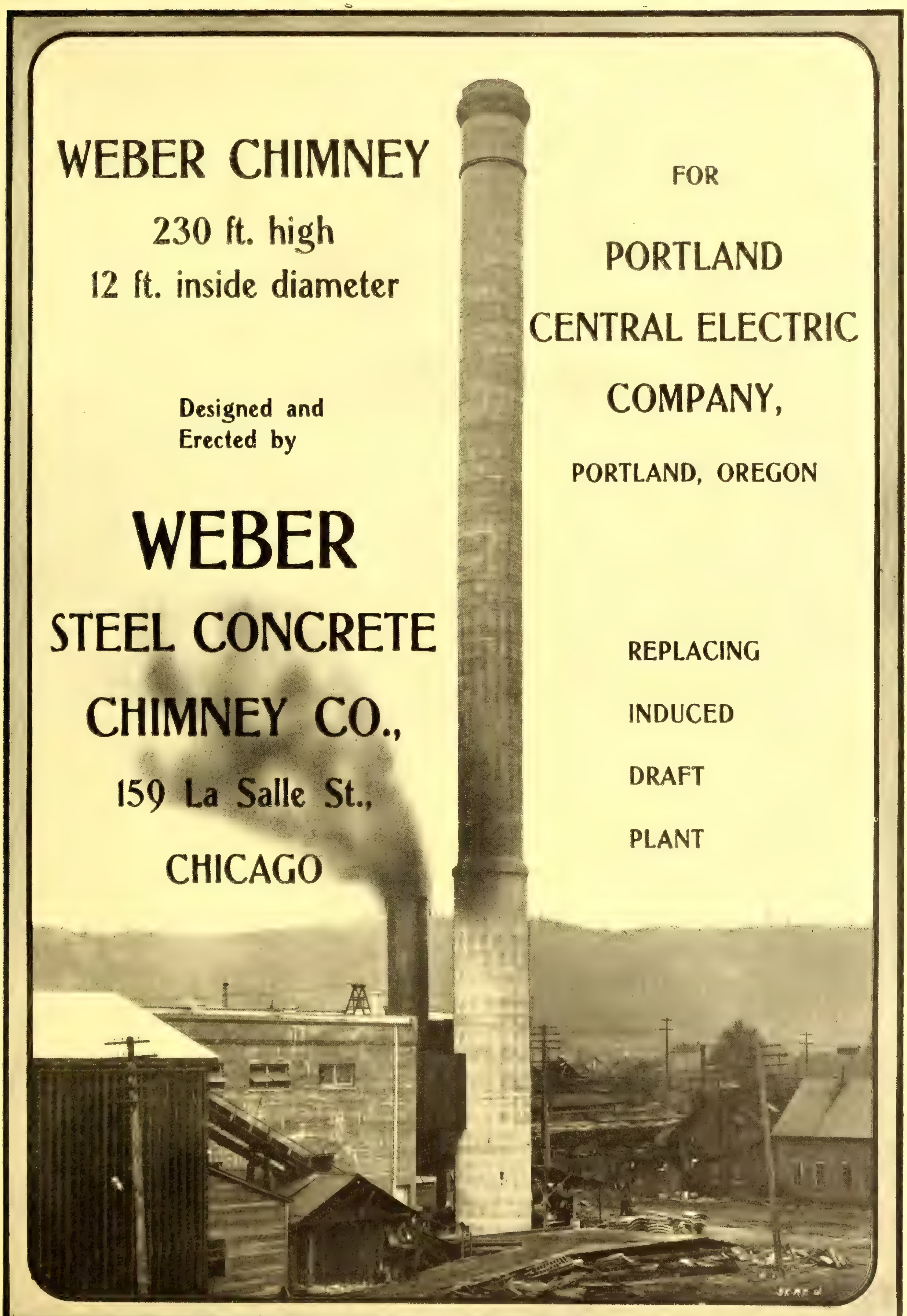


The U. S. Metallic Packing Co.
Philadelphia and Chicago


WEBER CHIMNEY
230 ft. high
12 ft. inside diameter
Designed and
Erected by
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STEEL CONCRETE
CHIMNEY CO.,
159 La Salle St.,
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FOR
PORTLAND
CENTRAL ELECTRIC
COMPANY,
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REPLACING
INDUCED
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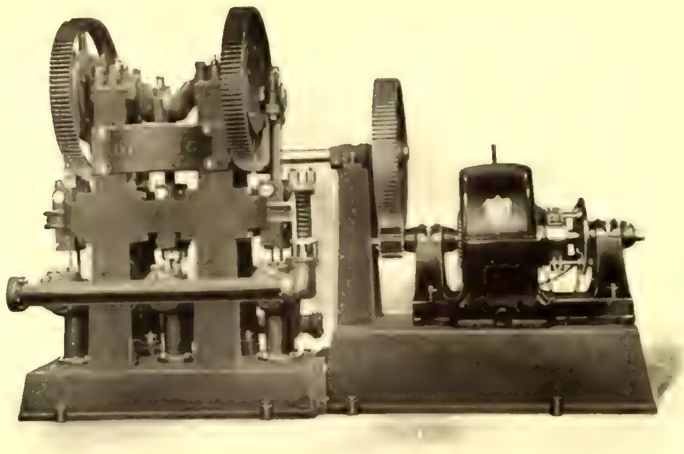
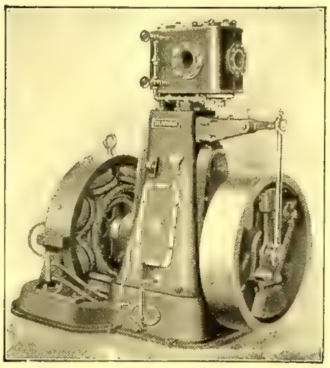
PLANT



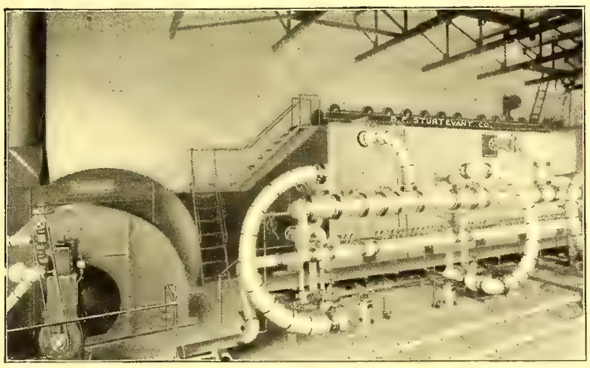
STURTEVANT



GENERATING SETS

Are built in a line of 36 sizes, ranging in capacity from 3 to 100 K.W., with simple vertical and horizontal, and compound vertical engines. Entirely enclosed, with forced lubrication and watershed partitions. Especially adapted as boosters.

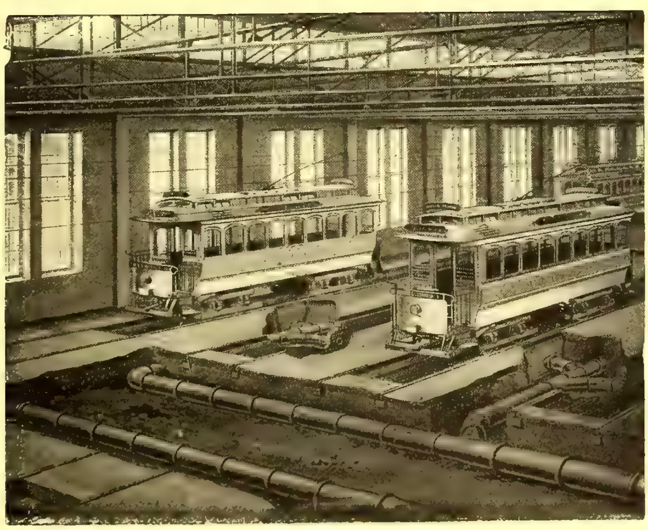
Economizers and Mechanical Draft



Increase boiler capacity and efficiency. The Economizers are built with staggered pipes and metal-to-metal joints—no gaskets.

The Mechanical Draft Fans are built for endurance. They save cost of chimney and burn the cheapest fuels.

System of Heating Car Barns



Instantly melts snow and ice from the running gear.

Facilitates cleaning and repairs. Warms the entire barn.

Air is heated by live or exhaust steam and forced into pits by means of a fan. The action is positive and rapid.

The entire heating surface is massed in a fire-proof casing in connection with the fan.

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New York **Philadelphia** Designers and Builders of Heating, Ventilating, Drying and Mechanical Draft Apparatus; Fans, Blowers and Exhausters; Steam Engines and Electric Motors and Generating Sets; Fuel Economizers; Forges, Exhaust Heads, Steam Traps, Etc. **Chicago** **London**

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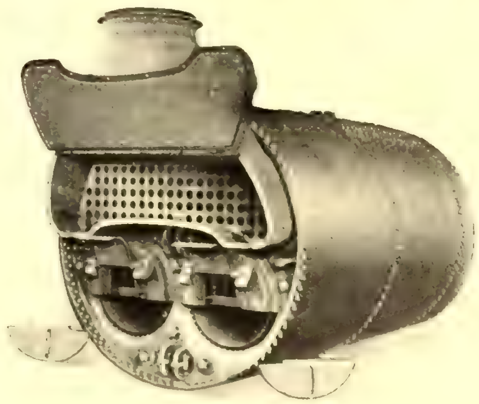
Incorporated Feb. 1, 1870

Builders of POWER PLANTS COMPLETE



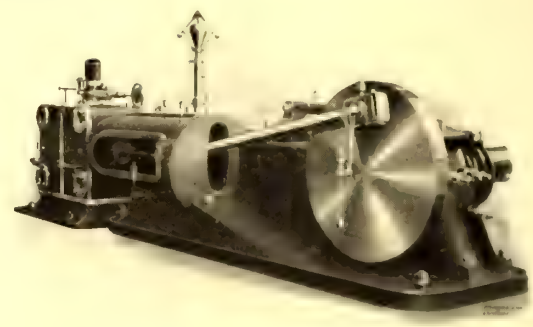
MURRAY TUBULAR, INTERNAL-FURNACE AND WATER-TUBE BOILERS

The Best Designs
First Class Materials
Honest Workmanship

MURRAY CORLISS ENGINES SAVE STEAM
STEAM IS COAL AND COAL IS CASH

SIMPLE AND COMPOUND

Absolutely the Best in Design,
Materials and Workmanship



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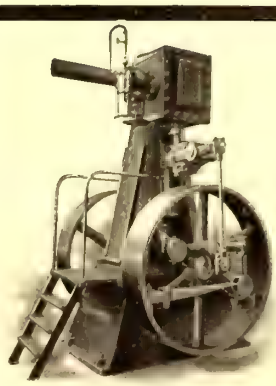

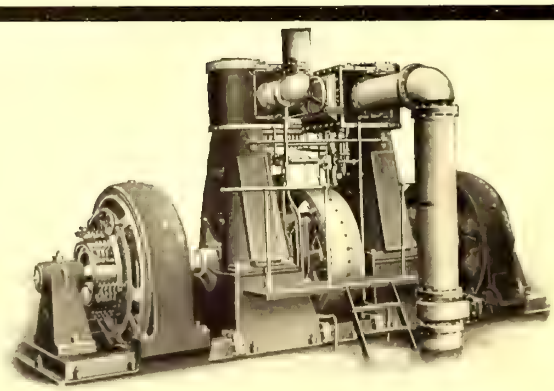

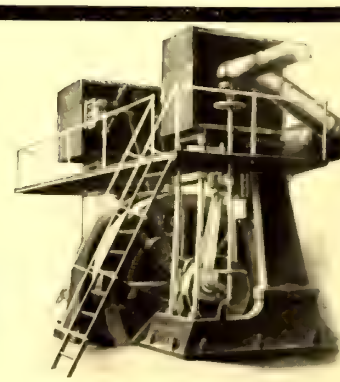

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EXCEL

because of their ability to take care of loads that suddenly undergo extreme variation.

They are economical, too — the coal pile showing that every pound of steam has been used to the best advantage.

As regards their design — every part is easy of access, and any important part can be removed singly without disturbing the other mechanism. See the point?

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THEY RECEIVED AT ST. LOUIS EXPOSITION

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FOR PERFECT, UNINTERRUPTED SERVICE

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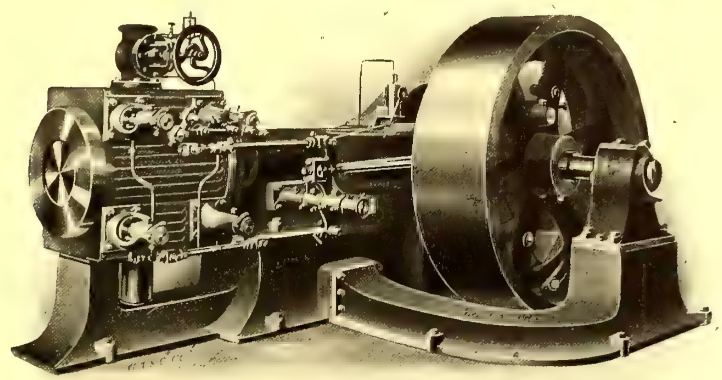

SINGLE CYLINDER FLEMING FOUR-VALVE ENGINE
(Also Built Compound, 100 to 2000 H.P.)

WE need hardly say that the best Prime-Mover is that which honestly and actually shows:

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These points may easily be determined if you will take but a little time to investigate.

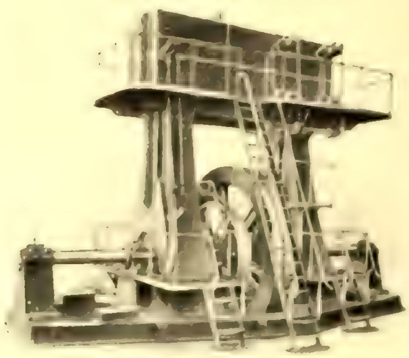
3d:—That its efficiency when measured in NET HORSE-POWER is the very highest.

4th:—That over Varying Loads the rate of steam consumption is most nearly uniform.

5th:—That it be so practical that these results and long life may be obtained with ordinary attendance.

FLEMING ENGINES WILL, WHEN SO VIEWED, SHOW BETTER THAN THERE IS ANY RECORD OF

QUINCY ENGINE WORKS QUINCY, ILL.



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it is in the Street Railway Power-house.

You want an engine on which you can depend. We can give it to you.

Horizontal Corliss Type or
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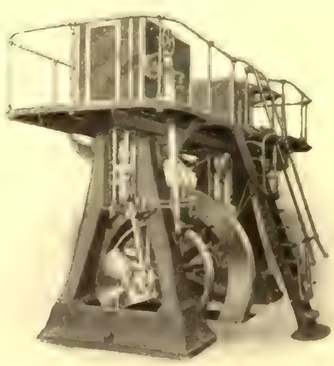

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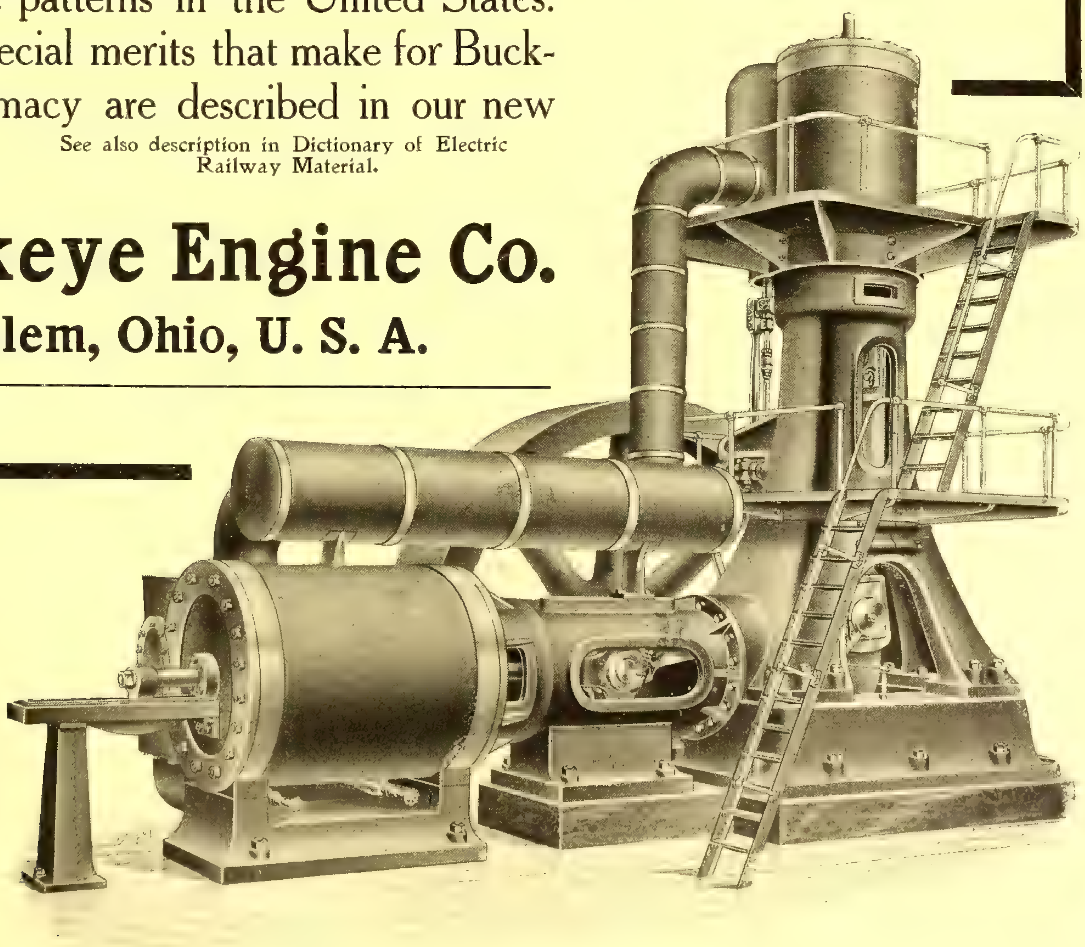

LMERS CO
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Bullock Railway Generators

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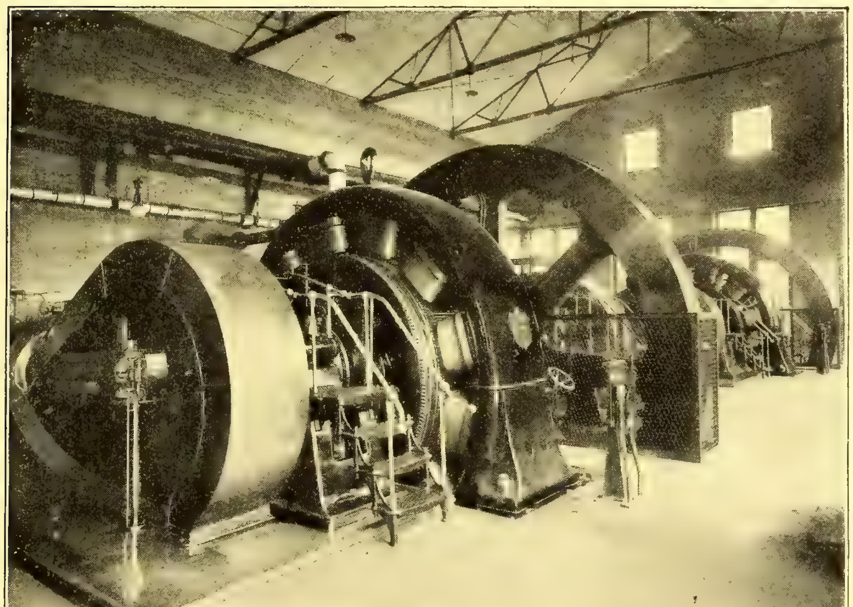
For Street Railway Purposes



Two 1000 k.w. Bullock Railway Generators installed at the PHILADELPHIA RAPID TRANSIT CO.

Highest Performance—Simple in Operation
Low Running Temperature
Built in all capacities up to 10,000 k.w.

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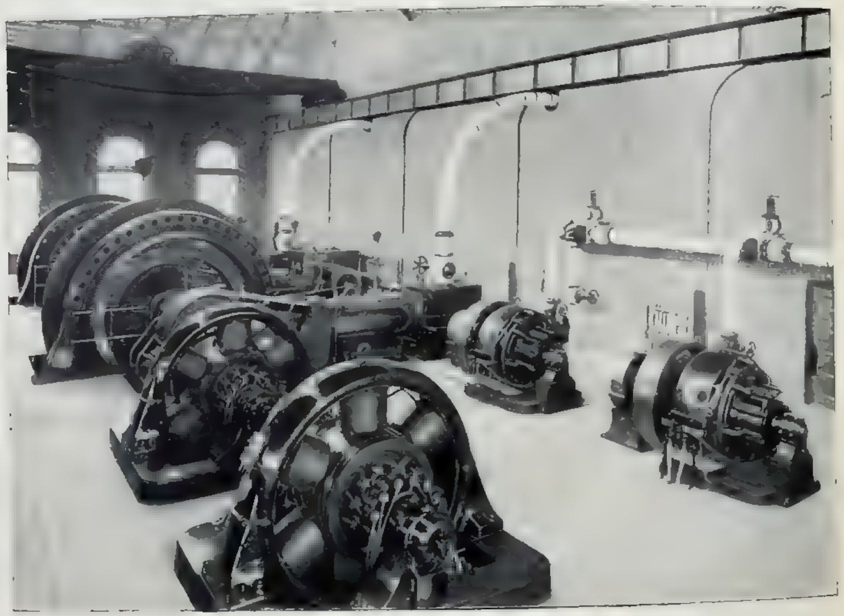
ALLIS-CHALMERS CO
MILWAUKEE WIS U S A

Bullock Rotary Converters

For Electric Railway Systems



Two 400 k.w. Bullock Rotary Converters installed in Main Station of the Scioto Valley Traction Co.

High Efficiency—Good Commutation
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Finest Workmanship—Best Material
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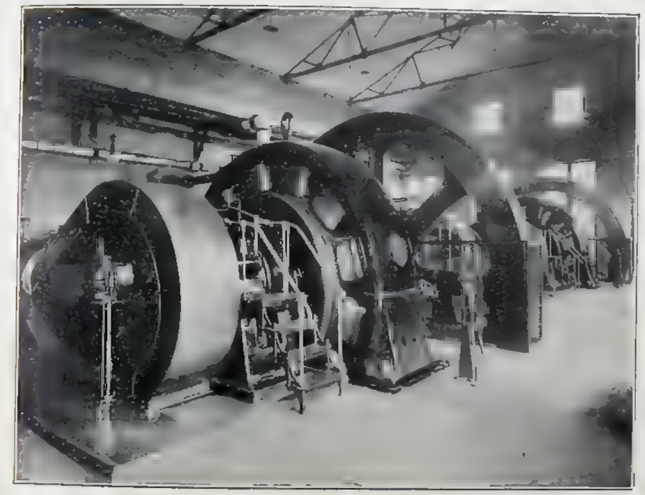
For Street Railway Purposes



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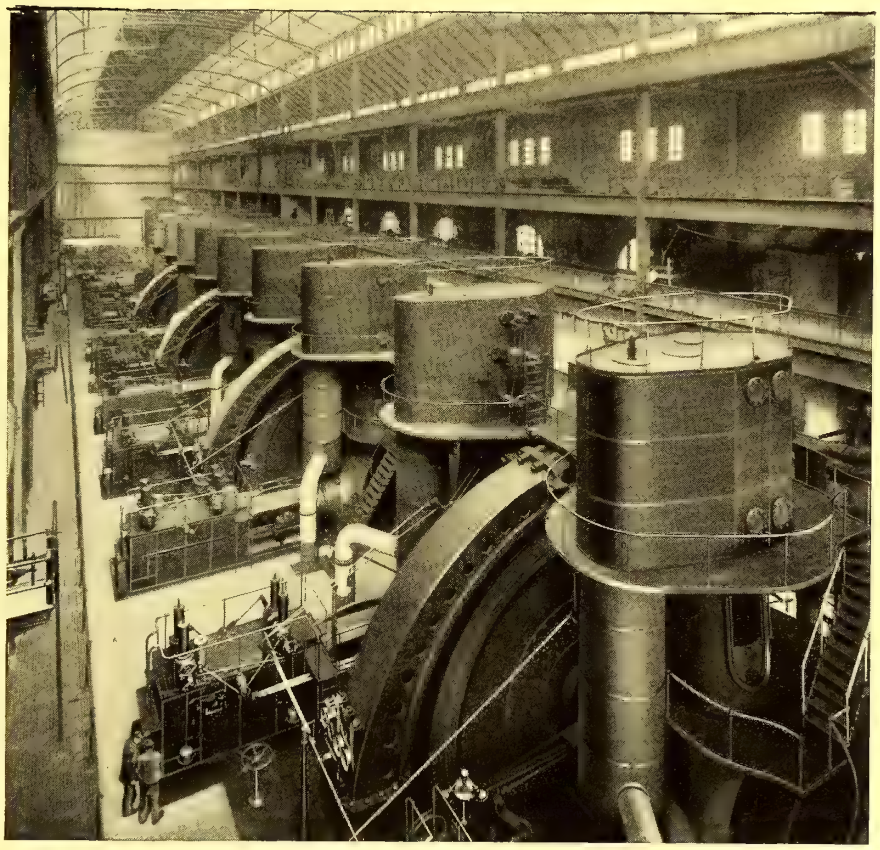
Our Most Powerful Testimony
is the
Record of our Achievement



Subway Power-House, New York, containing Nine 12,000 horse-power Allis-Chalmers Engines.

Our Reynolds Vertical Engines are installed in most of the leading large stations of this country and abroad.

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STEAM
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ELECTRICITY

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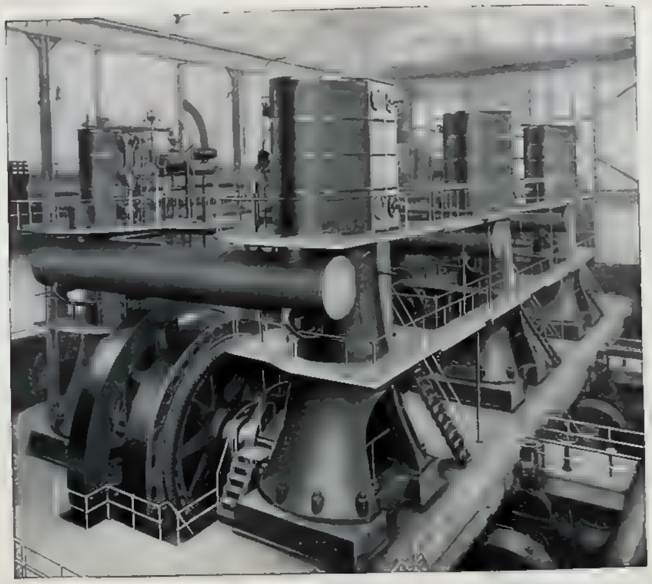
ALLIS-CHALMERS CO
MILWAUKEE WIS U S A

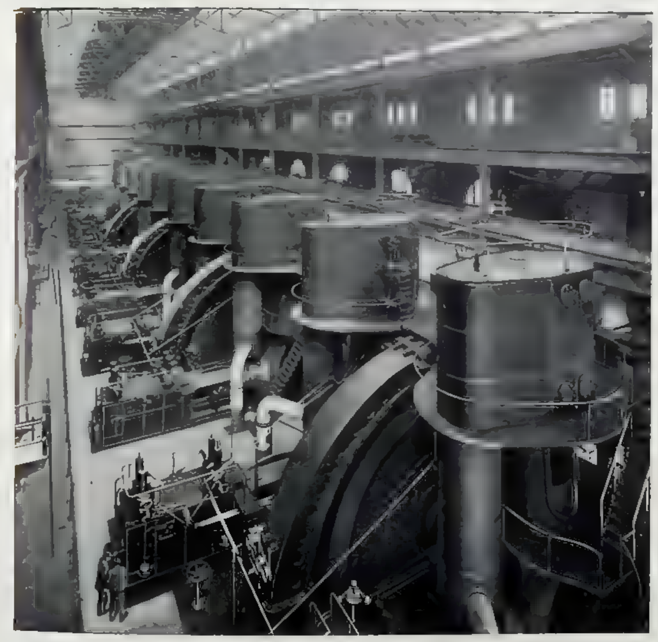
Reynolds Vertical Engines



Three 5,000 horse-power Reynolds Vertical Engines installed in Grand Avenue Station of the Metropolitan Street Railway Co., Kansas City, Mo.

Especially Adapted for Street Railway and Lighting Work.

Our Most Powerful Testimony is the Record of our Achievement



Subway Power-House, New York, containing Nine 12,000 horse-power Allis-Chalmers Engines.

Our Reynolds Vertical Engines are installed in most of the leading large stations of this country and abroad.

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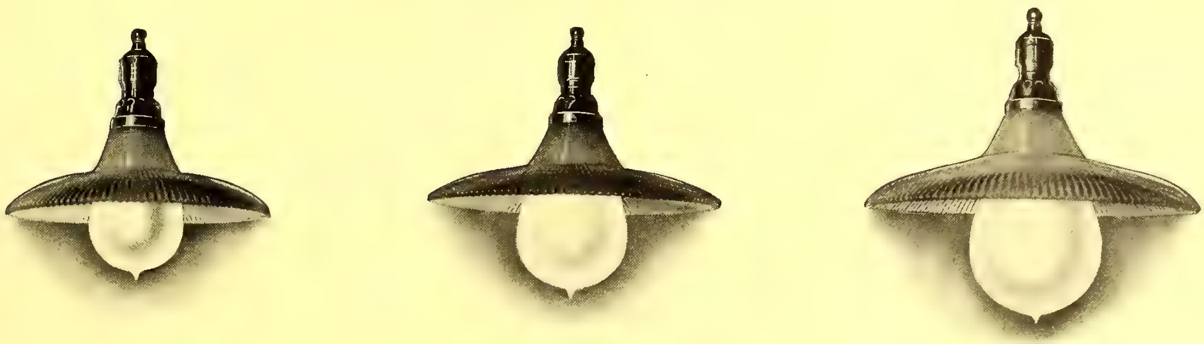
General Electric Company

The G. E. M. Lamp

For Railway Service



Nos. 3, 4 and 5 G. E. M. lamps with distributing Holophane Pagoda reflectors.

The high candle-power units of the new metallized carbon filament high efficiency incandescent lamps are especially suitable for lighting railway park buildings, car barns, waiting-rooms and offices.

Useful life equal to the present standard 16 C.P., 3.1 watts per C.P. Edison lamp. Consume 2.5 watts per mean horizontal candle-power.

Nos. 3, 4 and 5 G. E. M. lamps with concentrating Holophane Pagoda reflectors
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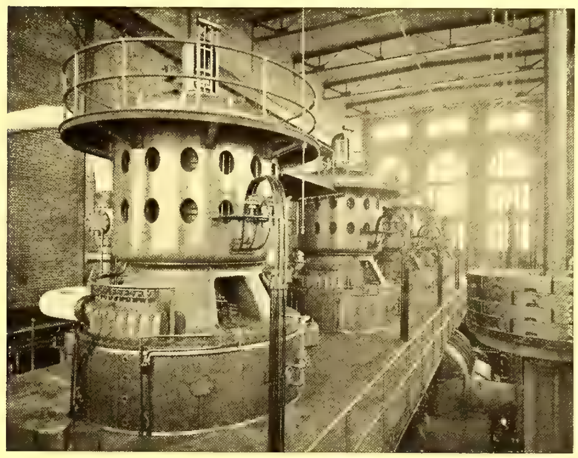
General Electric Company

Railway Power Station Equipments.

The model railway power station of to-day is a simple combination of Curtis Steam Turbine Generators, G. E. three-phase transformers and rotary converters, all controlled from a central switchboard equipped with G. E. instruments and high tension oil switches.

These illustrations show the power plant of the Quincy Street Railway Company, Quincy, Mass.



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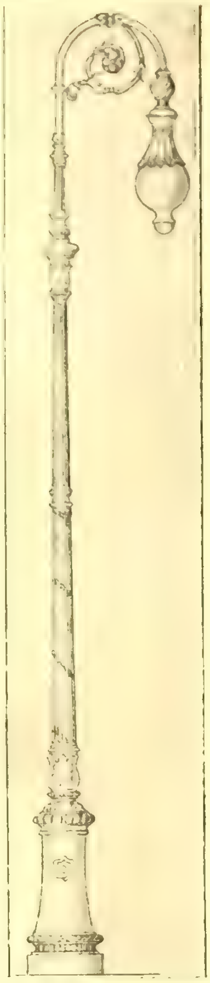

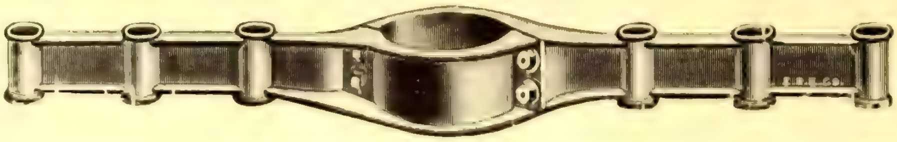

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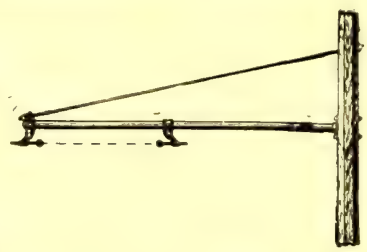

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It will save labor and wear.
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It has been and is doing this on some 49 roads on which it is a standard product.

Let us send you a trial order.

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The Quality and Design

OF ELECTRICAL SUPPLIES

For Street Railway, Mine and Industrial Plants,

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As RELIABLE and REPRESENTATIVE MATERIALS GUARANTEED in EVERY RESPECT, our line will interest you. *May we quote you prices?*

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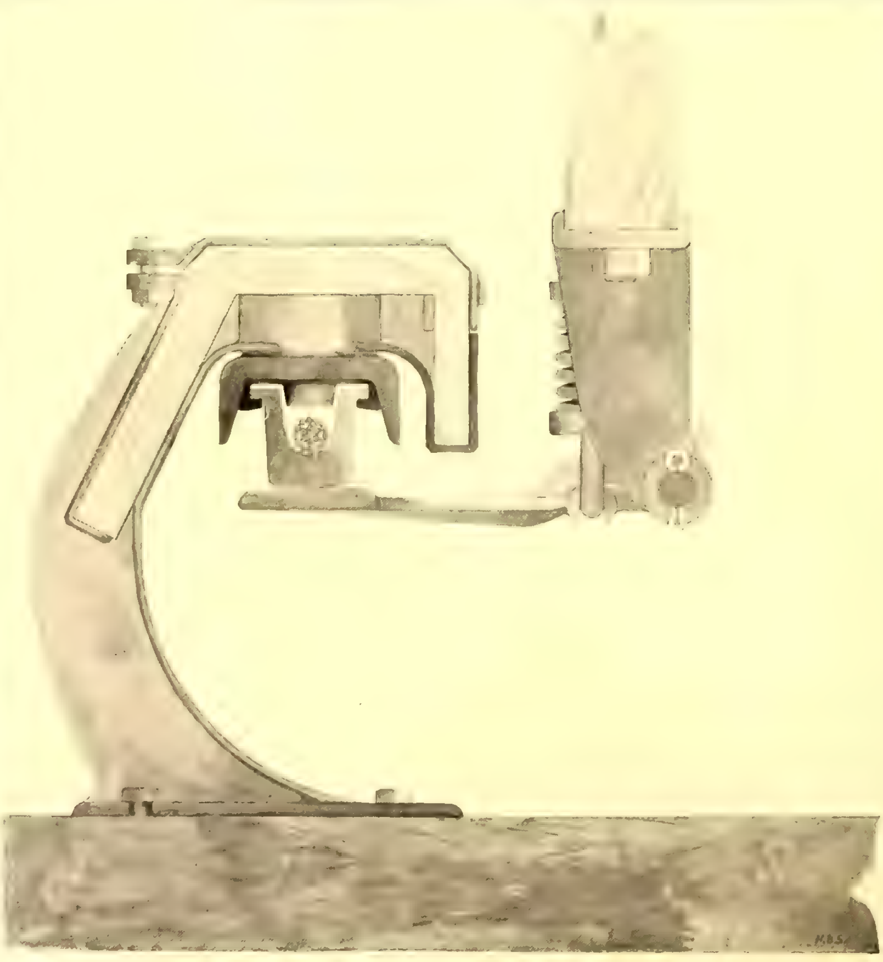

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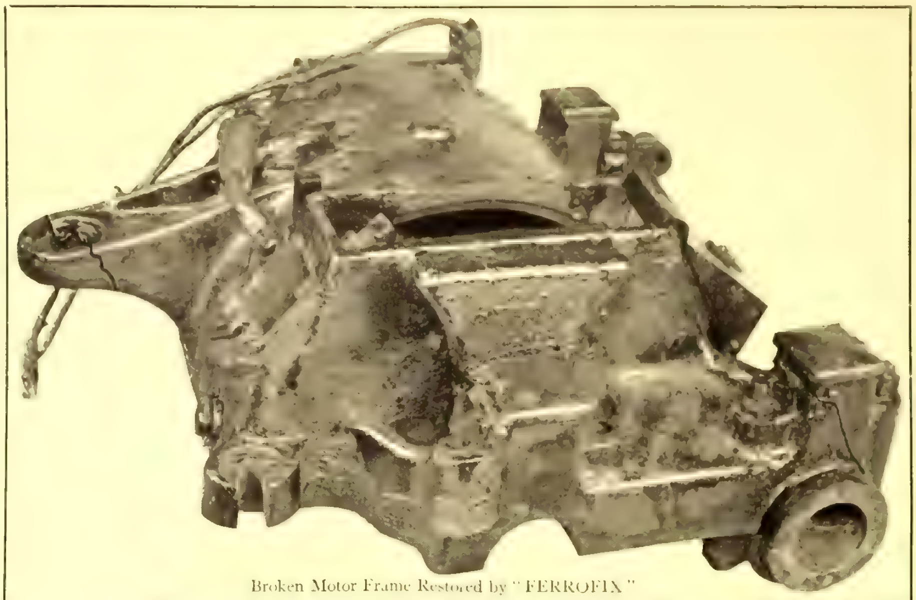

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Time Contracts for Repair Work at Very Reasonable Rates

Consultation Solicited

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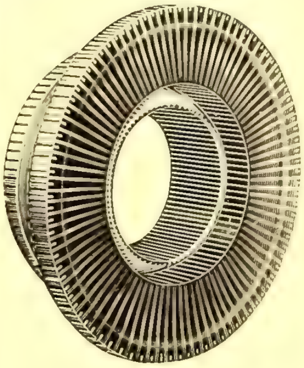

Complete Commutator

Replacing commutator Segments

by inferior ones is mighty poor economy. A defective segment may cause disastrous delay at a critical time. We have demonstrated the superiority of our harddrawn copper bars. The proof is yours for the asking. We repair commutators and make new ones, using pure, smooth, hard drawn copper bar and soft Canada Amber Mica.

Size, weight, quality and durability guaranteed. Write us.

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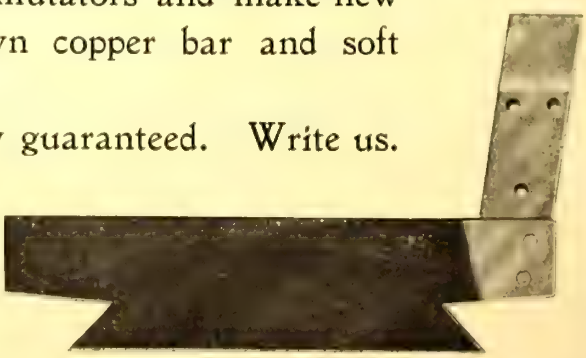
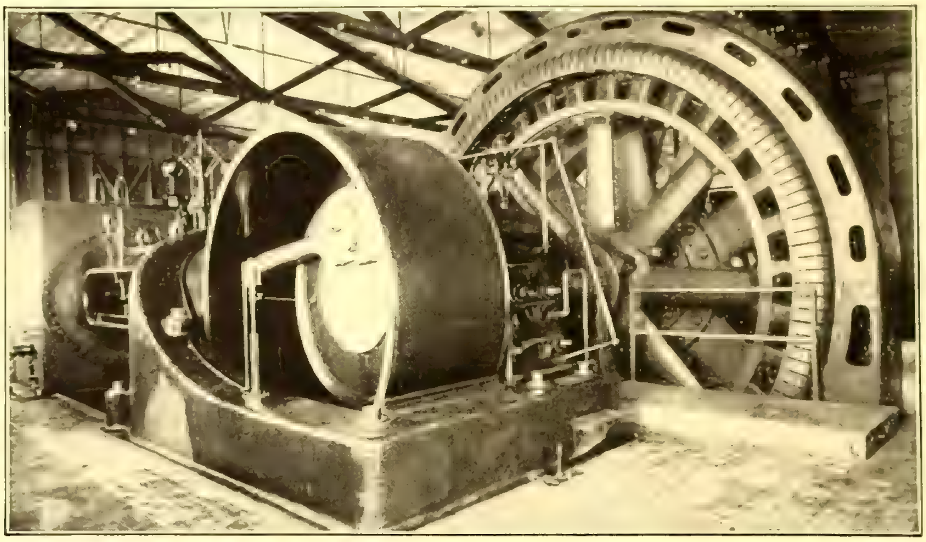


Commutator Segment, with Lug for Armature Leads

ST. R'Y JOURNAL

Second=Hand Electrical Machinery



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The above 1800 Kw. Unit, with Cross=compound engine; Generator, General Electric manufacture, 25 cycle, is one of the many high grade units we have available for immediate shipment. Full details furnished.

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MAIN OFFICE

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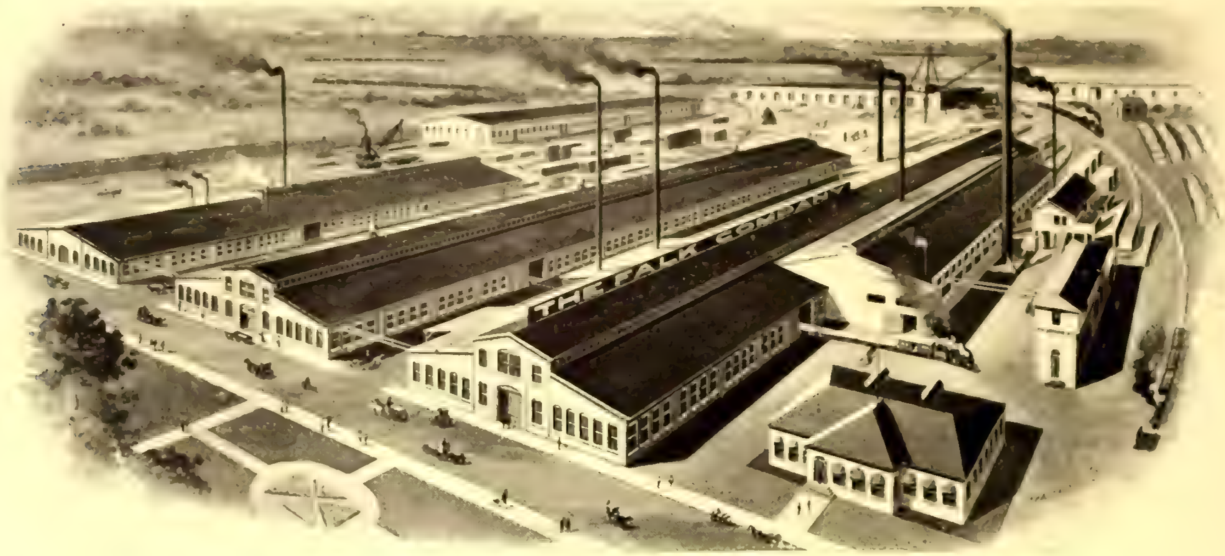
THE FALK COMPANY, Milwaukee Wis., U.S.A.



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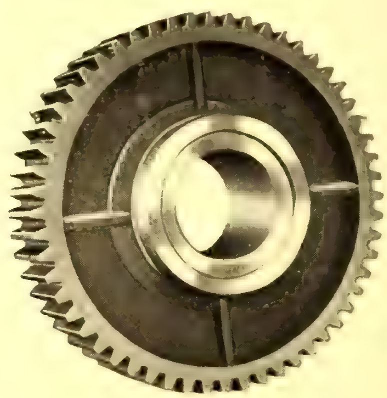

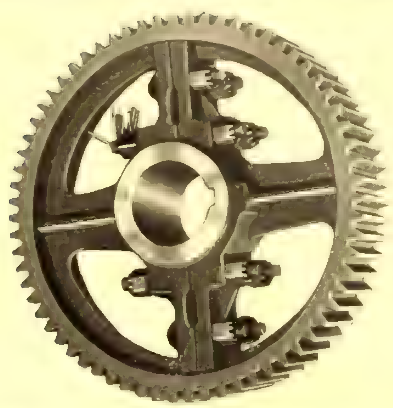

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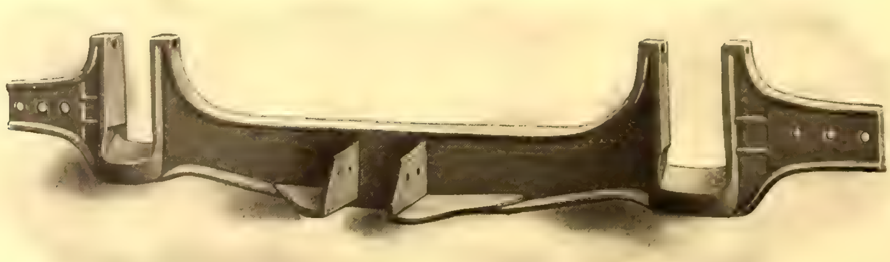

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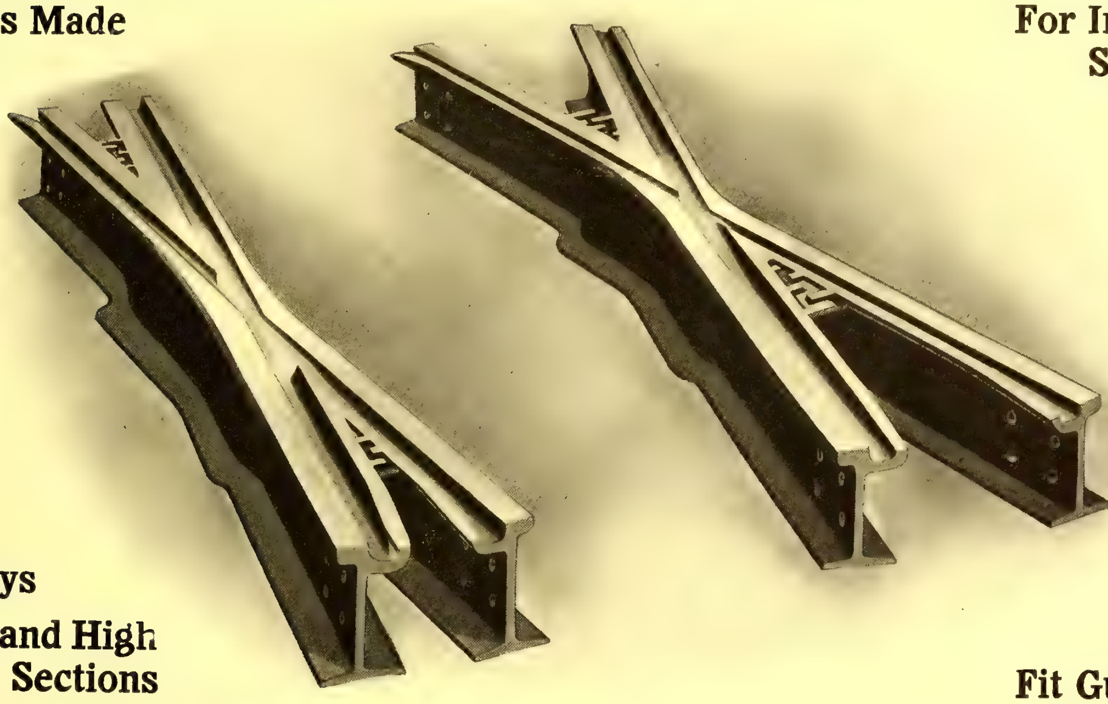

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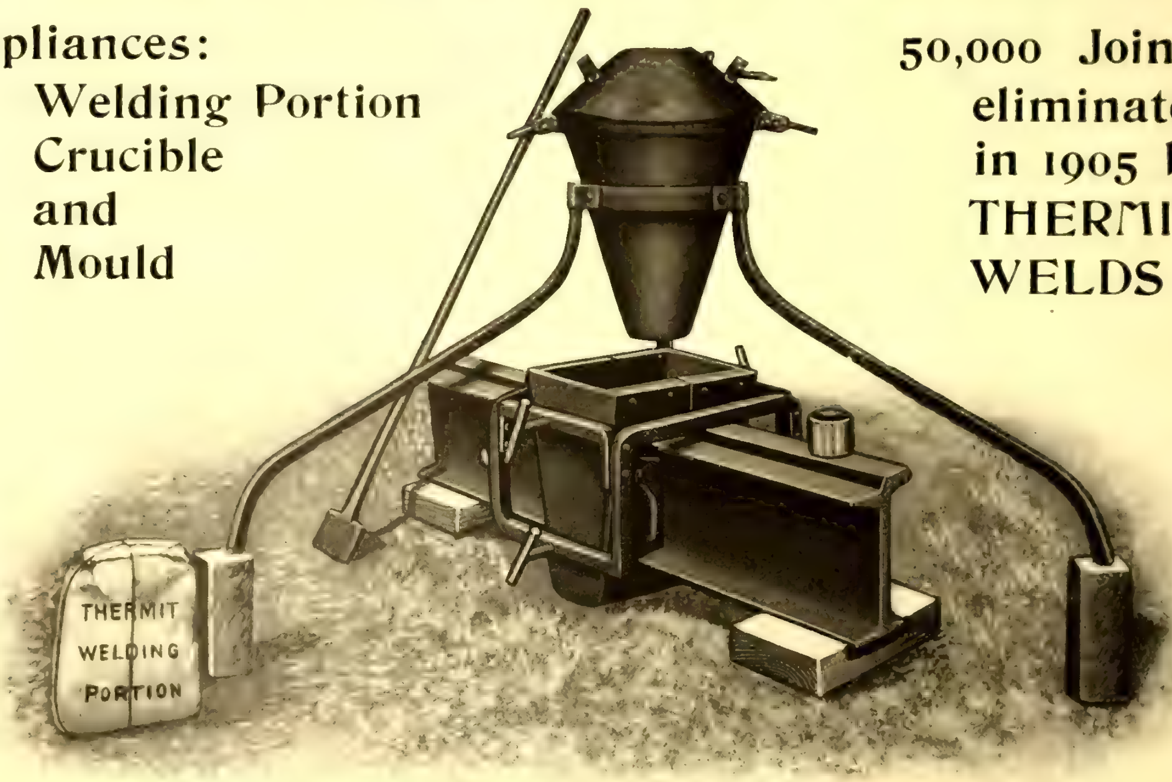

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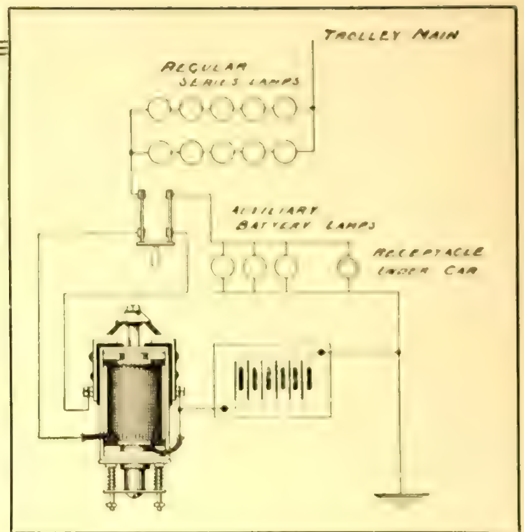

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CONTENTS.

PART I. General Discussion of Street Railway Systems and Conditions Governing Them. PART II. Inadequacy of Present Terminals and Service With Recommendations for Improvement Under Divisional Ownership. PART III. Growth of Population and Development of the Transportation Business, with a Discussion of Probable Future Increase and an Analysis of Capitalization and Financial Results Obtained in Past Operation. PART IV. Through Routes, Universal Transfers, and the One-City-One-Fare Question. PART V. Discussion of a New, Reorganized and Unified System of Street Railways for Chicago. PART VI. Technical Problems, Valuations and Estimates.

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CHAPTER I describes plans for a high-level and a low-level subway. The method of construction is clearly shown by eleven folded plates [see list]. In making these subways disposition has been made of all public utilities, such as water mains, gas mains, sewers, telephone, telegraph and power cables

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CHAPTER VI contains unit price estimates, i.e., the itemized cost of producing complete one mile of track using ten different types of construction.

CHAPTER VII contains itemized valuation estimates of the entire equipment of the various railway companies operating in Chicago. These include estimates on the cost of track, paving and trolley construction; power stations; rolling stock; and real estate. These cost estimates are supplemented by an analysis of the depreciation.

CHAPTER VIII contains data similar to those in the preceding chapter, except that the valuation estimates are made on certain grants which expired at a date earlier than July, 1903.

CHAPTER IX deals with the most interesting part, namely, the cost estimate of the construction and operation of the proposed subway and surface lines.

LIST OF FOLDING PLATES.

I. Typical Cross Section of Double Track Subway in 80 Foot Street over Large Tunnel. II. Typical Subway in 66 Foot Street over Small Tunnel. III. Typical Subway in 80 Foot Street at Station Point. IV. Typical Plan of Station Entrances on Subway Streets. V. Typical Plan of Station Entrances on Intersecting Streets. VI. Typical Longitudinal Section Through Subway Station. VII. Typical Cross Section of Single Track Subway in Wabash Avenue for Ascent to Elevated Structure. VIII. Typical Plan Showing Method of Passing Wires Under Station Platforms. IX. Typical Station at Intersection of High and Low Level Subways. X. Typical Underground Conduit Railway Construction. XI. Typical Underground Conduit Railway Construction, Showing Detail of Manholes. XII. Comparative Population Curves of Different Cities. XIII. Curves of Population Increase and Yearly Rate Decrease of Rate of Increase. XIV. Curves Showing Future Population of Chicago and Gross Passenger Receipts, covering a period of 52 years from January 1st, 1900. XV. Curves Showing Future Operating Expenses of a System of Street Railways for Chicago Capable of Earning the Gross Receipts shown on Plate 14.

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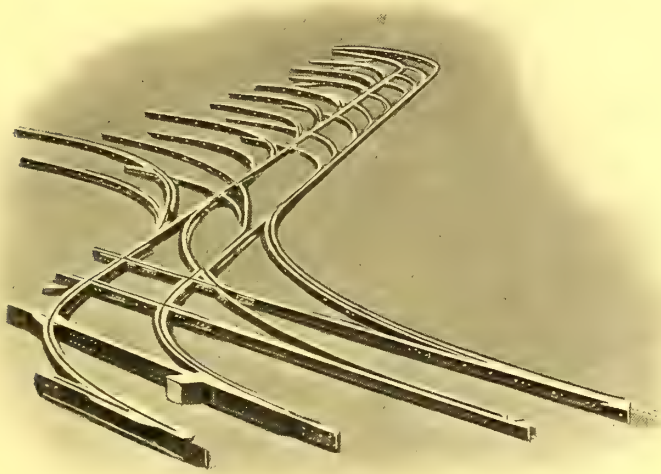

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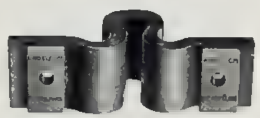

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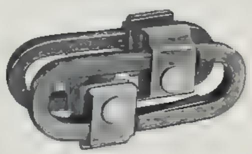

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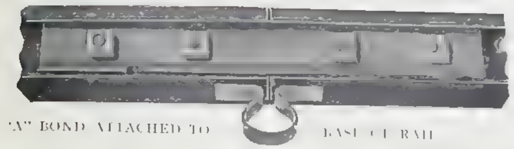

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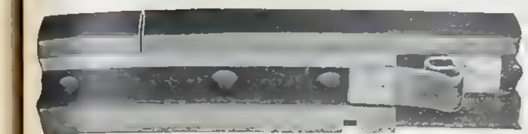

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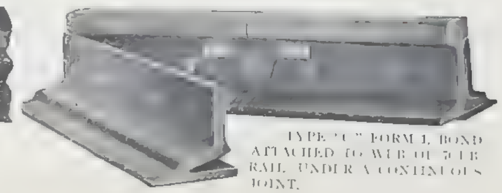

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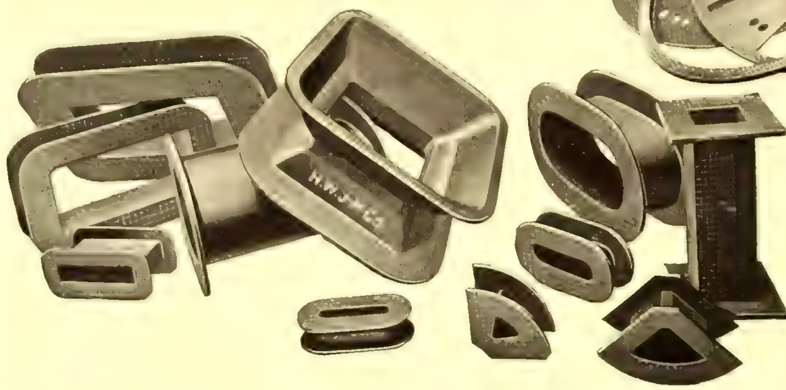

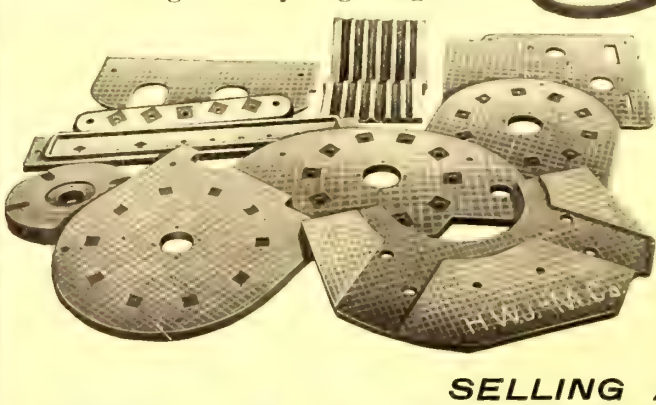

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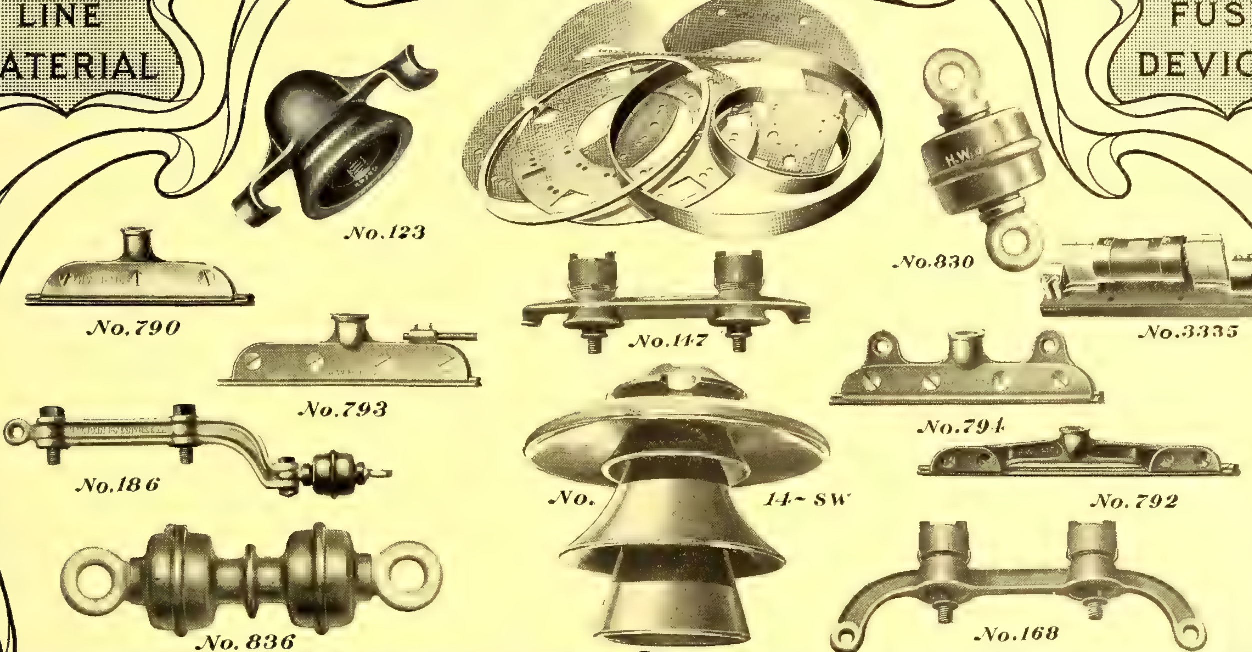

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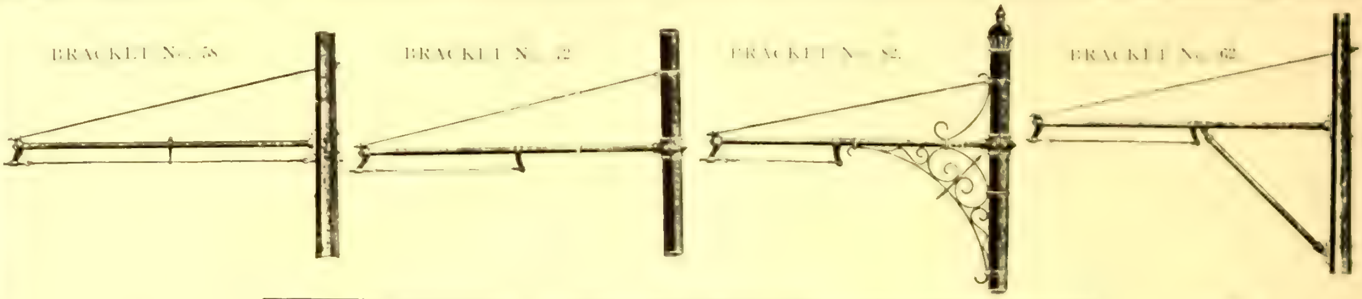
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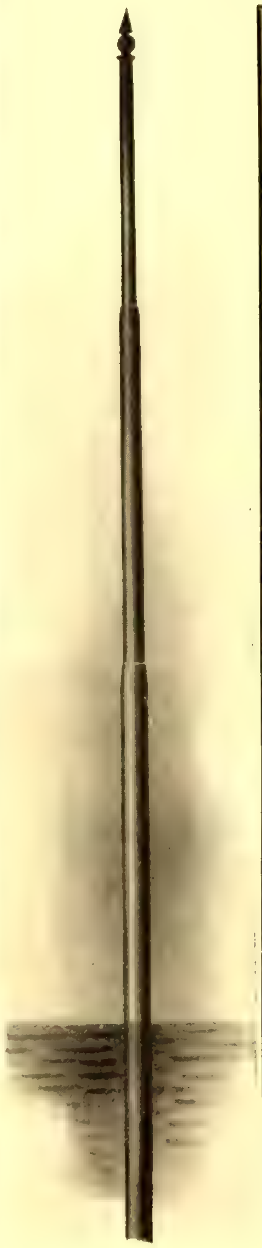

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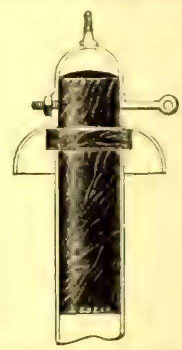
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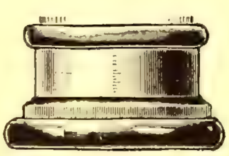
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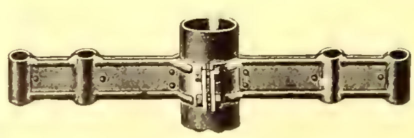
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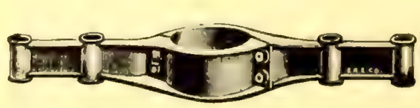
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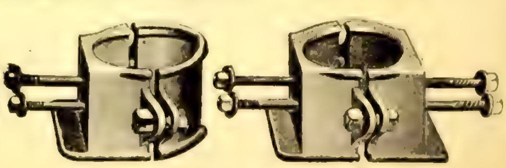
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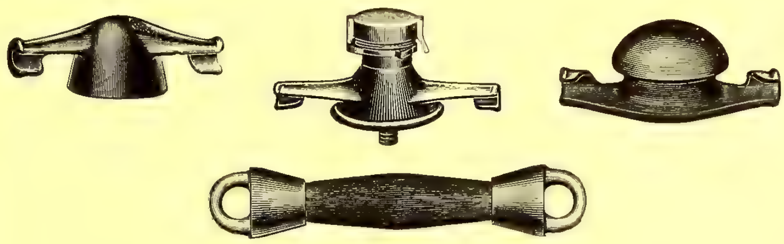

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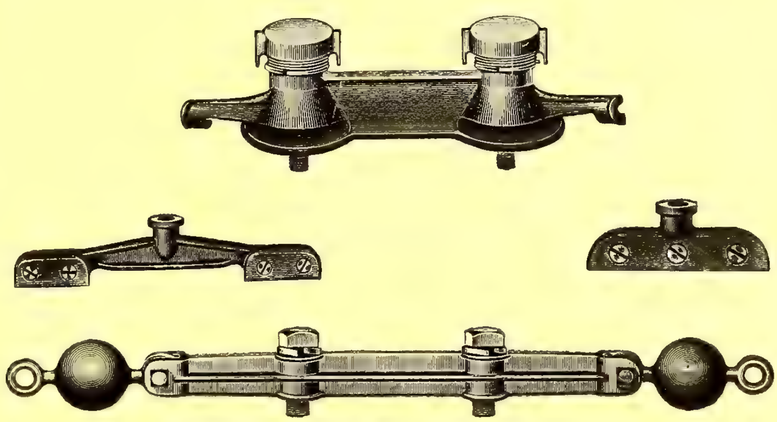

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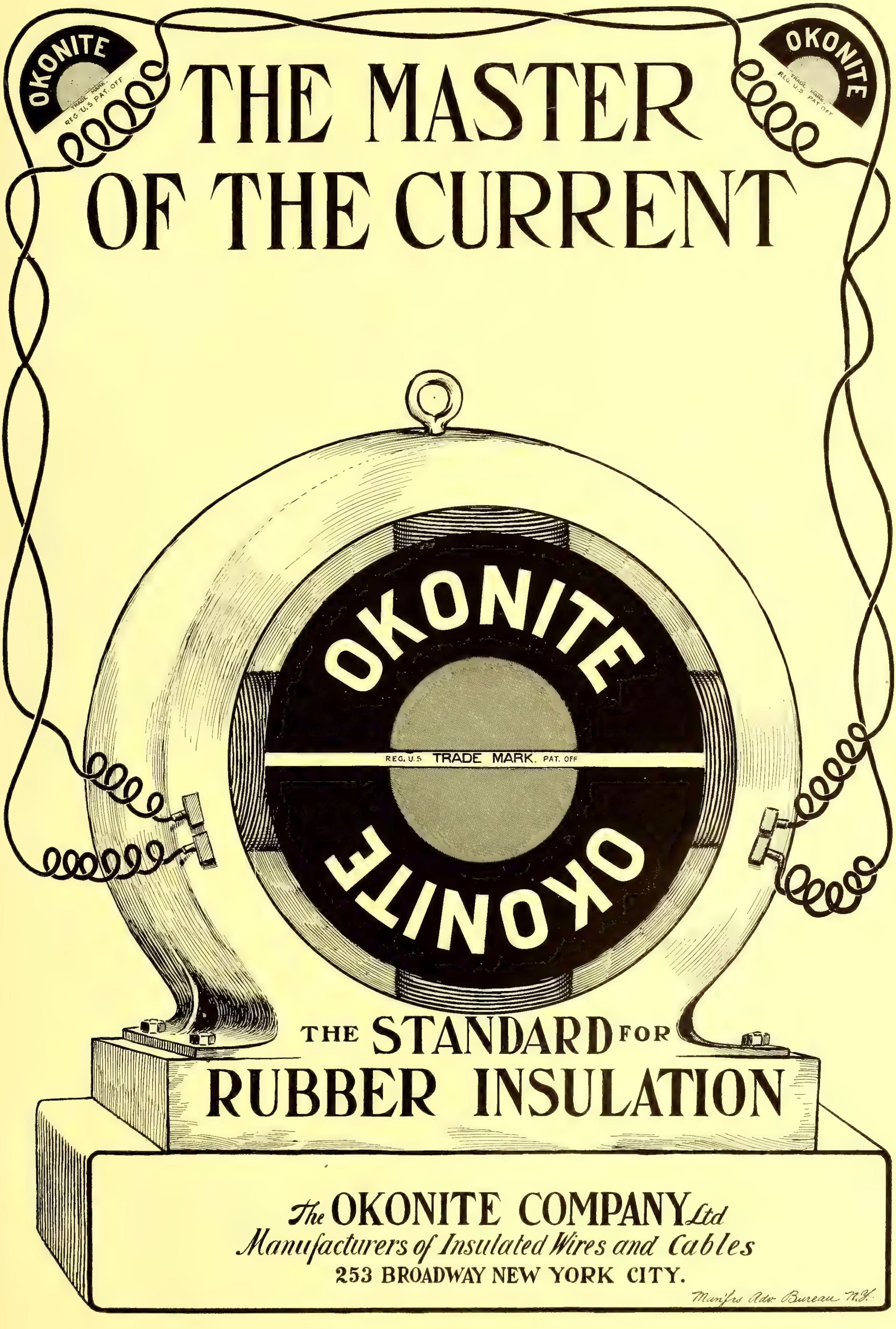
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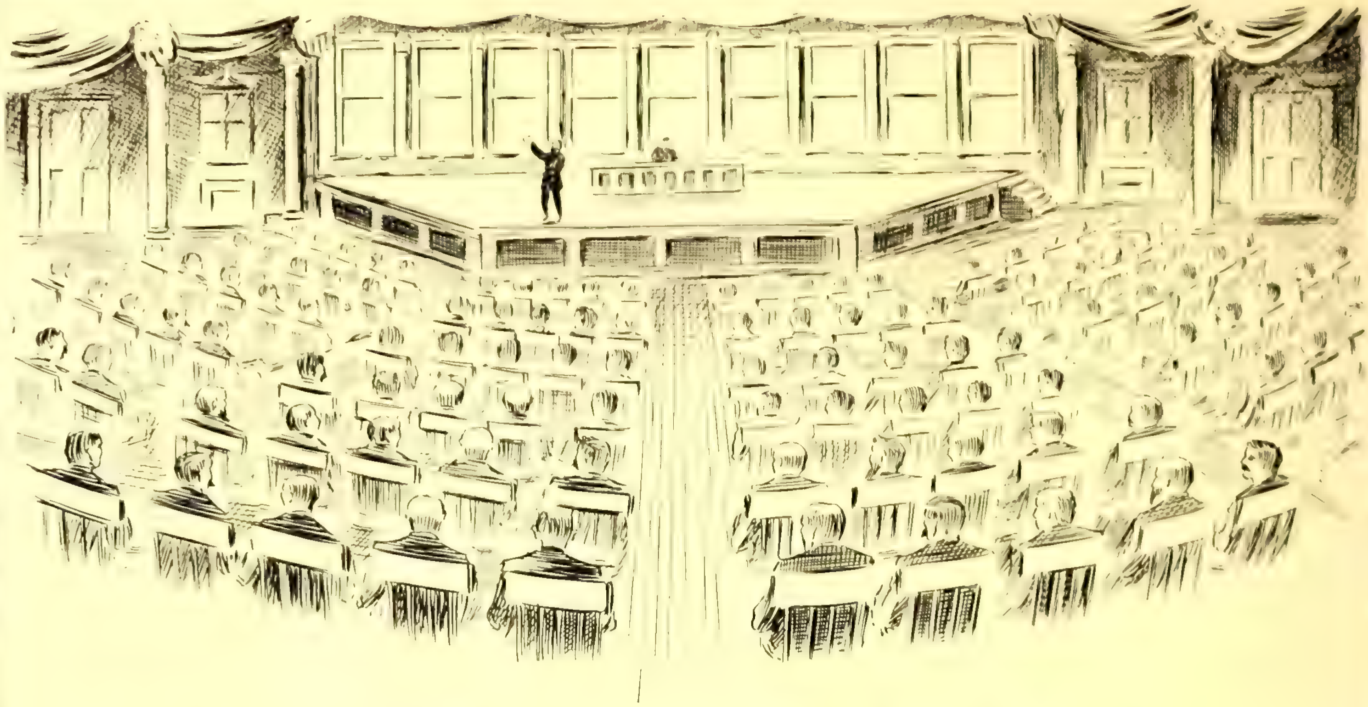

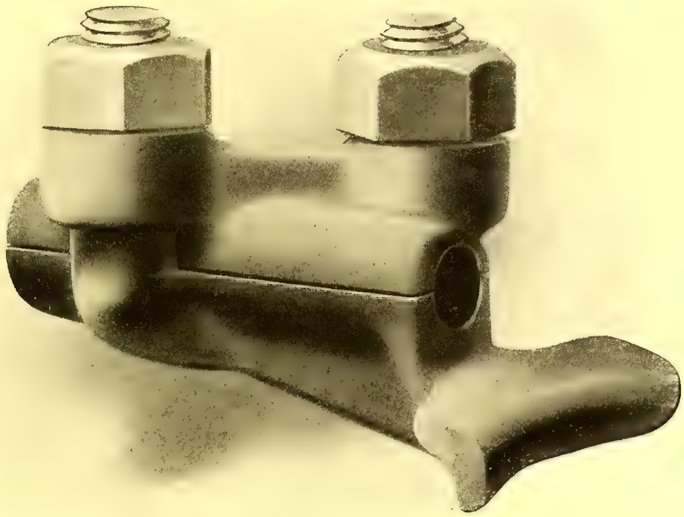

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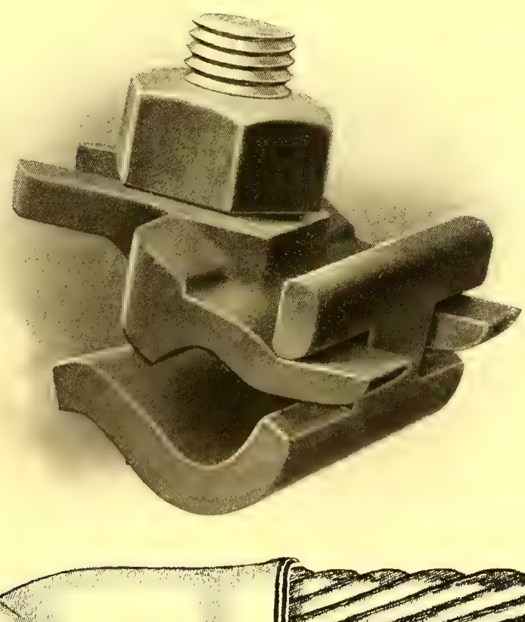

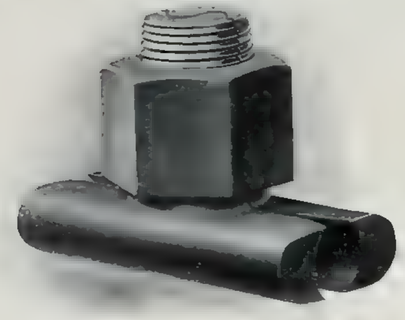

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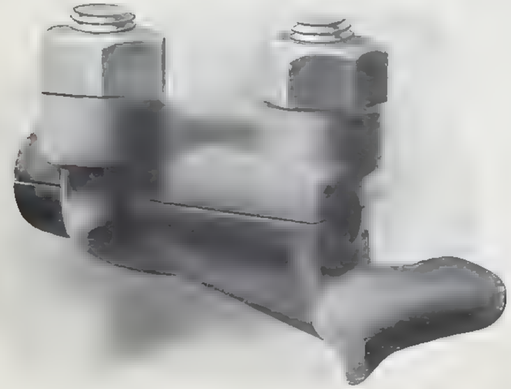

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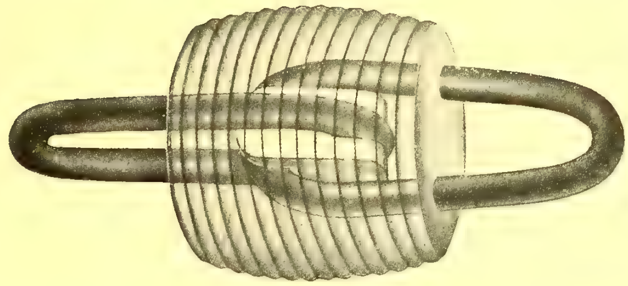

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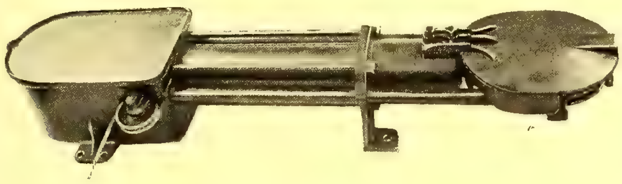

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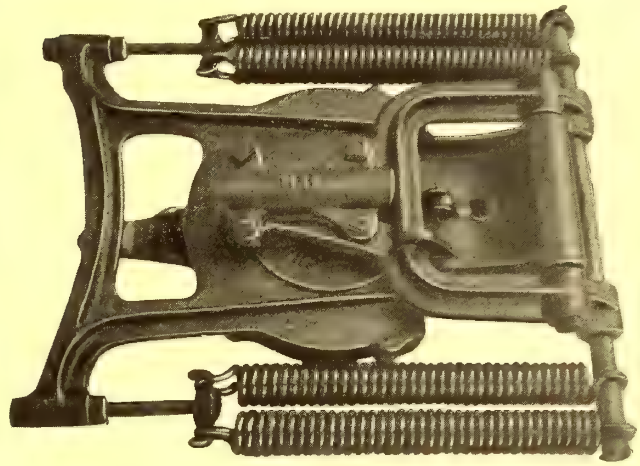

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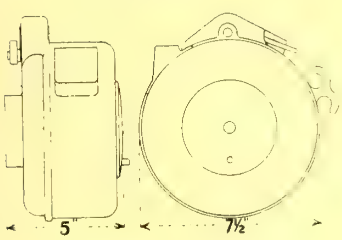

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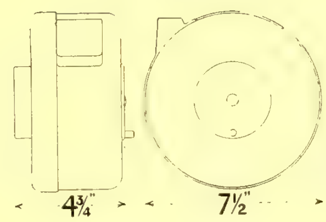


Weight 9 lbs.

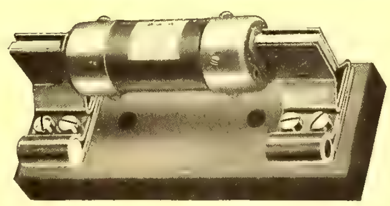
DON'T OVERLOOK THE FACT THAT WE ARE THE

Pioneers in the Enclosed Fuse Industry

30 Ampere, 600 Volt, Cut-out Nat. Elec'l Code Standard

When you really want the best

BUY "D. & W."



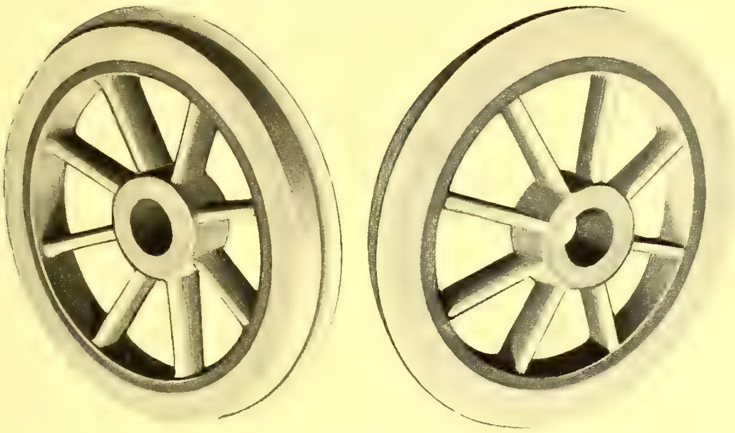
200 Ampere, 250 Volt, Cut-out Nat. Elec'l Code Standard

D. & W. FUSE CO., PROVIDENCE, R. I.

A. HALL BERRY, New York Representative, 97 WARREN STREET

AGENCIES

BOSTON—Pettingell-Andrews Co.
PITTSBURG—Western Electric Co.
ST. LOUIS—Western Electric Co.
NEW YORK—Western Electric Co.
CINCINNATI—Standard Elec. Co.
ST. PAUL—American Electric Co.
PHILADELPHIA—Western Elec. Co.
KANSAS CITY—Western Elec. Co.
SAN FRANCISCO—Cal. Elec. Works
CHICAGO—Central Electric Co.
DENVER—Western Electric Co.



The Woodworth-Engert Co.

CLEVELAND, OHIO

Steel Tired Wheels

We Make Two Kinds

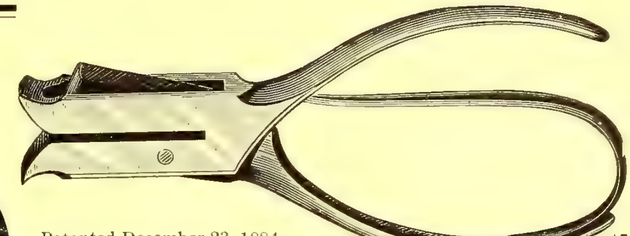
Tires are attached by our Patent Processes, which insure perfect safety

Absolute Safety, Durability and Economy
Tire Renewals Reduced to a Minimum

Send for our Descriptive Catalogue

Badges Buttons Punches

in a sufficiently wide variety to suit you exactly



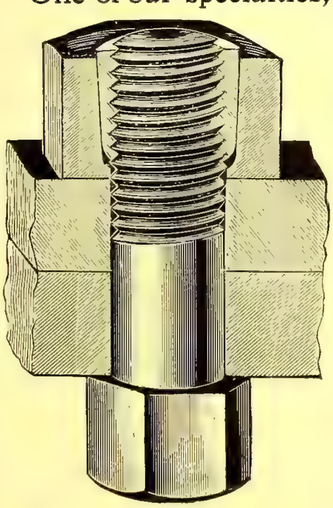
Patented December 23, 1884.

Made of the best materials and from most improved designs.
See our Exhibit, Space No. 7, Section C.

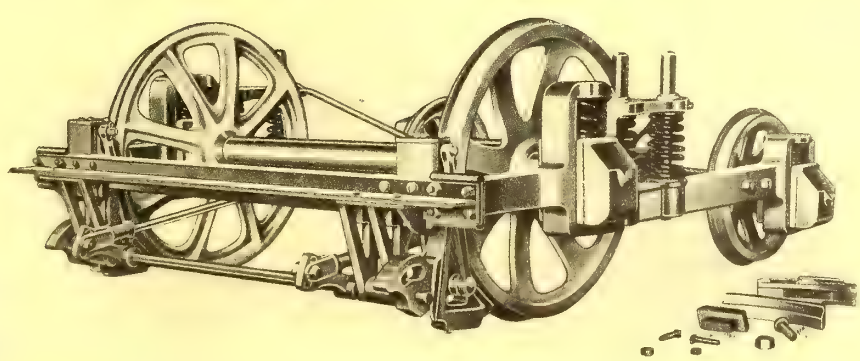
AMERICAN RAILWAY SUPPLY COMPANY

24 Park Place
New York

Combined Wheel and Track Brake



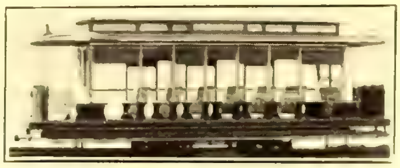
One of our specialties, and a mighty good one. Live managers appreciate it. Our *Victor Cast Steel Car Replacer* is needed on every Electric Road. Ask us for description. *Columbia Lock Nuts* grip and never let go. Easily removed when desired. You need them.



U. S. Metal & Manufacturing Co.

25 Broad Street, New York

General Electric
Railway City Service

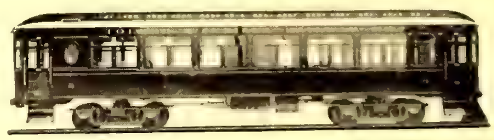


Streeter Shoe

BRAKE SHOES

for all Conditions of Electric Railway Service

Heavy Interurban
and High Speed
Equipment

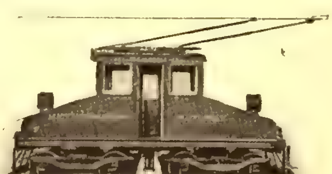


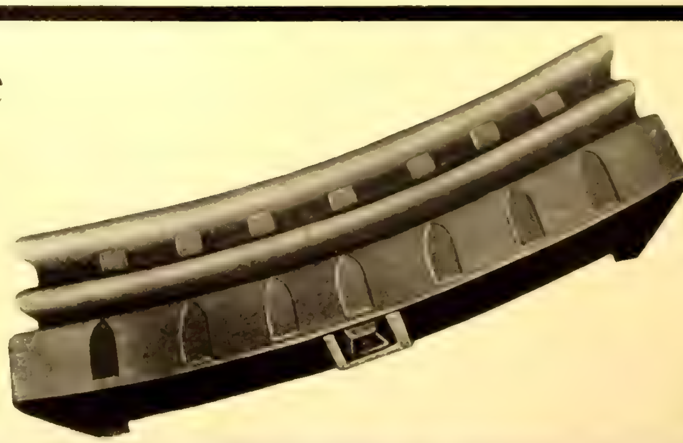
Steel Back
Diamond S Shoe

American Brake Shoe & Foundry Co.

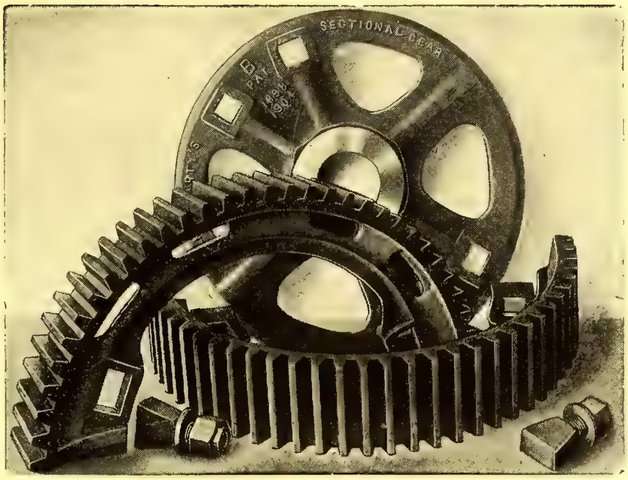
170 Broadway, New York **MAHWAH, N. J.** **Western Union Building, Chicago**

Electric Locomotive

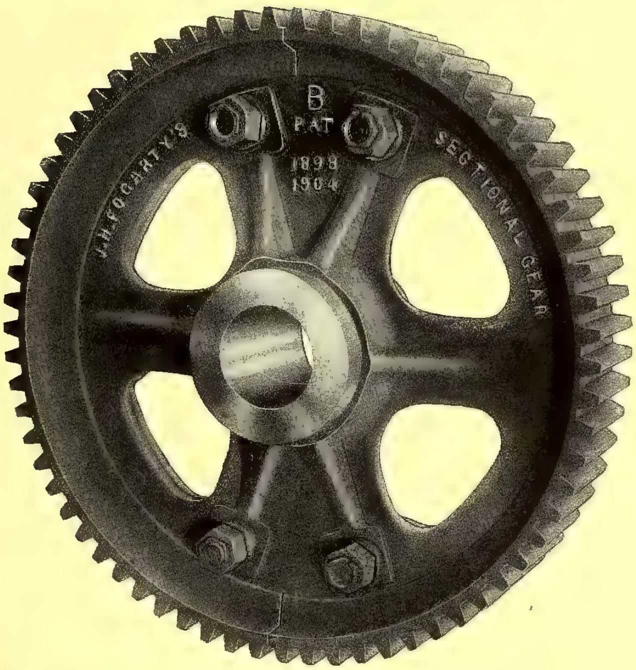




Perfecto Shoe



The New Idea of A Sectional Gear



has caused a radical change in the practice of electric railways.

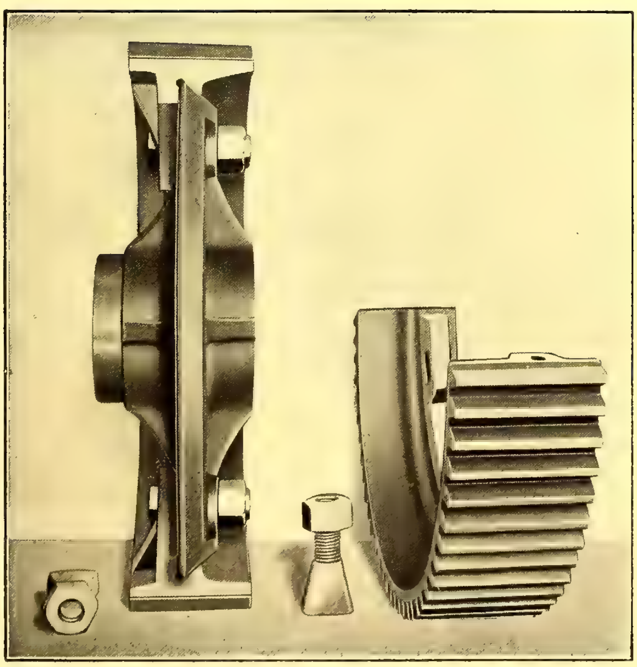
¶ Hub and Rim cast separately and rim is interchangeable.

¶ When the teeth wear, it is a matter of renewing the rim only.

¶ The hub remains as good as new, and the car does not have to go out of commission for the change.

¶ In use for three years on one of the largest electric railroads in the East.

¶ Send for my printed matter.

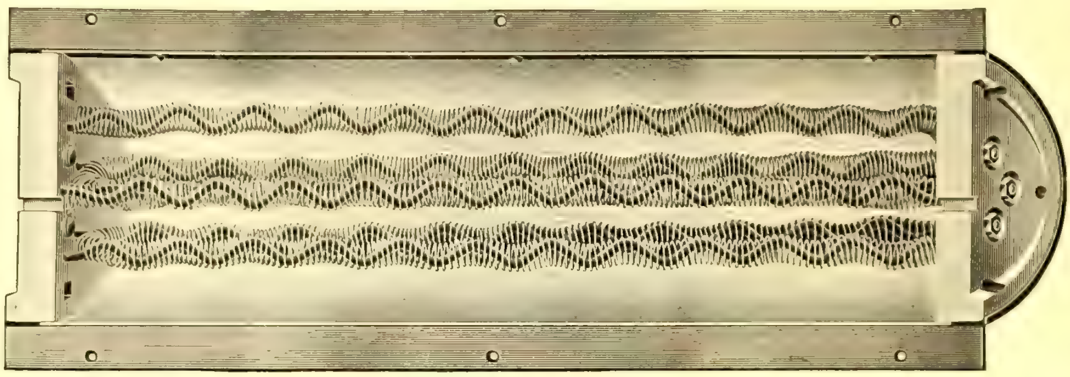


James H. Fogarty

126 Liberty St., New York

GOLD'S

Improved Electric Car-Heaters

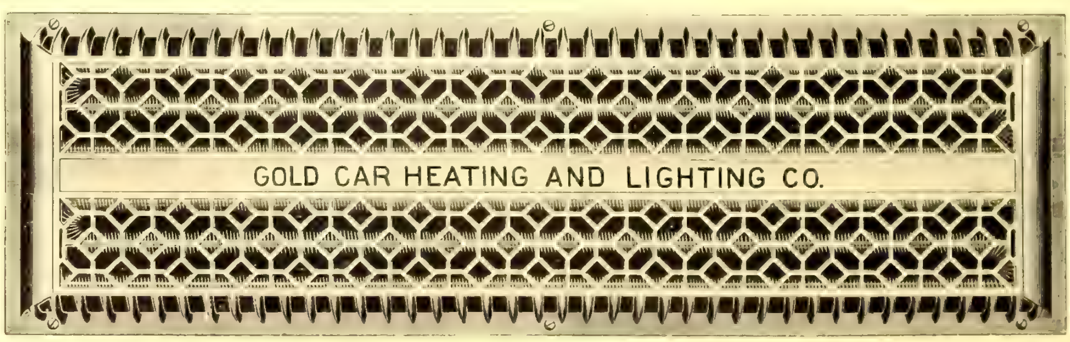


Allowing free circulation of air through the resisting coils, they do better work and use less power than any heater in which freedom of circulation is absent.

The Gold Electric Heater offers many important advantages over every other car heating system.

We make over 30 different styles. Also hot water systems for those who want them.

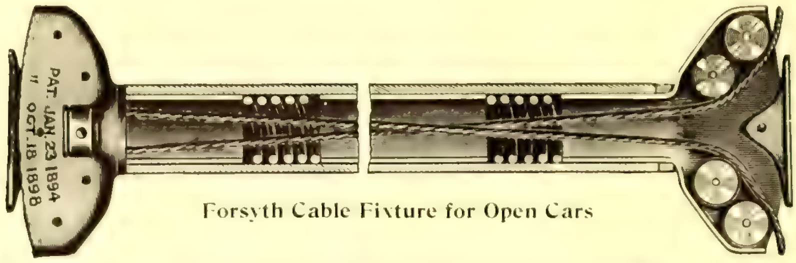
Our Red Book shows why Gold Heaters excel.



Gold Car Heating and Lighting Company

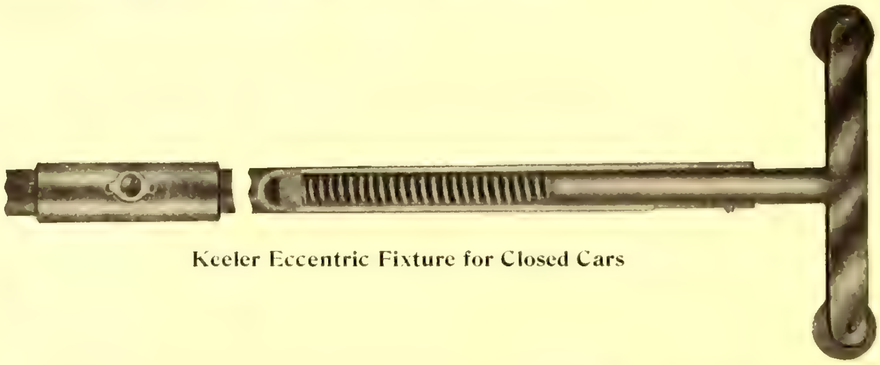
Whitehall Bldg., New York

CAR CURTAINS



Forsyth Cable Fixture for Open Cars

A convenience to the passengers, an economy to the road. Our automatic curtains are easy to operate, never stick, and do not get out of order. They work quickly and stop exactly where left.



Keeler Eccentric Fixture for Closed Cars

We furnish all kinds of curtains of every material for every kind of car. See also description in "Dictionary" in this issue.

Forsyth Roller Tip Fixture, No. 86, for Closed Cars

THE CURTAIN SUPPLY CO.

CHICAGO
NEW YORK

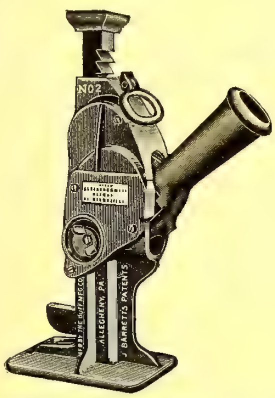
ST. R'Y JOURNAL

The Universal and General Use of

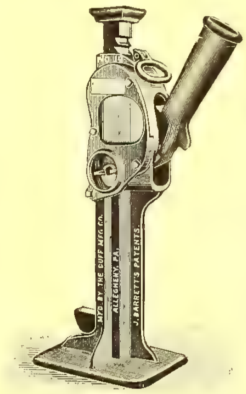
"All works of taste must bear a price in proportion to the skill, taste, time, expense and risk attending their invention and manufacture. Those things called dear are, when justly estimated, the cheapest; they are attended with much less profit to the artist than those which everybody calls cheap." RUSKIN.

BARRETT JACKS

ON THE RAILWAYS OF THE WORLD IS AN ELOQUENT AND SUBSTANTIAL INDICATION OF THEIR WORTH



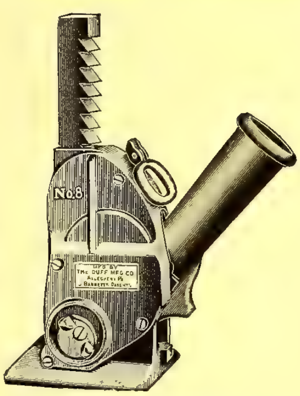
No. 2. Barrett Jack. 10 Tons.



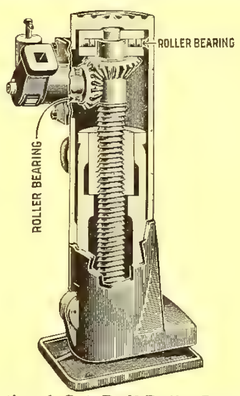
No. 19. Barrett Jack. 15 Tons.

Barrett Track and Car Jacks and Duff Roller Bearing Screw Jacks are the result of over **twenty years'** experience, confined entirely to the manufacture of of Lifting Jacks. They represent the **highest attainment** in the line of lifting devices for railroad or electric railway purposes.

WE MANUFACTURE THE LARGEST AND MOST COMPLETE LINE OF JACKS OFFERED ANYWHERE IN THE WORLD, COVERING EVERY TRACK PURPOSE AND FOR THE SAFE, ECONOMICAL AND RAPID HANDLING OF RAILWAY EQUIPMENT AND GENERAL LOADS FROM ONE TO SEVENTY TONS IN WEIGHT.



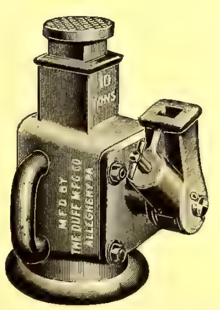
No. 8. Barrett Journal Jack.



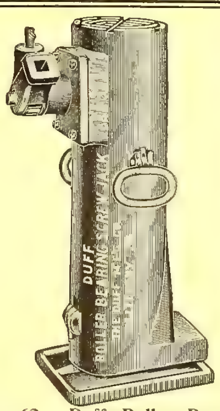
Sectional Cut Duff Roller Bearing Jack.

CAUTION

We desire to warn the trade against the purchase of CHEAP IMITATIONS of a few of our sizes of Jacks. These IMITATIONS are cheaply constructed, and represent only increased operating expenses and inconvenience.



No. 58. Duff Cone Bearing Journal Jack. 10 Tons.



No. 62. Duff Roller Bearing Jack. 35 Tons.

SEND FOR COMPLETE CATALOG OF BARRETT TRACK AND CAR JACKS, BARRETT GEARED RATCHET CAR JACKS AND DUFF ROLLER BEARING SCREW JACKS. MANUFACTURED EXCLUSIVELY BY

THE DUFF MANUFACTURING CO.

ESTABLISHED 1883

Works: Allegheny, Pa. PITTSBURG, PA., U.S.A.


156
01857


CASH
141
63
IN

Sing a song of registers,
A pocket full of fares,
If the railway loses some
The fault is only theirs.

Sing the song "Security,"
Each nickel earned is made,
And profits are a surety
And dividends are paid.
Single Recorder
Double Recorder
SECURITY REGISTERS
are secure against tampering. They secure to the company every nickel earned, and are built in a sufficient variety of types to suit the requirements of all railways.
SEND FOR PARTICULARS
Double Numeral
Single Numeral
No. 5 or 2X Register
SECURITY REGISTER CO.
St. Louis, Mo.
GILES S. ALLISON
42 Broadway, N. Y. City

The Golden Rule System

THE MACDONALD SYSTEM OF CASH FARE RECEIPTS

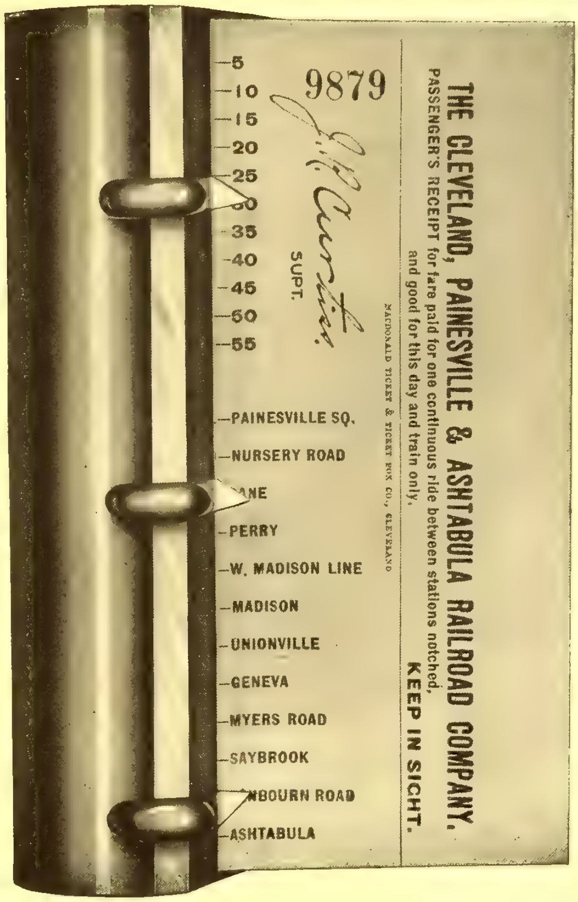
creates a satisfied condition between employer and employe, that can only exist where this System is used. It is the "GOLDEN RULE SYSTEM" applied in a practical way to the every-day duties of life. The Company is protected to a degree never before known in the Railway business.

The Conductor is encouraged to labor and to do unto others as he would be done by.

The Passenger receives a receipt for his transportation, showing amount of fare paid, destination and point of entrance.

IT'S THE COMING SYSTEM.

MacDonald Ticket & Ticket Box Company CLEVELAND, OHIO, U. S. A



WAY BILLING

BY THE EGRY SYSTEM

SAVES TIME, LABOR AND MONEY

ELIMINATES ERRORS AND OMISSIONS

Four full copies of each Way Bill issued at one writing without the handling of carbon or changing of stationery, an automatic speed being produced.

No. 1 is Auditor's copy.
No. 2 Original Bill of Lading.
No. 3 Receipt from Consignee.
No. 4 Duplicate Bill of Lading.

HAS THE ENDORSEMENT OF ALL USERS
COST IS NOMINAL
PRODUCES THE RESULTS

Write us for full particulars

The Egry Autographic Register Co.
Dept. W-B. DAYTON, OHIO, U. S. A.

LOOK FOR US EXHIBITION HALL SECTION D-25

RAPID READY CHANGE CARRIER

The most convenient device ever invented for making change for Street Railway Conductors.

Change quickly and correctly made in the dark as well as in the light.

Money automatically locked; can't drop out; no bagging of coats and pockets; looks neat and dressy.

Sent on receipt of price, $1.75, with privilege of returning if not satisfactory.

CHAS. F. ETTER
904 N. Second St., HARRISBURG, PA.

Taking a Transfer Ticket from Machine.

The Transfer Problem is Solved

by the

OHMERGRAPH

A TRANSFER ISSUING MACHINE

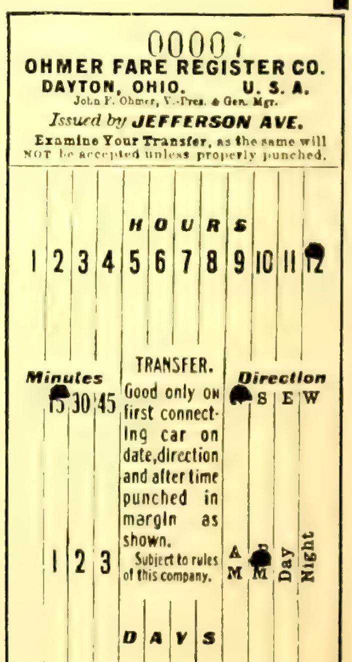
It prevents the abuses that followed the introduction of the transfer system.

It gives the conductor the opportunity of collecting cash fares during rush hours, and of issuing properly punched transfers at the same time.

The machine is automatic and is operated with only one hand, there being but a single lever to work. It is so light that its weight is hardly felt by the operator. It keeps an absolute check on every transfer by punching and registering the issue.

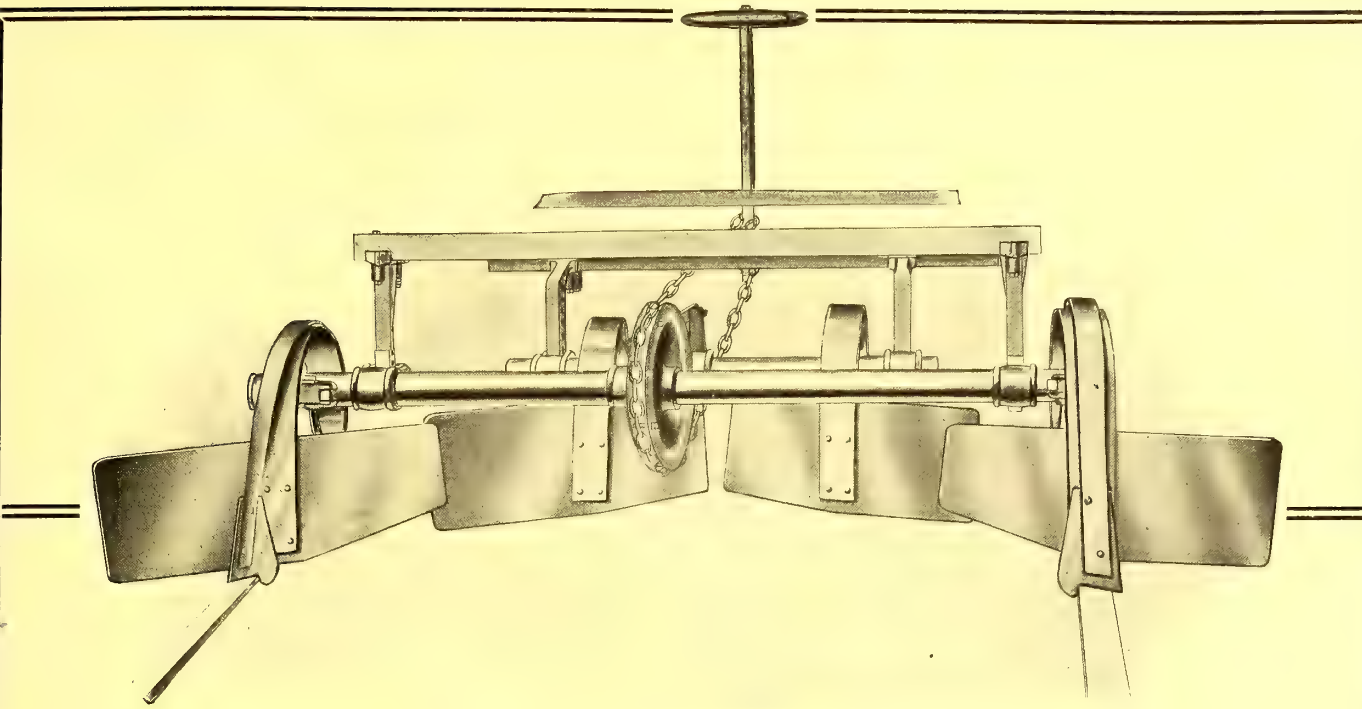
We have also added four new type, two-fare recording registers to our inventions. These machines are for use on city lines.

Additional information cheerfully given.



Ohmer Fare Register Co.

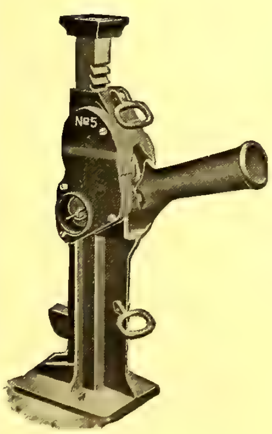
Dayton, Ohio, U. S. A.



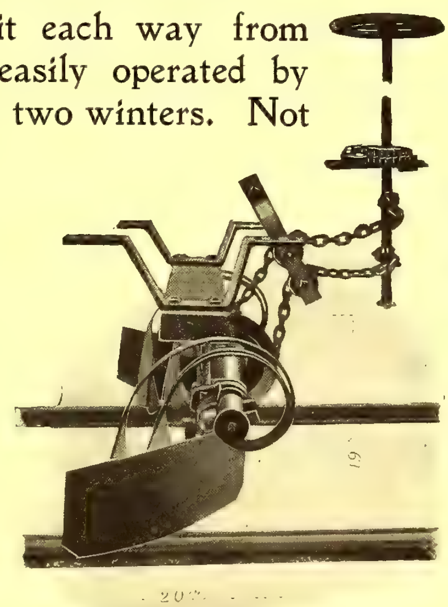
No. 5 KALAMAZOO SCRAPER

The Root Scrapers For a Clean Track

Notice our No. 5 as now perfected. Costs only one-twentieth as much as a sweeper, yet will accomplish results just as satisfactory. Cleans all the snow from between the rails and for a space of nine inches outside, throwing it each way from the center. No extra expense for labor—easily operated by motorman. No brooms to renew. In use for two winters. Not one returned as unsatisfactory. ¶Our No. 2 special is perfection also. ¶Both of these scrapers are guaranteed to give you greater satisfaction than any other on the market. ¶We will prepay freight on sample orders and take back the goods if they don't satisfy you.



KALAMAZOO RATCHET JACK



No. 2 SPECIAL SCRAPER
Showing how it installs on high or short platform cars

HOW ABOUT JACKS?
THE KALAMAZOO POSSESSES MERITS
THAT SHOULD ATTRACT YOU

Our Catalogue Might Interest You

Kalamazoo Railway Supply Co., Manufacturers

KALAMAZOO, MICHIGAN

Knutson Trolley

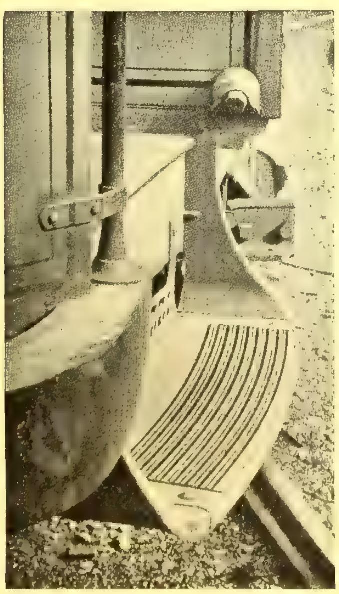
RETRIEVER

pulls the pole down instantly, when it leaves the wire, and holds it to two or three feet below. It is re-set automatically, without touching the machine, and does not re-set till retrieving spring is wound so that it will retrieve properly. Will withstand the severest trolley-tension conditions. Has an unequaled long service record, and is now in use on a majority of the high-speed lines in the country. Guaranteed unconditionally. Sample equipments furnished without obligation to buy unless satisfactory.

THE TROLLEY SUPPLY COMPANY
CANTON, OHIO, U. S. A.

Mason Safety Tread

FOR CAR STEPS AND STATIONS



NON-SLIPPERY
PRACTICALLY UNWEARABLE
NOT AFFECTED BY FROST
MANY THOUSANDS IN USE

¶ Mason Safety Tread has no equal for the purposes for which it is designed, and this fact is recognized by the best railway managements throughout the country.

¶ It is in use on steam and electric car steps and on station stairs from the Atlantic to the Pacific.

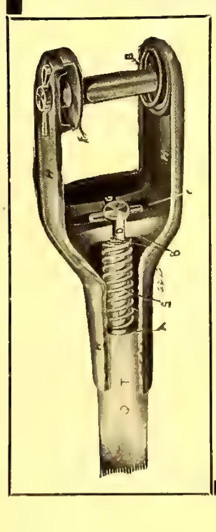
¶ We have an agent in every large city. See him or write to the Home Office for particulars.

American Mason Safety Tread Co.
BOSTON, MASS.

Changing Trolley Wheels in 10 Seconds

without tools, without stopping the car, without skilled help is made possible by means of the

Bayonet Detachable Trolley Harp



Heads can be changed without loss of schedule time. In addition, this harp stops excessive arcking, thus saving trolley wheels and wire.
We'll do our share to help you try it—a dozen on 30 days' trial if you want them. Speak up!

Bayonet Trolley Harp Co.
Springfield, Ohio

Clark's Automatic Car Fender Co.

A fender that never fails, and will pick up anything from a cat to a cow. No dropping by motorman, who has no time nor thought to drop a fender in emergency cases. No triggers or trips, no mechanism to get out of order. Simple, reliable in action. Approved in all cities of California; also in St. Louis, Mo.; at the great fender trials in March and April, 1902, it stood Rank No. 1 out of 104 fenders.

The Clark Automotic Fender is a non-protruding truck fender. We also make a buffer to go with this fender, where city authorities call for a buffer, or a protruding fender. Further particulars and testimonials furnished upon request.

432 South Main Street, - - Decatur, Ill.

EDWARDS WINDOWS

WINDOW FIXTURES
SHADE ROLLERS
SASH BALANCES

— TRADE —
"PAOWNYC"
— MARK —

AUTOMATIC PLATFORM

TRAP DOORS

FOR BLUE PRINTS AND INFORMATION ADDRESS

The O. M. EDWARDS Co.
Syracuse, N.Y.

No. 55 F.

OUR car seats have many superior characteristics which have caused them to be adopted by the largest, best equipped and most successful roads.

Write to us for catalog and prices

HEYWOOD BROTHERS AND WAKEFIELD COMPANY

WAKEFIELD, MASS., U.S.A.

Export Department, 129 Charlton St., New York

Represented in Germany and Austria Hungary by Ferd. Romunder, Cologne.
Holland and Belgium by Leyden & Van Beest, Rotterdam and Brussels.
Norway and Sweden by Aktiebolaget Sodertelge Verkstader, Sodertelge, Sweden.

No. 52 C.

The RIDLON Trolley Catcher

POSITIVE

In Its

ACTION

MALLEABLE IRON CASE AND REEL

DURABLE

and

SIMPLE

FOR EITHER HIGH SPEED OR SLOW SPEED CARS

A Sample Catcher Sent on Thirty Days Trial

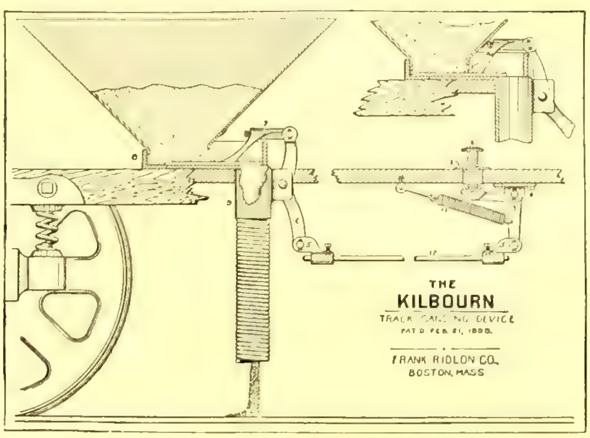
FRANK RIDLON COMPANY

MANUFACTURERS

Office: 200 Summer St., Boston.
Telephone, Maine 6700, Connecting all Departments

Factory, A St. - - - So. Boston
Brass Foundry, Binford St. So. Boston

The Kilbourn Track Sanding Device



THE MOST EFFICIENT

SAND BOX

EVER PLACED UPON THE MARKET

All parts are of Malleable Iron, thereby reducing to a minimum the chances for breakage.

The Spout is made from Spiral Steel Spring

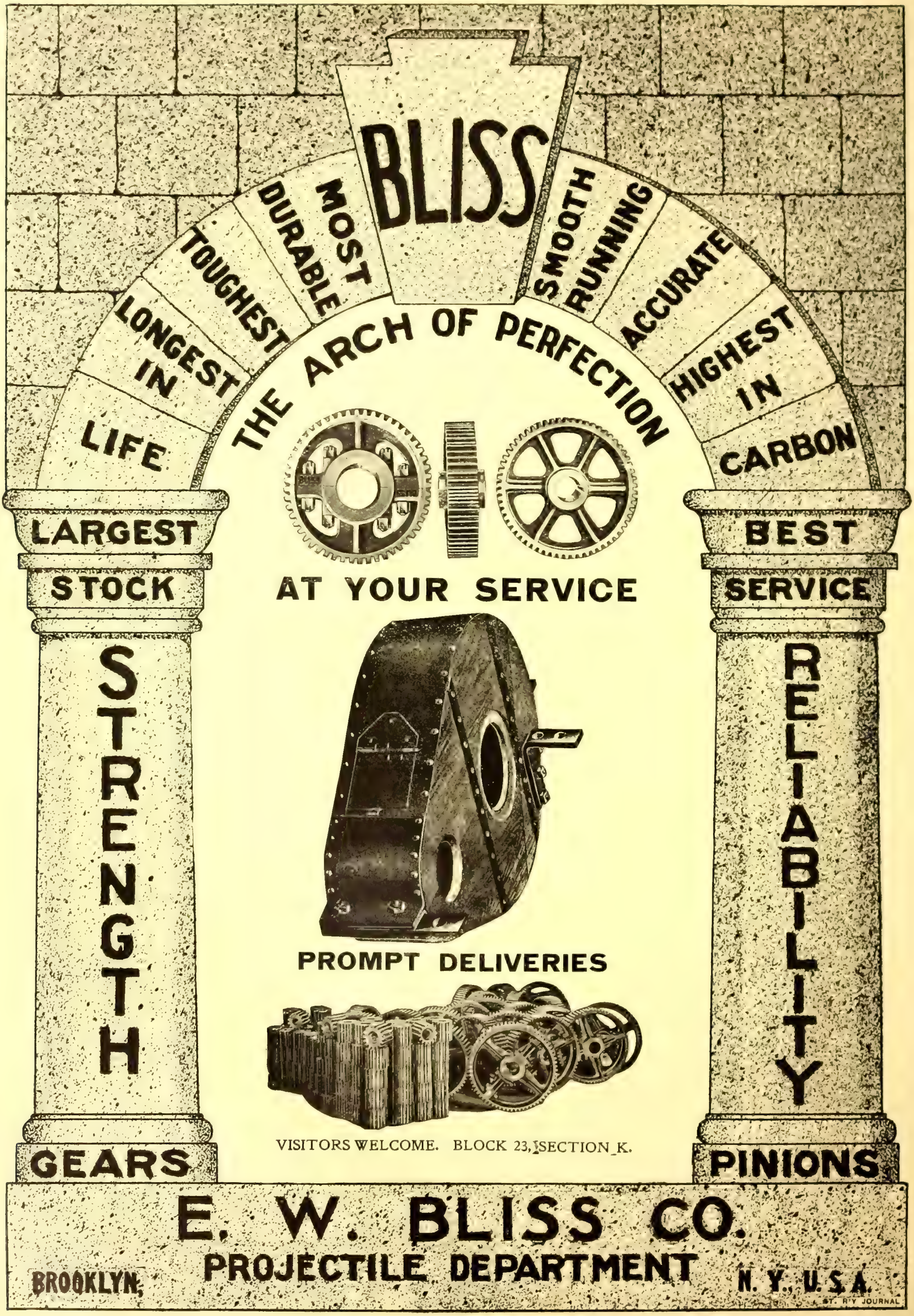
It will handle Anything from Fine Sand to Gravel or Crushed Stone either Wet or Dry.

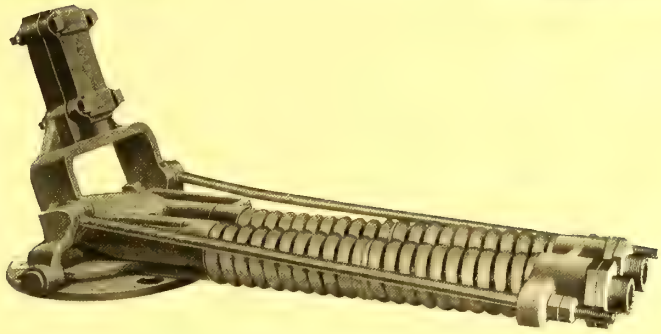
FRANK RIDLON COMPANY, Manufacturers

Office: 200 SUMMER STREET, BOSTON.

TELEPHONE, MAINE 6700
Connecting with all departments

Factory, A St.; Brass Foundry, Binford St., So. Boston.


BLISS
MOST DURABLE
TOUGHEST
LONGEST IN LIFE
SMOOTH RUNNING
ACCURATE
HIGHEST IN CARBON
THE ARCH OF PERFECTION
LARGEST STOCK
BEST SERVICE
STRENGTH
RELIABILITY
AT YOUR SERVICE
PROMPT DELIVERIES
VISITORS WELCOME. BLOCK 23, SECTION K.
GEARS
PINIONS
E. W. BLISS CO.
BROOKLYN, PROJECTILE DEPARTMENT N. Y., U. S. A.



Form 10

New Type Ball Bearing Trolleys

Our New Ball Bearing Trolley Bases, Forms 10 and 11, are specially adapted to meet conditions where a 4 or 4½ inch trolley is necessary, but will operate equally as well in general service. The Double Spring, or Form 10, Type will allow the use of an extremely long pole and give ample wire pressure. Every part is carefully proportioned and machined, the ball races are made of specially high carbon steel, accurately finished and assembled. Detail description and prices on application.

R. D. Nuttall Company

Pittsburg, Pa.

Form 11

ST. R'Y JOURNAL

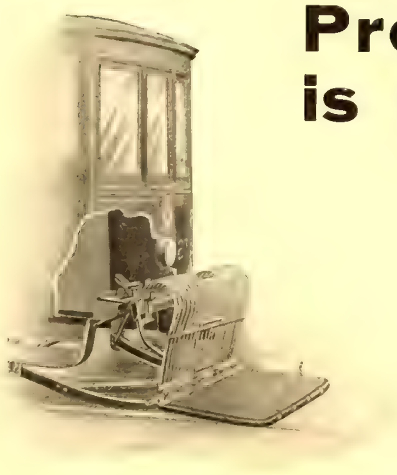
A Harp and a Wheel that bring forth songs of praise

There's perfect harmony of opinion as to the merits of the Kalamazoo Trolley Harp. No one who tries it or even examines it can have any doubts. The springs are protected and can't break. They never need replacing. Kalmazoo Trolley Wheels are as near perfection as the Harp, and that's as near as manufactured things can get. It's hard to find a road that's not using them. Better get our circulars.

STAR BRASS WORKS

KALAMAZOO

Protection to Pedestrians is self-protection to a road



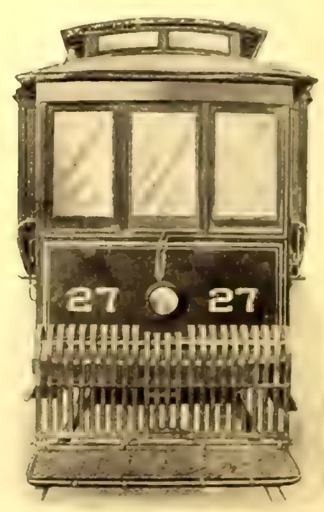
LOCKED DOWN

It doesn't take many damage suits to equal the cost of a fender equipment that will prevent most accidents. Here's the perfect

CHAMPION FENDER

A LIFE-SAVER

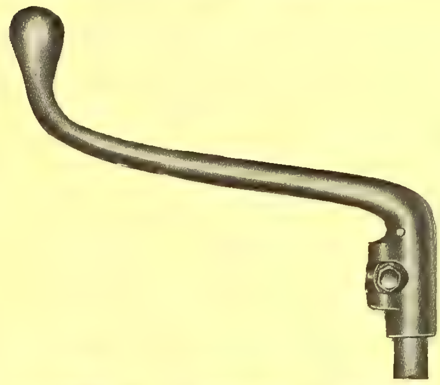
and, therefore, a money saver. Can be dropped to track instantly and positively by slight foot-pressure. Locks down automatically, impossible for bodies to get under it. Can be returned to its normal position without motorman's leaving or stopping car. Light but very strong. Write for circular.

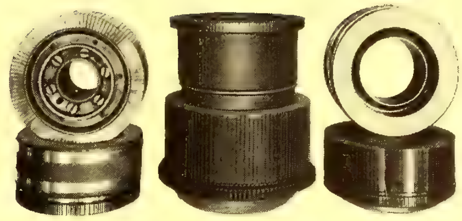


DROPPED TO RAIL

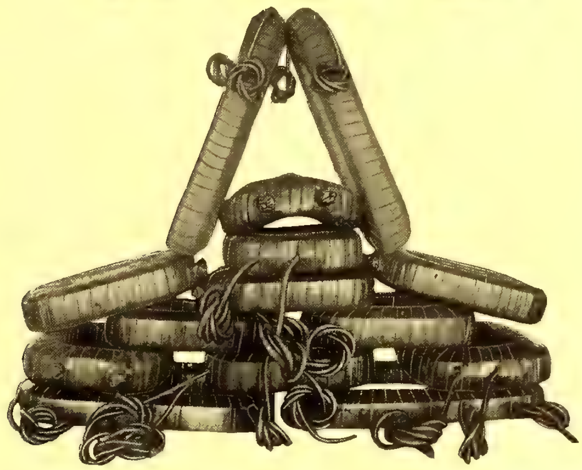
The Star Brass Works, Kalamazoo

Columbia Specialties for Electric Railways





Steel Trolley Poles
Field and Armature Coils
Malleable Iron Gear Cases
Controller Handles
Ratchet Brake Handles
Malleable Iron Car Trimmings
Illuminated Car Signs
Armature and Axle Bearings and Commutators

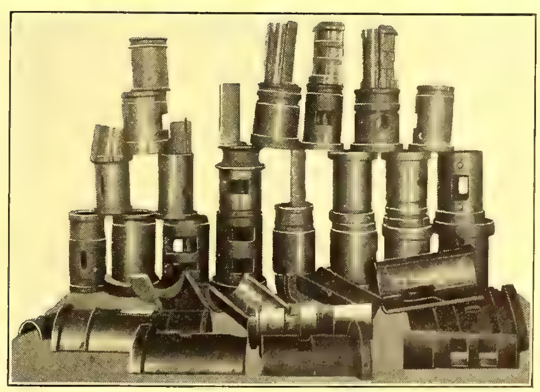


also the

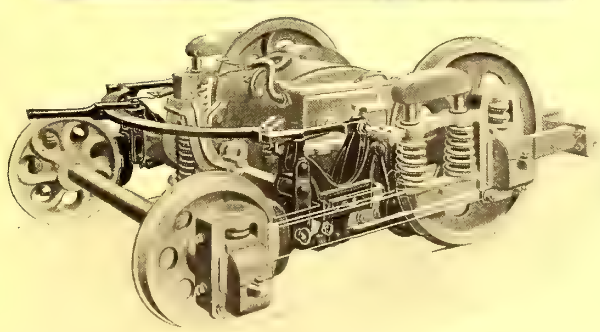
COLUMBIA BRAKE

FOR PONY TRUCK

Most Efficient Brake in Use. Brakes are Between Wheels. Does Away with Brake Beams. No Long Chains. No Flat Wheels. Simple in Adjustment. Complete Set of Shoes. Changed in Twenty Minutes. Shoes Wear Equal on All Wheels. Brakes are Adjusted Independently Either Side. Brake is Quick Acting. Requires only Three-Quarter Turn of Handle to Apply. Your Old Brakes can be Removed and New Brake Applied at Small Expense. Makes Your Trucks Stronger. Gives More Room for Motors. Does Away with Offset Brake Rods. Stops Chattering of Brake Shoes.



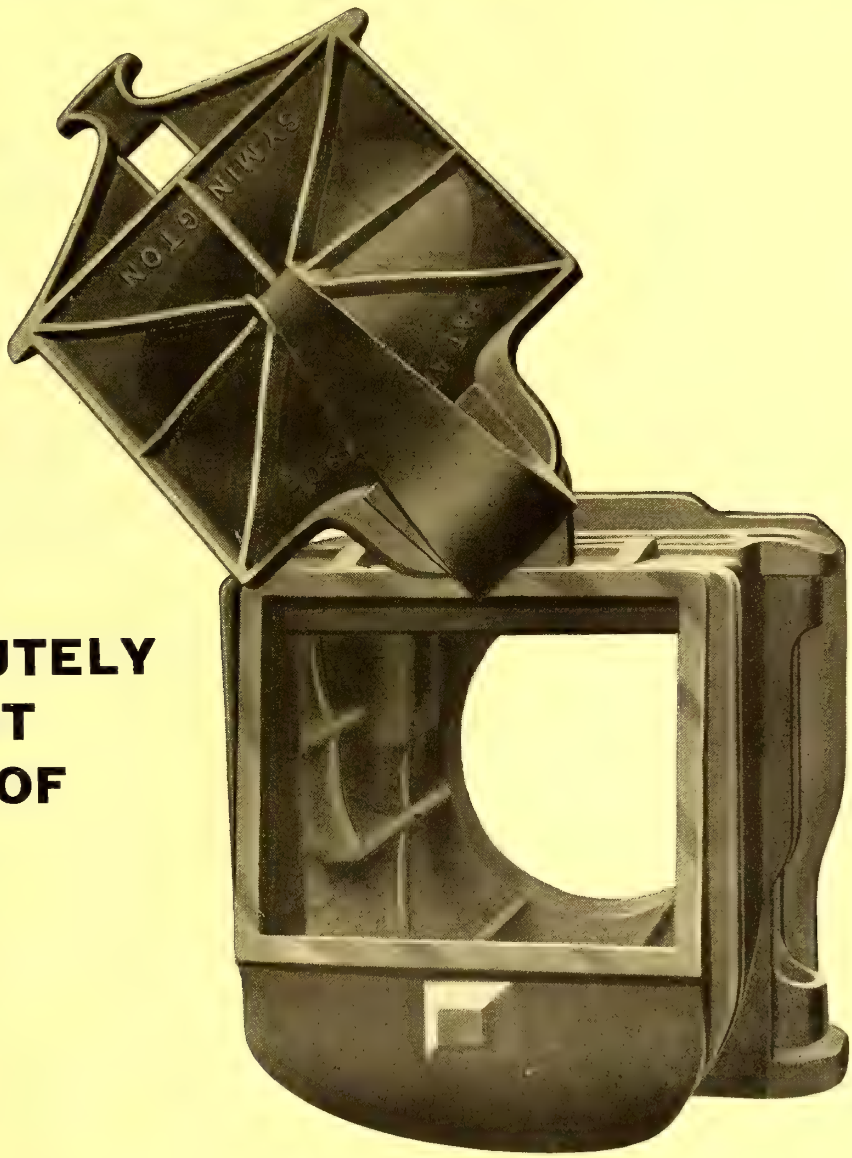
SEND FOR DETAILS



PATENTED

Columbia Machine Works
And Malleable Iron Company
BROOKLYN, N. Y.

THE SYMINGTON JOURNAL BOX



ABSOLUTELY DIRT PROOF

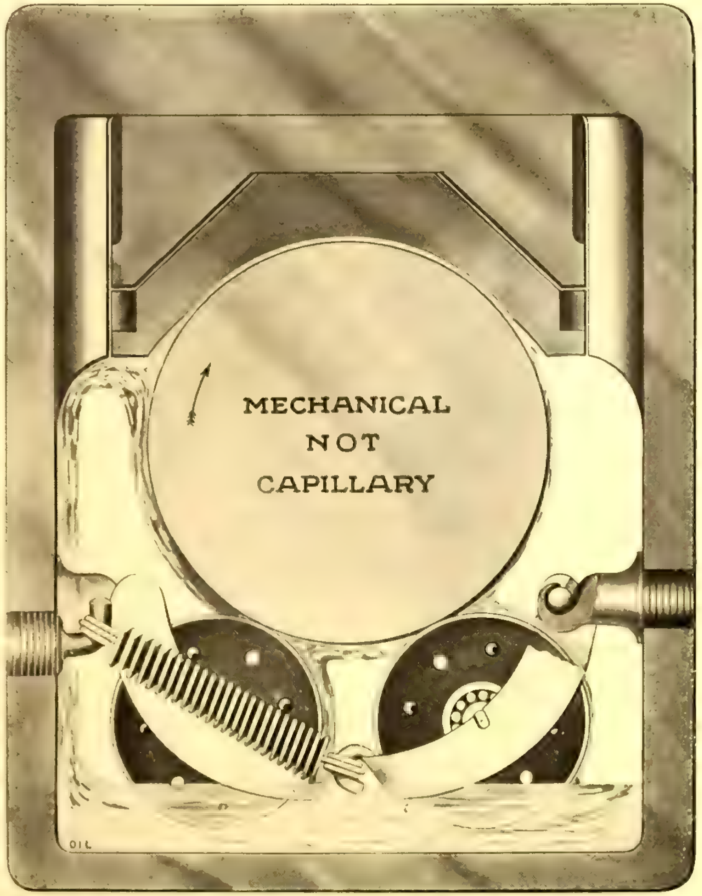
MADE OF SEMI-STEEL

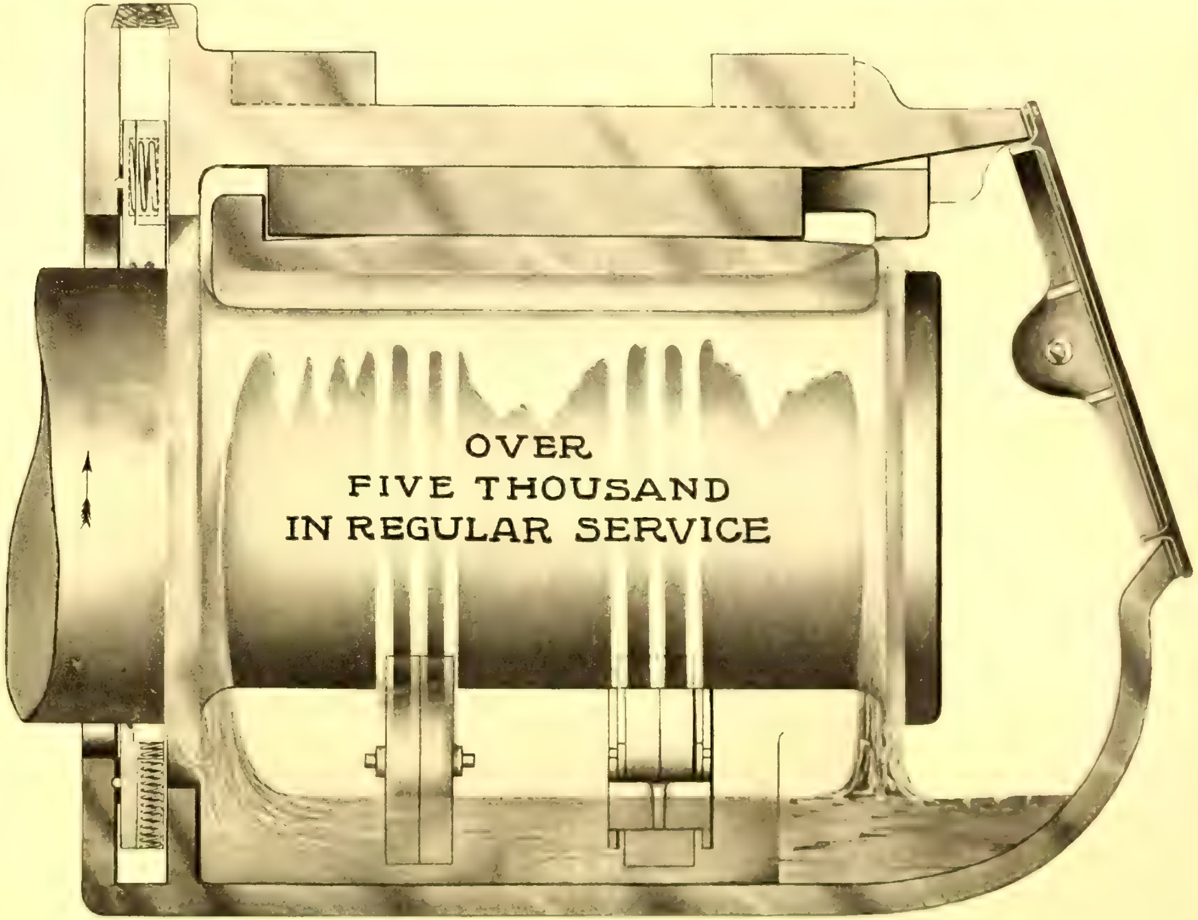
FOR M. C. B. HIGH SPEED TRUCKS

THE T. H. SYMINGTON COMPANY

Calvert Building, Baltimore **315 Railway Exchange, Chicago**

The Economy Journal Lubricator and Dustguard





(For description, see LUBRICATOR, CAR JOURNAL, in Dictionary.)

COMBINED SAVINGS WILL MORE THAN REPAY ORIGINAL INVESTMENT, INCLUDING INSTALLATION AND MAINTENANCE, BEFORE EQUIPMENT COVERS 100,000 MILES. IF INTERESTED, WRITE OUR NEAREST CFFICE FOR OUR PROPOSITION AND A LIST OF RAILWAY AND MECHANICAL MEN WHO HAVE HAD EXPERIENCE WITH OUR EQUIPMENT ON THEIR ROADS. CORRESPONDENCE SOLICITED

THE RAILWAY JOURNAL LUBRICATING COMPANY

NEW YORK: 26 Cortlandt St. **MILWAUKEE:** 12th St. and St. Paul Ave. **CHICAGO:** Monadnock Block

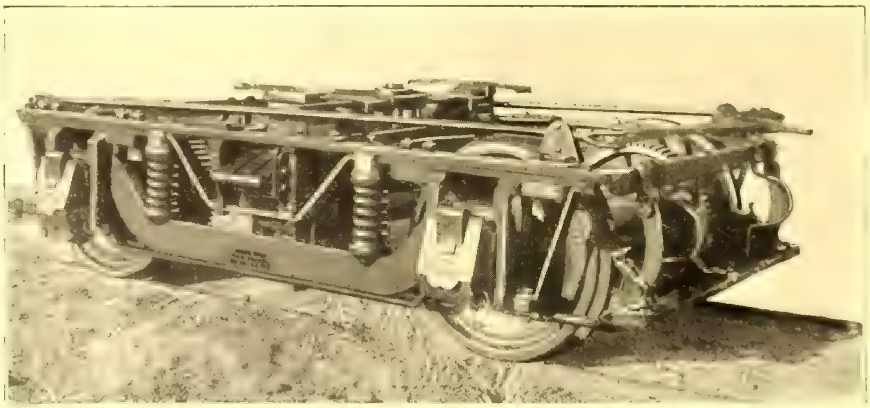
1157-1158-1159
Monadnock Building
CHICAGO

The Dorner

Trucks, Wheels, Axles

Etc., Etc.

No. 20.
M. C. B.
Truck for
High-speed
Suburban
and Elevated
Electric
Railway
Service.



THE TOLEDO & WESTERN RAILWAY COMPANY
OFFICE OF THE GENERAL MANAGER

SYLVANIA, OHIO, September 9th, 1905.

File #380

The Dorner Mfg. Co.
H. A. Dorner, General Manager,
Chicago, Ill.,

Dear Sir -

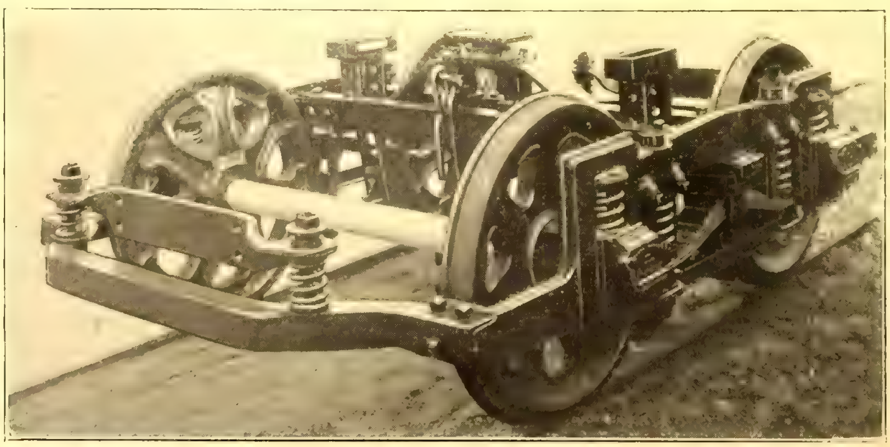
Your 20-A trucks have been received and I was very much pleased with them. You certainly put up a fine truck when you built them. Believe they are the best truck for the class of service we will use them for, that I have ever seen.

Yours truly,

General Manager.

What a
purchaser
says:

No. 21.
Steel Frame
Truck for
Long City
Cars.



WRITE US FOR
PRINTS,
PHOTOGRAPHS
AND
SPECIFICATIONS

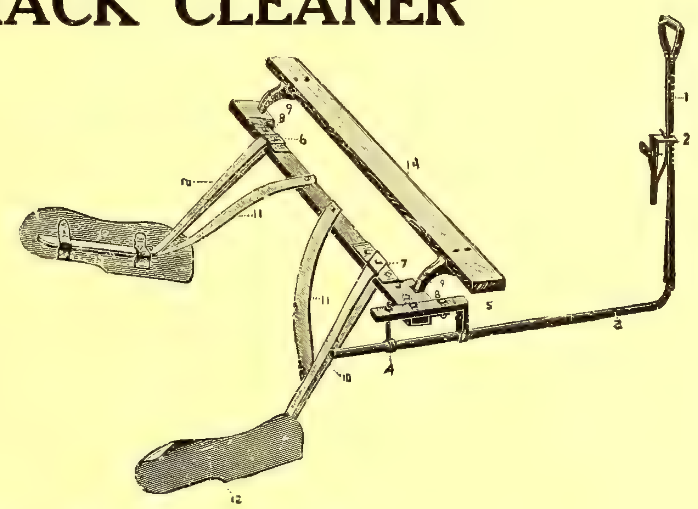
Manufacturing Co.

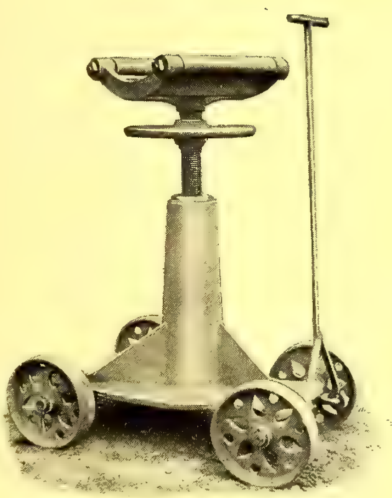
Track Cleaners, Hot Water Heaters
Brake Shoes Pit Jacks

THE RELIANCE TRACK CLEANER

A..... POSITIVE SCRAPER

Keeps snow, ice and mud from rails at all times.





OUR PIT JACK

is made of cast iron with brass bushing and steel screw, wood rollers on cradles for armatures, and flat top for receiving motors; flat or flanged wheels for track.

The NEW BRAKE SHOE

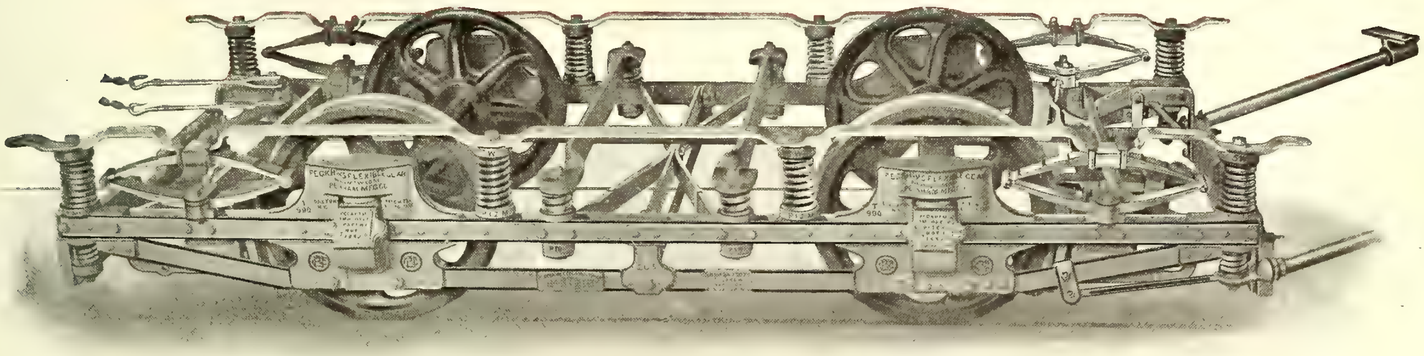
THE "SPEAR"

Long Life.
Highest Braking Power.
Tire and Wheel Saving.
It is the Best and Cheapest.

CATALOGUES AND PRICES SUPPLIED ON REQUEST.

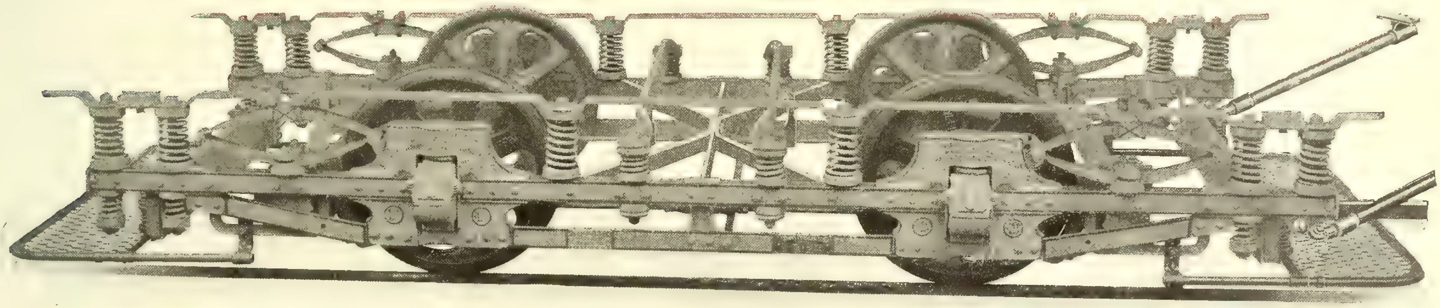
PECKHAM'S "Non-Oscillating" Cantilever Extension (Single) Motor Trucks

STANDARD Designed for 18 ft. Closed and 26 to 30 ft. Open Electric Cars



DIMENSIONS—Length of Top Frame 14 ft. 10 in. Spring Base 13 ft. 4 in. with 7 ft. Wheel Base. Diameter of Wheels 30 in. Axles 4 in. Height (light) 27 1-2 in.

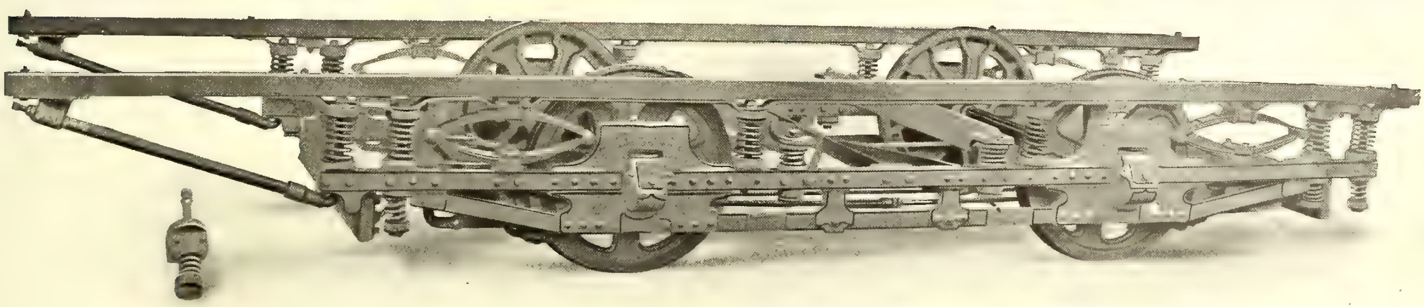
EXTRA LONG Designed for 20 ft. Closed and 28 to 30 ft. Open Electric Cars.



DIMENSIONS—Length of Top Frame 16 ft. 6 in. Spring Base 14 ft. 6 in. with 7 ft. Wheel Base. Diameter of Wheels 30 or 33 in. Axles 4 in. Height (light) with 30 in Wheels 27 1-2 in.

"Extra Strong," ("Metropolitan Special")

Designed for 22 to 24 ft. Extra Heavy "HIGH SPEED" Closed Cars and 30 to 35 ft. Open Electric Cars



DIMENSIONS—Length of Top Frame 17 ft. Spring Base 15 ft. with 7 ft. 6 in. Wheel Base. Diameter of Wheels 30 or 33 in. Axles 4 1-2 or 5 in. (Hammered Steel). Height (light) with 30 in. Wheels 27 1-2 in.
ADOPTED AS STANDARD BY METROPOLITAN R. R. OF NEW YORK

For Price List, Catalogue and Blue Prints, apply to

The Peckham Manufacturing Co.

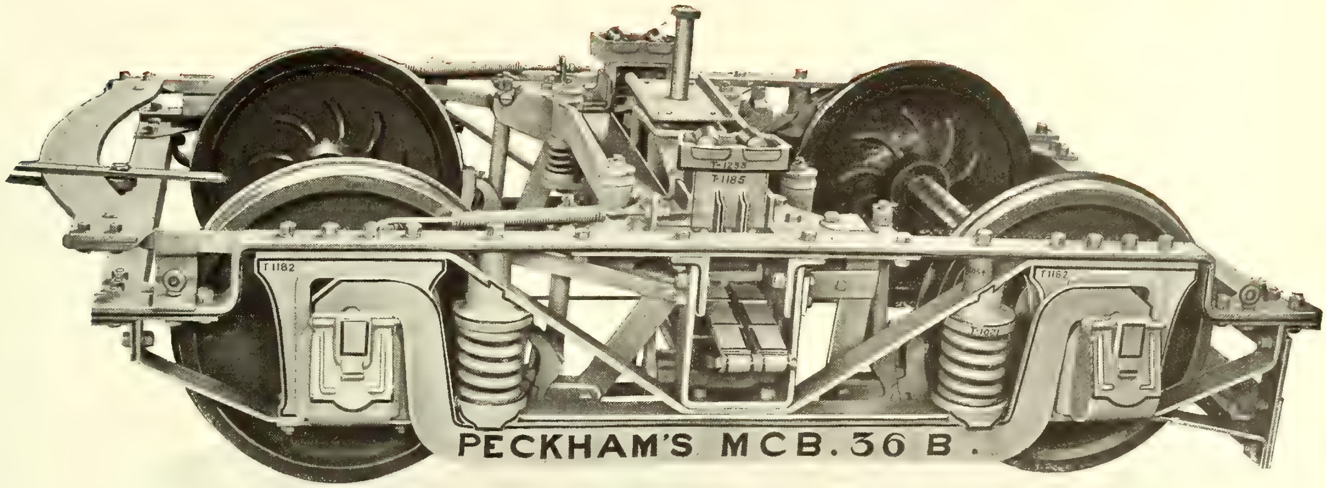
KINGSTON, N. Y.

General Sales Office: HAVEMEYER BLDG., 26 CORTLANDT STREET, NEW YORK

Branch Sales Offices: CLEVELAND, 312 Electric Bldg. CHICAGO, Monadnock Bldg. PHILADELPHIA, 1108 North American Bldg. SAN FRANCISCO, 91 Fremont Street. SEATTLE, 418 New York Block. LONDON OFFICE, Queen Ann's Chambers.

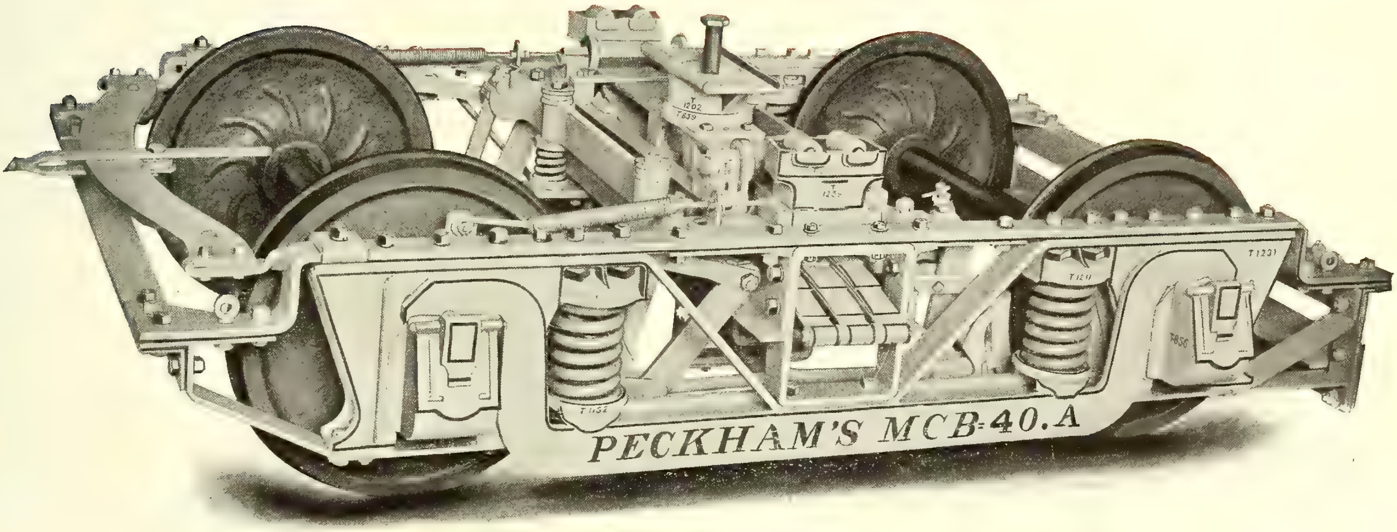
High-Speed M. C. B. Trucks

"MEDIUM" No. 36-B. Truck



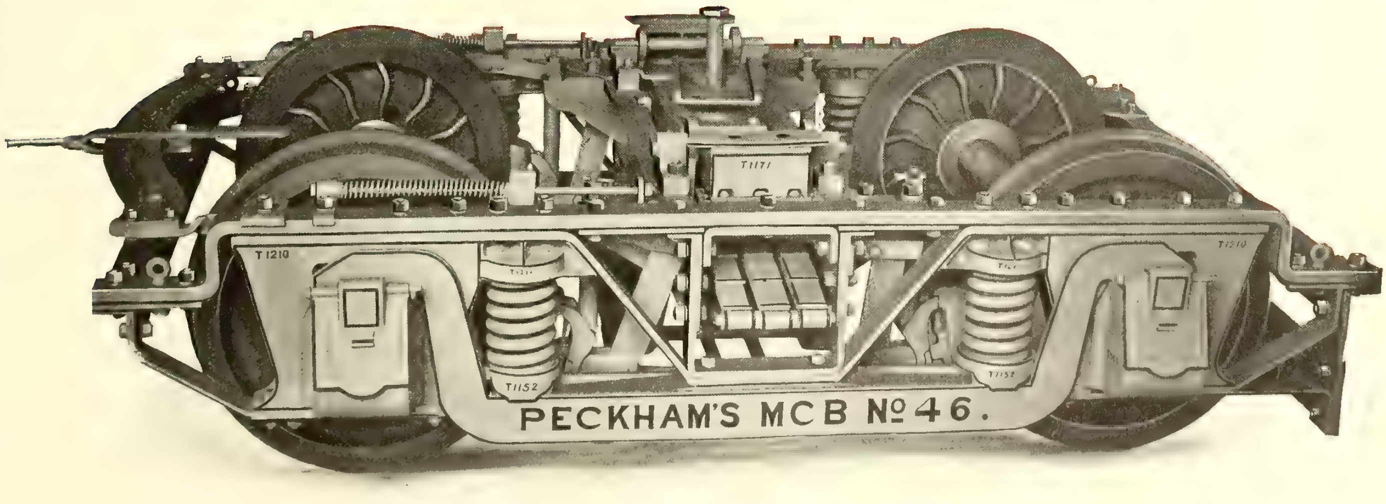
Designed for 40 to 50 ft. Cars. Capacity 60,000 lbs. per Car.

"STANDARD" No. 40-A Truck



Designed for 40 to 60 ft. Cars. Capacity 80,000 lbs. per Car

"EXTRA STRONG" No. 46 Truck

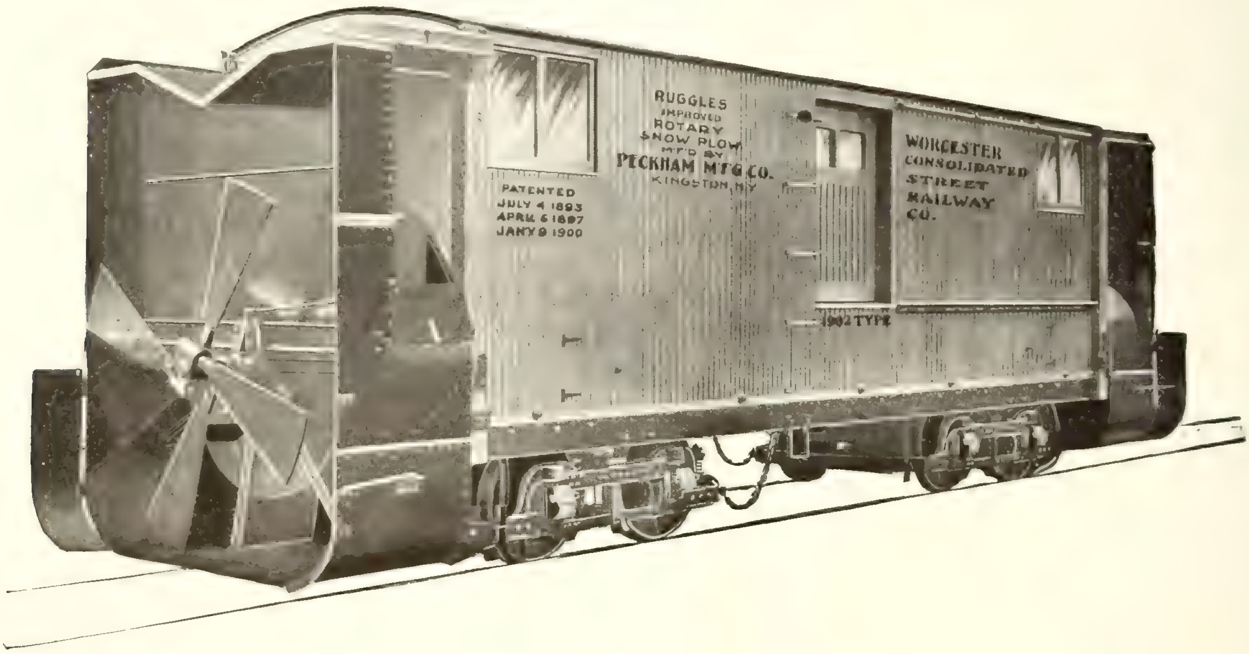


Designed for 50 to 70 ft. Cars. Capacity 100,000 lbs. per Car.

EQUIPPED WITH Peckham's (Patent) Side Frames, Peckham's (Patent) Flexible Motor Suspension, Taylor's (Patent) Non-Chattering Brake Hanger and Elliptic Spring (all steel) Bolster.

THE RUGGLES ELECTRIC ROTARY SNOW PLOW

Is designed for use on Electric Railways which experience difficulties in maintaining a clear track in the most severe snow storms, even with Push Plows and Sweepers. We guarantee the Ruggles' Plow to do this work under the most severe weather conditions.



It is constructed upon the same general principle as the Rotary Plow used upon steam railways, but so modified as to be operated by electric motors, and so constructed that it can be moved in either direction. The Plow is mounted upon either a single or double equipment of electric trucks upon which are mounted motors of the same capacity as used for operating electric cars. The snow is removed from the track by revolving steel blades which are operated from a fan shaft running through the body of the cab from end to end, to which are attached electric motors of sufficient capacity.

The steel blades which remove the snow, are protected by steel scoops, which are close to the rails and are the extreme width of the machine. The snow is received on the rapidly revolving blades and expelled laterally through chutes near their upper periphery, the direction and distance being controlled by the adjustable top wings.

SOLE MANUFACTURERS

The Peckham Manufacturing Co.

KINGSTON, N. Y.

General Sales Office: HAVEMEYER BLDG., 26 CORTLANDT STREET, NEW YORK

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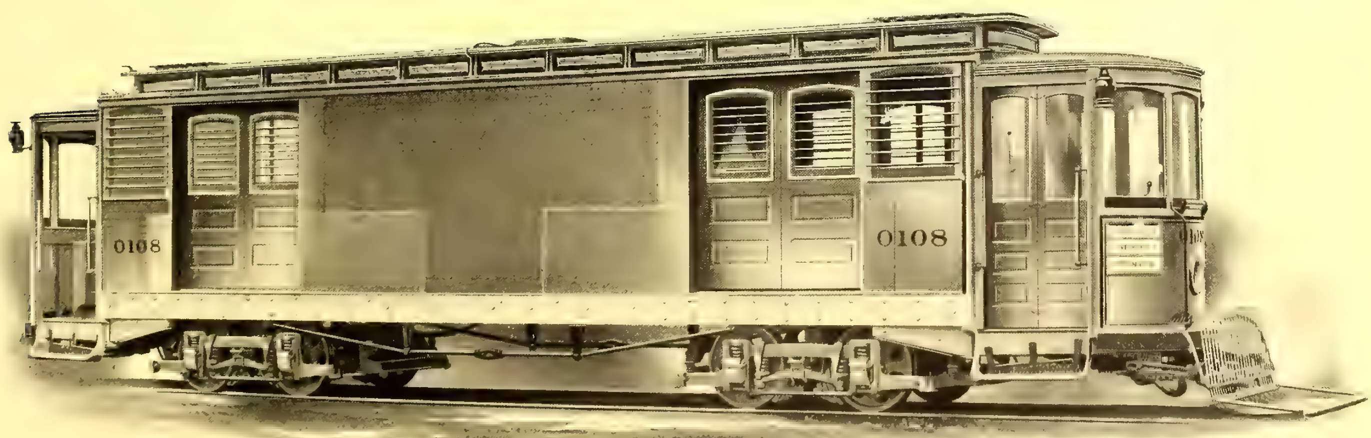
AMERICAN CAR COMPANY

ST. LOUIS, MISSOURI

CARS AND TRUCKS

Convertible Car (Brill Patents). Vestibuled "Detroit" Platforms. Mounted on Brill No. 27-G Trucks

Center-Vestibule Interurban Type. Semi-Convertible (Brill Patents). Mounted on Brill No. 27-E Trucks



Express Car for Heavy City and Suburban Service. Mounted on Brill No. 27-G Trucks

See Dictionary of Electric Railway Material for Descriptions.

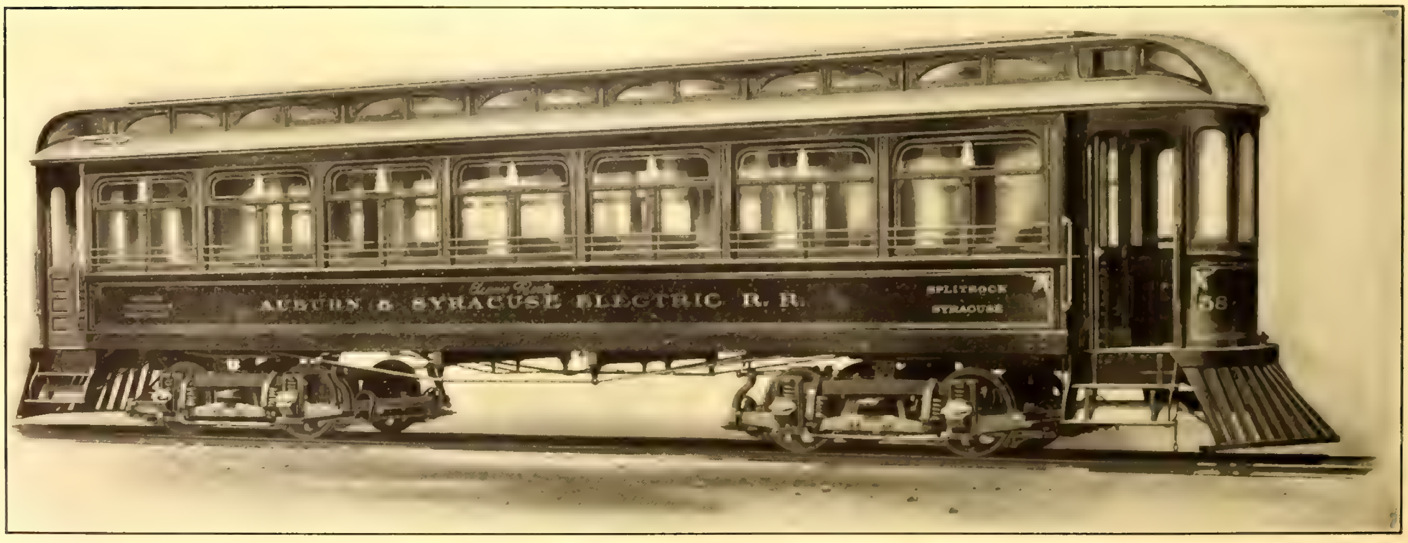
THE G. C. KUHLMAN CAR CO.

CLEVELAND, OHIO

CARS FOR EVERY FORM OF SERVICE

Convertible on Entrance Side (Brill Patents). Fifty Built for Cleveland. Mounted on Brill No. 27-F Trucks

Standard Type with Longitudinal Seats. "Detroit" Platform at Rear. Mounted on Brill No. 27-F Trucks



Passenger and Smoking Car. A Popular Type in the Middle-West. Mounted on Brill No. 27-E Trucks

See Dictionary of Electric Railway Material for Descriptions.

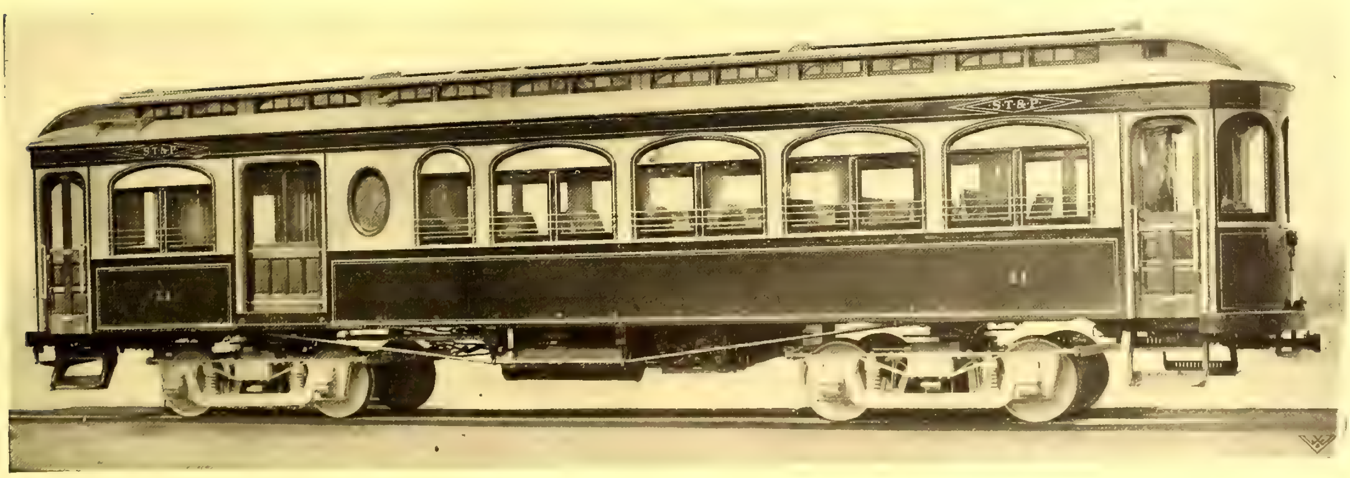
JOHN STEPHENSON COMPANY

ELIZABETH, NEW JERSEY

CARS AND TRUCKS

Stephenson Semi-Convertible Car (Patented). Upper Sashes Raise, Lower Drop. Mounted on Stephenson Short-Base Trucks

Passenger and Smoking Car, Suited to Large Variety of Conditions. Mounted on Brill No. 27-E Trucks



Passenger and Baggage Car, Fifty Feet Long over Vestibules. Mounted on Stephenson No. 8 Trucks

See Dictionary of Electric Railway Material for Descriptions.

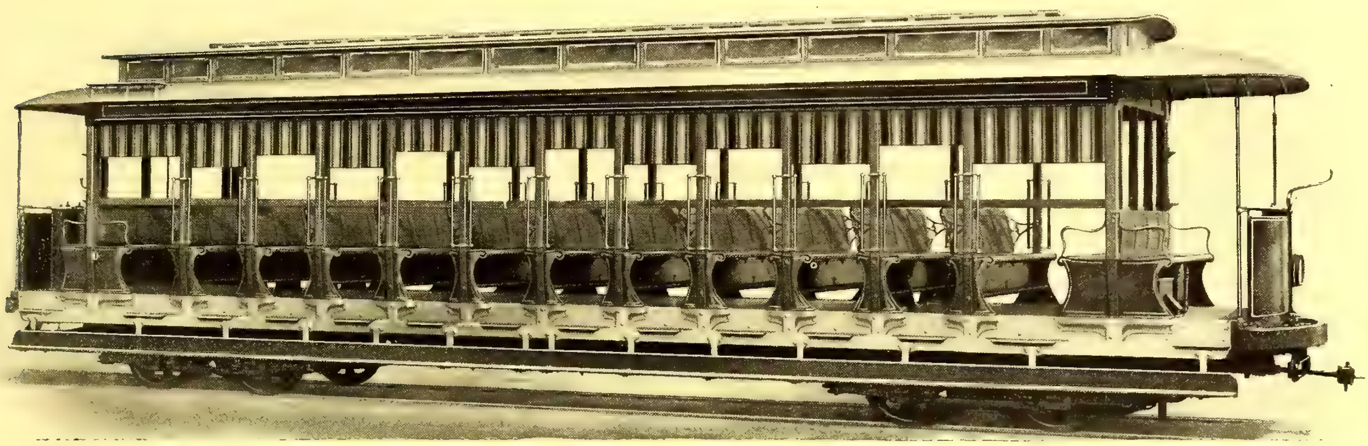
PHILADELPHIA, U.S.A.
Cablegrams
"Brill," Philadelphia
Telegrams
"Axles," London

J. G. BRILL COMPANY

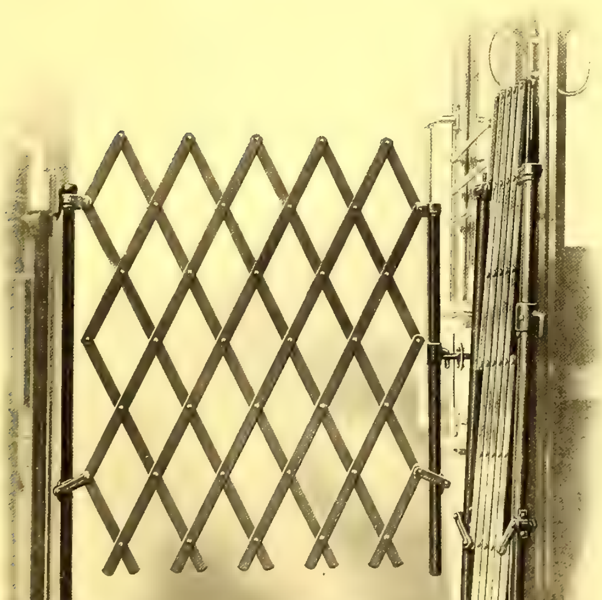
CARS AND TRUCKS

110 CANNON STREET
London, E.C. England
NOYES BROTHERS
109 Pitt St., Sydney
Agents for Australasia

Convertible Car (Patented). Panels and Sashes in Roof Pockets. Mounted on Brill "Eureka" Maximum-Traction Trucks



"Narragansett" Car (Patented). The Only Practical Double-Truck Open Car. Mounted on Brill No. 27-G Trucks



Folding Gates (Patented).

Portable Vestibule

See Dictionary of Electric Railway Material for Descriptions.

PHILADELPHIA, U.S.A.
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"Brill," Philadelphia
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"Axles," London

J. G. BRILL COMPANY

CARS AND TRUCKS

110 CANNON STREET
London, E. C. England
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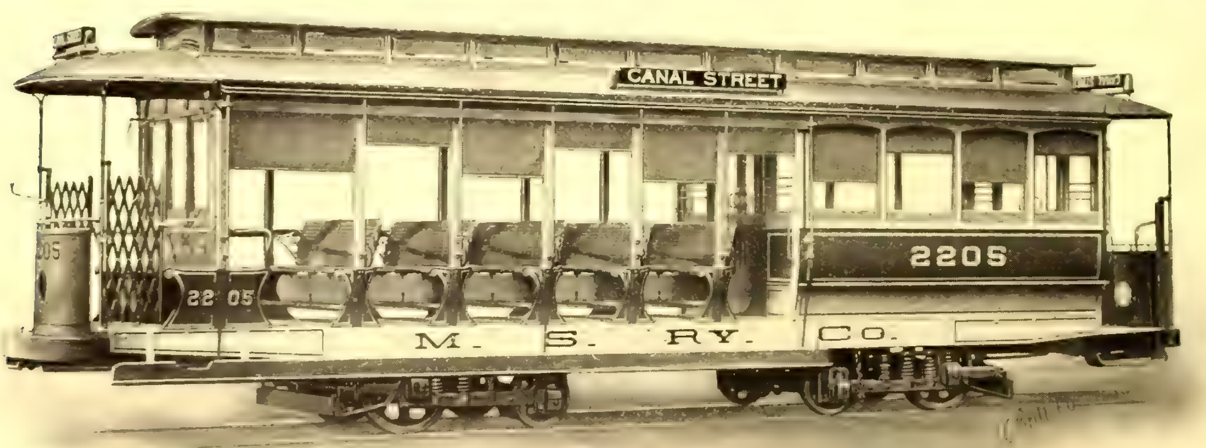
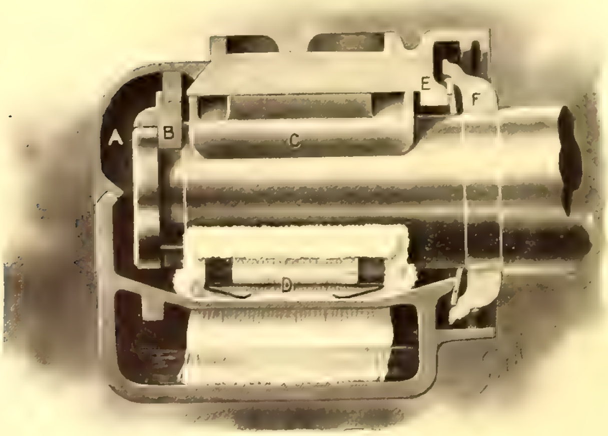
109 Pitt St., Sydney
Agents for Australasia

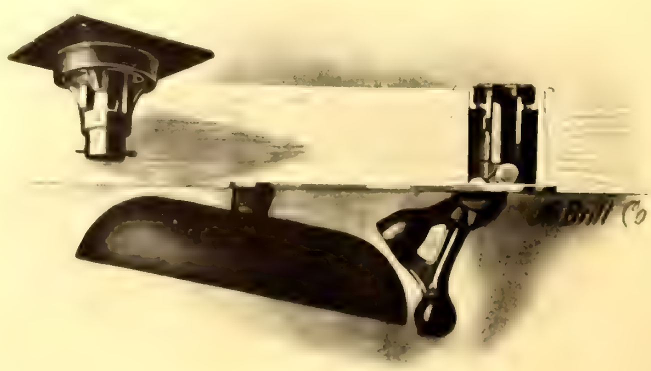
"California" Car (Patented). Angle Iron Sub-Sills Support Platforms. Mounted on Brill No. 21-E Truck



"Metropolitan" Combination Car. A popular City Type. Mounted on Brill "Eureka" Maximum-Traction Trucks

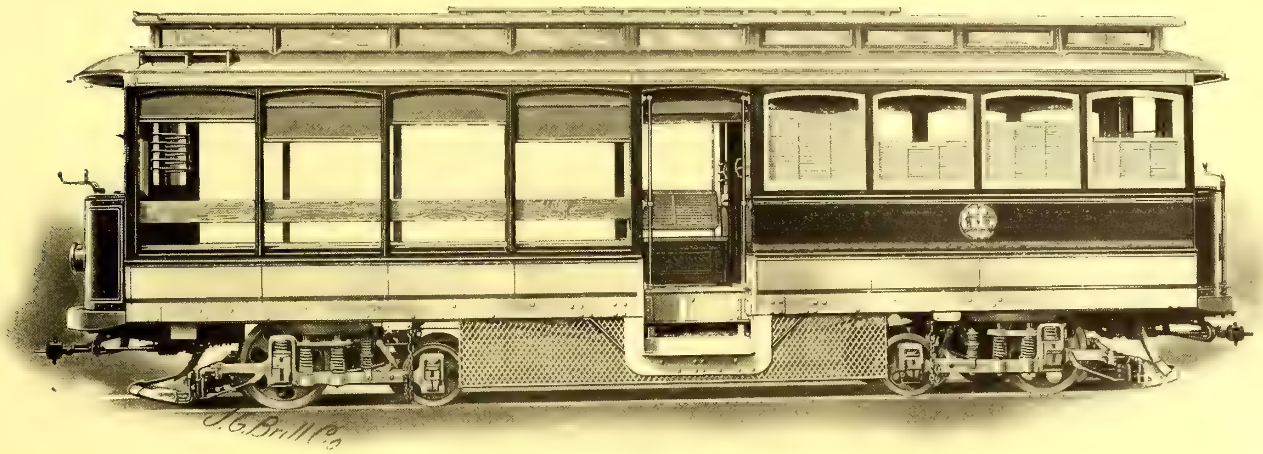


Journal Box (Patented).

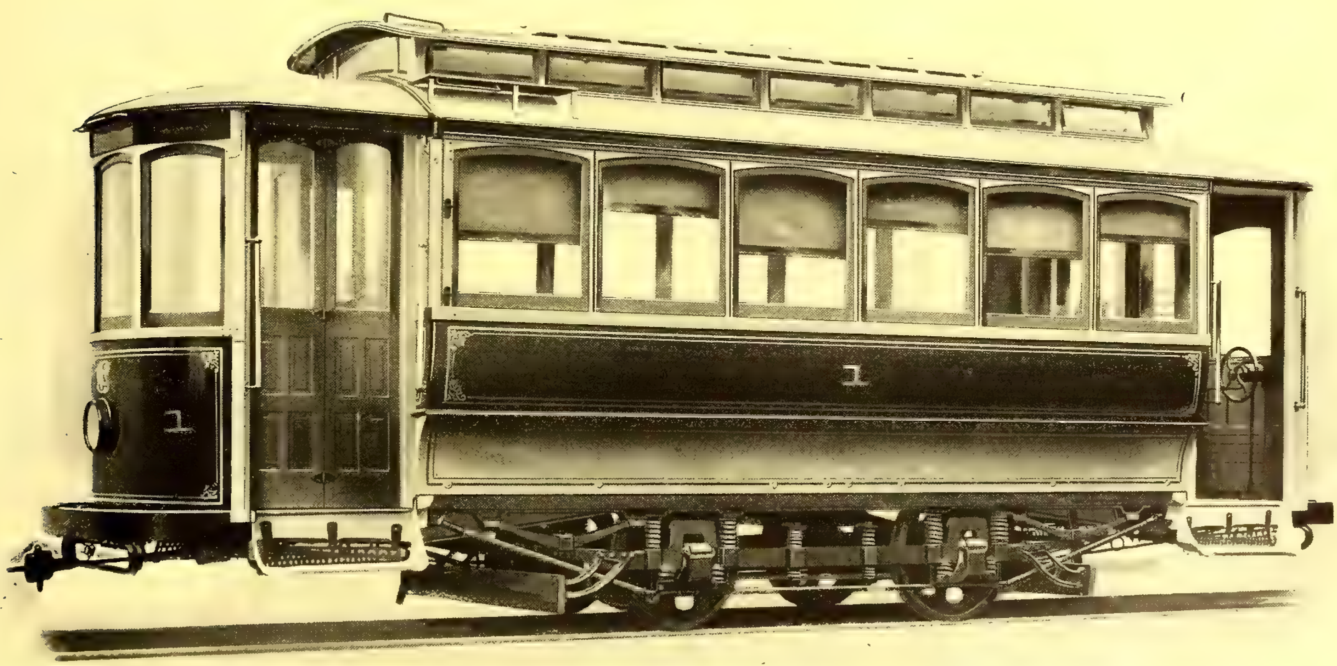


"Dedenda" Platform Gong (Patented).

See Dictionary of Electric Railway Material for Descriptions.

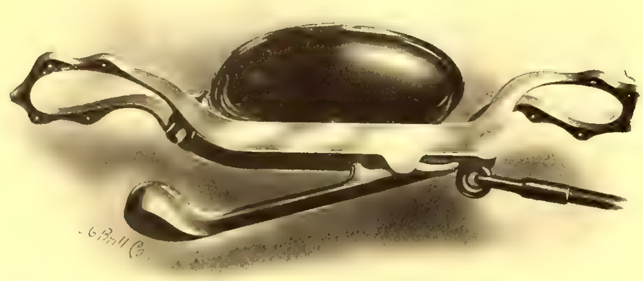


Center-Vestibule Combination Car (Patented). Sliding Seat in Vestibule. Mounted on Brill "Eureka" Maximum-Traction Trucks



Standard Type of Longitudinally Seated Car. Mounted on Brill No. 21-E Truck

Radial Draw Bar (Patented).



"Retriever" Signal Bell (Patented).

PHILADELPHIA, U.S.A.
Cablegrams
"Brill," Philadelphia
Telegrams
"Axles," London

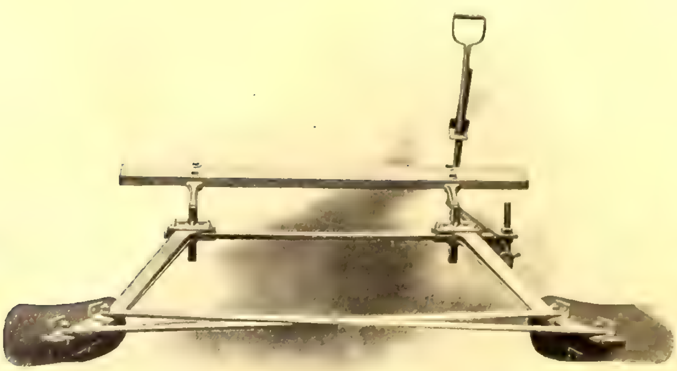
J. G. BRILL COMPANY

CARS AND TRUCKS

110 CANNON STREET
London, E.C. England
NOYES BROTHERS
109 Pitt St., Sydney
Agents for Australasia

Heaviest Type of Baggage Car. Fifty-Six Feet Long over Ends. Mounted on Brill No. 27-E Trucks

Standard Snow Sweeper. Rapid and Efficient. Mounted on Brill Gear Truck



Track Scraper (Patented).

"Dumpit" Sand Box (Patented).

See Dictionary of Electric Railway Material for Descriptions